ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN No 624020

Proj.
ECN

2. ECN Category (mark one) Supplemental ☐ Direct Revision ☐ Change ECN ☐ Temporary ☐ Standby ☐ Supersedeure ☐ Cancel/Void ☐	3. Originator's Name, Organization, MSIN, and Telephone No. T.M. Brown, R2-12, 373-4437	3a. USQ Required? ☐ Yes ☒ No	4. Date 06/24/96
	5. Project Title/No./Work Order No. Supporting Document for the Historical Tank Content Estimate for AX-Tank Farm	6. Bldg./Sys./Fac. No. 2750/200E	7. Approval Designator N/A
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-309, Rev. 10	9. Related ECN No(s). N/A	10. Related PO No. N/A
11a. Modification Work ☐ Yes (fill out Blk. 11b) ☒ No (NA Blks. 11b, 11c, 11d)	11b. Work Package No. N/A	11c. Modification Work Complete N/A _____ Cog. Engineer Signature & Date	11d. Restored to Original Condition (Temp. or Standby ECN only) N/A _____ Cog. Engineer Signature & Date

12. Description of Change

1. Complete rewrite and update of the introduction section.
2. Added HTCE and Supporting Document flow diagram.
3. Added NE quadrant tank farms timeline diagram.
4. Updated and restructured waste and level history plots.
5. Removed temperature data tables since they are available on PC-SACS. Added a 3-dimension temperature plot for AX Farm.
6. Removed drywell data, plots, and well layout diagram.
7. Removed chemical and radionuclide sample data and laboratory reports.
8. Removed unknown tank transfer plots from LANL.
9. Added the Hanford Tank Chemical and Radionuclide Inventories: HWD Model, Rev. 3, containing the Tank Layer Model, Supernatant Mixing Model, and inventory estimate tables.

13a. Justification (mark one)

Criteria Change ☐	Design Improvement ☒	Environmental ☐	Facility Deactivation ☐
As-Found ☐	Facilitate Const ☐	Const. Error/Omission ☐	Design Error/Omission ☐

13b. Justification Details

To update the supporting document with more complete historical and tank inventory information.

14. Distribution (include name, MSIN, and no. of copies)

See attached distribution sheet.

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1. ECN (use no. from pg. 1)

624020

15. Design Verification Required ☐ Yes ☒ No	16. Cost Impact <table border="1"> <tr> <th colspan="2">ENGINEERING</th> <th colspan="2">CONSTRUCTION</th> </tr> <tr> <td>Additional</td> <td>☐ \$</td> <td>Additional</td> <td>☐ \$</td> </tr> <tr> <td>Savings</td> <td>☐ \$</td> <td>Savings</td> <td>☐ \$</td> </tr> </table>	ENGINEERING		CONSTRUCTION		Additional	☐ \$	Additional	☐ \$	Savings	☐ \$	Savings	☐ \$	17. Schedule Impact (days) Improvement ☐ Delay ☐
ENGINEERING		CONSTRUCTION												
Additional	☐ \$	Additional	☐ \$											
Savings	☐ \$	Savings	☐ \$											

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	☐	Seismic/Stress Analysis	☐	Tank Calibration Manual	☐
Functional Design Criteria	☐	Stress/Design Report	☐	Health Physics Procedure	☐
Operating Specification	☐	Interface Control Drawing	☐	Spares Multiple Unit Listing	☐
Criticality Specification	☐	Calibration Procedure	☐	Test Procedures/Specification	☐
Conceptual Design Report	☐	Installation Procedure	☐	Component Index	☐
Equipment Spec.	☐	Maintenance Procedure	☐	ASME Coded Item	☐
Const. Spec.	☐	Engineering Procedure	☐	Human Factor Consideration	☐
Procurement Spec.	☐	Operating Instruction	☐	Computer Software	☐
Vendor Information	☐	Operating Procedure	☐	Electric Circuit Schedule	☐
OM Manual	☐	Operational Safety Requirement	☐	ICRS Procedure	☐
FSAR/SAR	☐	IEFD Drawing	☐	Process Control Manual/Plan	☐
Safety Equipment List	☐	Cell Arrangement Drawing	☐	Process Flow Chart	☐
Radiation Work Permit	☐	Essential Material Specification	☐	Purchase Requisition	☐
Environmental Impact Statement	☐	Fac. Proc. Samp. Schedule	☐	Tickler File	☐
Environmental Report	☐	Inspection Plan	☐		☐
Environmental Permit	☐	Inventory Adjustment Request	☐	N/A	☒

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number/Revision
N/A		

20. Approvals

	Signature	Date	Signature	Date
<u>OPERATIONS AND ENGINEERING</u>			<u>ARCHITECT-ENGINEER</u>	
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Cog. Mgr. J. W. Cammann	<i>J.W. Cammann</i>	<i>6/27/96</i>	QA	_____
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Safety	_____	_____	Design R. L. Newell	<i>RLN</i> <i>6-27-96</i>
Environ.	_____	_____	Environ.	_____
Other	_____	_____	Other	_____
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	_____	_____	<u>DEPARTMENT OF ENERGY</u>	
	_____	_____	Signature or a Control Number that tracks the Approval Signature	
	_____	_____	<u>ADDITIONAL</u>	
	_____	_____	_____	
	_____	_____	_____	
	_____	_____	_____	

Supporting Document for the Historical Tank Content Estimate for AX-Tank Farm

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ICF Kaiser Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 624020 UC: 2070
Org Code: 5A400 Charge Code: E44205
B&R Code: EW3120074 Total Pages: 22/

Key Words: Northeast quadrant, Historical Tank Content Estimate, tank farms, tank level, tank temperature, aerial photos, in-tank montages, TLM, SMM, waste temperature plots, inventory estimates, riser locations

Abstract: This Supporting Document provides historical in-depth characterization information on AX-Tank Farm, such as historical waste transfer and level data, tank physical information, temperature plots, liquid observation well plots, chemical analyte and radionuclide inventories for the Historical Tank Content Estimate Report for the northeast quadrant of the Hanford 200 East Area.

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V.L. Burkland 6/28/96
Release Approval Date

Approved for Public Release

**SUPPORTING DOCUMENT FOR THE
HISTORICAL TANK CONTENT
ESTIMATE FOR**

AX TANK FARM

WORK ORDER E44205

Prepared for

Westinghouse Hanford Company

May 1996

Prepared by

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Richland, Washington**

**SUPPORTING DOCUMENT FOR THE
HISTORICAL TANK CONTENT
ESTIMATE FOR
AX TANK FARM**

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ACKNOWLEDGMENTS

A project of the this magnitude would not be possible without the help of a significant number of persons and organizations. ICF Kaiser Hanford Company would like to acknowledge the contributions made by our Los Alamos National Laboratory counterparts: Stephen F. Agnew, Kenneth A. Jurgensen, Robert A. Corbin, Tomasita B. Duran, Bonnie L. Young, Theodore P. Ortiz, John FitzPatrick, and James Boyer. Also, Todd Brown and Brett Simpson of Westinghouse Hanford Company are recognized for their contributions.

INFORMATION FEEDBACK CARD

**SUPPORTING DOCUMENT FOR THE HISTORICAL
TANK CONTENT ESTIMATE FOR
AX TANK FARM
E44205**

COMMENTS AND CONTRIBUTIONS

The reader is requested to use this card to comment on this document, report any discrepancies, or contribute new information to improve the accuracy and content of the report. Please use the space provided, add additional pages if necessary, and return the comments to the person noted at the address listed below.

Send Comments to: Mr. John W. Hunt
TWRS Technical Baseline Integration
P.O. Box 1970, MSIN R2-12
Richland, WA 99352

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Appendix D	Temperature Graphs
Appendix E	Surface Level Graphs
Appendix F	Riser Configuration and Tank Cross Section
Appendix G	Tank Farm Photograph and Tank Montages
Appendix H	Tank Layer Model, Supernatant Mixing Model, and Inventory Estimates

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1.0 Introduction

1.0.1 Purpose

The purpose of this historical characterization document is to present the synthesized summaries of the historical records concerning the physical, radiological, and chemical composition of mixed wastes stored in underground single-shell tanks and the physical conditions of these tanks. The single-shell tanks are located on the Department of Energy Hanford Site, approximately 25 miles northwest of Richland, Washington. The document will be used to assist in characterizing the waste in the tanks in conjunction with the current program of sampling and analyzing the tank wastes. Los Alamos National Laboratory (LANL) developed computer models that used the historical data to attempt to characterize the wastes and to generate estimates of each tank's inventory. A historical review of the tanks may reveal anomalies or unusual contents that could be critical to characterization and post characterization activities.

This report was developed by reviewing the operating plant process histories, waste transfer data, and available physical and chemical data from numerous resources. These resources were generated by numerous contractors from 1945 to the present.

Waste characterization, the process of describing the character or quality of a waste, is required by Federal law (Resource Conservation and Recovery Act) and state law (Washington Administrative Code (WAC) 173-303, Dangerous Waste Regulations). Characterizing the waste is necessary to determine methods to safely retrieve, transport, and/or treat the wastes.

This document is not intended for use as a total design basis document. Further investigations of the information may be required before using this data for design purposes or safety analysis.

1.0.2 Scope

The scope of this document covers available information about the wastes contained in the single-shell tanks in the AX Tank Farm. Waste transfer and level data, tank physical information, and surveillance data of tanks and wastes have been compiled for this report. The inventory estimates of waste types and volumes generated by the computer modeling programs developed by LANL are included also. A summary of this information is contained in the *Historical Tank Content Estimate (HTCE) for the Northeast Quadrant of the Hanford 200-East Area* (Brevick et al., 1994). The northeast quadrant document covers six single-shell tank farms. These six tank farms, A, AX, B, BX, BY, and C, are located in the 200-East Area and are shown on the map in Figure 1. A flow diagram showing the relationships between the sources of data, the HTCE, and the supporting documents is in Figure 2.

This document also includes information on the safety issues affecting the tanks and the plants and processes that produced the waste in the underground waste storage tanks.

1.0.3 Approach

This report was compiled from work performed by ICF Kaiser Hanford Company (ICF KH), LANL, and Westinghouse Hanford Company (WHC). ICF KH reviewed the historical records of the

FIGURE 1: 200 EAST AREA

Figure 2 HTCE and Supporting Document Flow Diagram

tanks and incorporated the inventory estimates and models of waste layers in the tanks being developed by LANL into the report.

1.1 Safety Issues

The safety issues that affect the tanks can be divided into two groups: watch list and non-watch list. The watch lists are a listing of all tanks that are believed to pose potential safety hazards to workers, the environment, and the public. Non-watch list issues are of concern because of the possible impact on workers and the environment. Occurrences are unusual events on the Hanford Site that sometimes are related to safety issues.

1.1.1 Watch List Safety Issues

Watch list safety issues for these tanks were identified as "issues/situations that contain most of the most necessary conditions that could lead to worker (onsite) or offsite radiation exposure through an uncontrolled release of fission products" under Public Law 101-510, Section 3137, of the *National Defense Authorization Act of Fiscal Year 1991* (i.e., the Wyden Amendment). As of November 1995, 48 single-shell tanks and 6 double-shell tanks are on watch lists. See the *Approach for Tank Safety Characterization of Hanford Site Waste* (Eberlein et al., 1995) for more information on the watch list issues.

1.1.2 Non-Watch List Safety Issues

Non-watch list issues include safety hazards such as leaking tanks. Tank leaks are a safety hazard because of the potential to release chemicals and radioactive liquids to the ground. Corrosion is the main cause of tank leaks. Three other safety issues that do not require a watch list and continual monitoring under the Wyden Amendment include criticality, tank bumps, and toxic vapor releases. The following sections provide a general description of the different non-watch list safety issues. See the *Hanford Site Tank Farm Facilities Interim Safety Basis* (Leach and Stahl, 1993) for more information.

■ Corrosion

Corrosion is the most probable degradation mechanism of the steel tank liners resulting from contact with liquid, liquid-vapor, vapor, and solid phases of the wastes. The corrosion mechanisms producing a reduction in the thickness of the carbon steel liners can be divided into two categories: localized and general or uniform. Localized corrosion occurs on a localized area of the liner surface. Some of the localized corrosion mechanisms include pitting corrosion, stress corrosion cracking, and crevice corrosion. General or uniform corrosion occurs over the entire liner surface. Corrosion of the steel tank liners may take the form of one or more of the mentioned mechanisms. Corrosion is a safety issue because it has the potential to degrade the tank liner to the point of causing a leak or, more seriously, structural failure of the tank. Either condition could release contamination to the environment.

■ Criticality

Criticality is a self-sustained, nuclear chain reaction that can occur when a sufficient mass of fissile material is present in the proper configuration along with a neutron source to start the nuclear reaction. Criticality in the tank farms has been declared an unreviewed safety question, even though the *Hanford Site Tank Farm Facilities Interim Safety Basis* (Leach and Stahl, 1993) indicates that a "...nuclear

criticality accident in the tank farms is probably not an imminent risk." The unreviewed safety question on criticality in the tank farms remains because the inventory of fissile material and its distribution within the tanks cannot be confirmed as being within the approved safety envelope defined in the current safety analysis reports. Criticality is a safety issue because of the potential to cause a release of contamination to the environment.

■ **Tank Bumps**

A tank bump is the sudden pressurization of the tank. This occurs when solids overheat in the lower portion of the tank followed by uncontrolled mixing of these solids. The stirred hot solids rapidly transfer heat to the liquid in the tank, some of which quickly vaporizes. The rapid vapor generation causes a sudden internal tank pressurization that causes a bump. Uncontrolled mixing of heated solids can occur when an airlift circulator fails allowing the solids to heat up followed by rapid startup of the airlift circulator which causes rapid mixing. Also, uncontrolled mixing can occur when a natural "rollover" of waste occurs in the tank. Tank bumps are a safety issue because of the potential to cause a release of contamination to the environment.

■ **Toxic Vapor Releases**

Toxic vapor releases are a recently analyzed safety concern at the Hanford Site. The entire issue of toxic gas releases at the tank farms is being investigated (Leach and Stahl, 1993).

1.1.3 Occurrences

Over the years, unusual events (occurrences) have occurred at the AX Tank Farm. An occurrence is an event that falls outside of the normal operating, maintenance and/or construction procedures of the tank farm. Occurrences have been documented by various reporting methods including unusual occurrences reports, off normal reports, event fact sheets, and occurrence reports. The occurrence documentation in each report that could be located was evaluated for its significance in determining the waste content of the tanks before being included in this document. The types of significant occurrences included are occurrences written about surface level changes, temperature changes, and radioactivity changes (activity in the drywells). This document does not contain complete information from the reports, only summaries of the events. For more information on occurrences, refer to the Occurrences section for the specific tank.

1.2 Waste Generating Plants and Processes

1.2.1 Plants Processes

Brief descriptions and histories of the plants and processes that generated waste now contained in the single-shell and double-shell tanks are presented in alphabetical order. Typically, the name of the plant and the process are synonymous. The dates and events described in the following brief histories are presented on time lines in Figures 3 and 4. Although not all of the processes listed below contributed waste directly to tanks in the northeast quadrant, the waste they generated could have been transferred indirectly tank-to-tank.

■ A Plant (PUREX)

The Plutonium Uranium Extraction (PUREX) plant (i.e., A Plant) began operating in January 1956 (Gerber, 1993b). "The PUREX process is an advanced solvent extraction process that uses a tributyl phosphate in kerosene solvent for recovering uranium and plutonium from nitric acid solutions of irradiated uranium. Nitric acid is used instead of metallic nitrates to promote the extraction of uranium and plutonium from aqueous phase to an organic phase." (Wilson and Reep, 1991, p. B-4) Two campaigns of the Thorex process were conducted in 1966 and 1971 (Jungfleisch, 1984). The Thorex process recovered ^{235}U from thorium irradiated in the Hanford Site reactors (Wilson and Reep, 1991). PUREX reprocessed aluminum-clad fuel elements and zirconium alloy clad fuel elements, and provided plutonium for research reactor development, safety programs, and defense. Also, PUREX recovered slightly enriched uranium to be recycled as fuel in reactors generating electricity and plutonium (Rockwell, 1985). PUREX was put on standby in 1972 (Gerber, 1993b).

The PUREX plant was restarted in November 1983 but was shut down in December 1988 (see Figure 3). The plant was shut down due to the lack of steam pressure needed to operate the support backup safety equipment. There was a brief stabilization run in early 1990. In October 1990, PUREX was placed on standby by Secretary of Energy James Watkins. DOE issued the final closure order in December 1992 (Gerber, 1993c).

■ B Plant

B Plant used the bismuth phosphate process at first, and later changed its processing capabilities to strontium and cesium fractionation. The bismuth phosphate process "separated plutonium from uranium and the bulk of fission products in irradiated fuel by co-precipitation with bismuth phosphate from a uranium nitrate solution. The plutonium was then separated from fission products by successive precipitation cycles using bismuth phosphate and lanthanum fluoride. The plutonium was isolated as a peroxide and, after dissolving in nitric acid, was concentrated as plutonium nitrate. The waste, containing the uranium from which the plutonium had been separated, was made alkaline (neutralized) and stored in underground single-shell tanks. Other acid waste (which included most of the fission products) generated by this process was neutralized and stored in other single-shell tanks." (Wilson and Reep, 1991, p. B-3). "Some of the strontium and cesium fission products were removed (fractionated) from the waste and separately isolated to reduce the heat generation in the tanks. B Plant...was modified in 1968 to permit removal of these fission products by a combination of precipitation, solvent extraction, and ion-exchange steps. The residual acid waste from the processing was neutralized and stored in single-shell tanks." (Wilson and Reep, 1991, p. B-4 and B-5).

B Plant began its first batch run on April 13, 1945 (Anderson, 1990) and was shutdown in 1952 (Gerber, 1993c) (see Figure 3). Shortly after the renovations to B Plant were completed in December 1955, the 4X Program was abandoned. The 4X Program "planned to utilize the capabilities of all four Hanford processing plants (B, T, REDOX, and PUREX)" (Gerber, 1993c, p. 12); however, the large production and economic efficiency of the PUREX plant caused the 4X Program to be abandoned (Gerber, 1993c). B Plant restarted in 1968 to recover cesium and strontium from stored liquid waste. Cesium and strontium recovery was completed in September 1983 and February 1985, respectively (Rockwell, 1985).

■ 225-B (WESF)

The Waste Encapsulation and Storage Facility (WESF) converted solutions of cesium and strontium nitrates recovered in B Plant to strontium fluoride and cesium chloride solids that are doubly encapsulated in metal (Ballinger and Hall, 1991). "Strontium and cesium capsules have been used in applications of fission byproducts for gamma and heat sources" (Wilson and Reep, 1991, p. B-5).

WESF was constructed in 1974 (see Figure 3). The process optimization for cesium and strontium was completed in 1978 and 1981, respectively (Rockwell, 1985). The cesium processing ended in 1983 and strontium encapsulation in 1985. The capsule return program started in 1988 and ended in 1995 (Gerber, 1996).

■ C Plant (Strontium Semiworks)

The Strontium or Hot Semiworks facility (i.e., C Plant) began operating in 1952 as a hot pilot plant for the REDOX process (see Figure 3). In 1954, the plant was converted to a pilot plant for the PUREX process and continued operating until 1956 (Ballinger and Hall, 1991). "The process building (201-C) contains three hot cells equipped only for contact maintenance and is supported by an aqueous makeup and control building (271-C) and a solvent handling building (276-C). The facility also includes a fiberglass exhaust filter and a 200-ft stack." (PNL, 1991, Vol. 1, p. 3.6). In 1960, the plant was reactivated as a pilot plant used to recover strontium 90, promethium 147, and cesium 144 from PUREX waste. The plant was shut down in 1967 and the building and the site have been decontaminated and decommissioned (PNL, 1991).

■ S Plant (REDOX)

The Reduction and Oxidation extraction (REDOX) plant (i.e., S Plant) began processing on January 9, 1952 (Anderson, 1990) (see Figure 3). "The REDOX extraction process was a second-generation recovery process and the first process to recover both plutonium and uranium. It used a continuous solvent extraction process to extract plutonium and uranium from dissolved fuel into a methyl isobutyl ketone (hexone) solvent. The slightly acidic waste stream contained the fission products and large quantities of aluminum nitrate that were used to promote the extraction of plutonium and uranium. This waste was neutralized and stored in single-shell tanks. The volume of high-level waste from this process was much smaller than that from the bismuth phosphate process, but larger than that from the PUREX process." (Wilson and Reep, 1991, pp. B-3 and B-4). REDOX operated until 1967 (Rockwell, 1985).

■ T Plant

T Plant was the first full-scale separations plant at the Hanford Site. T plant used the bismuth phosphate process to separate plutonium from uranium and the bulk of fission products in irradiated fuel (B Plant used the same process). "The waste containing the uranium from which the plutonium had been separated was made alkaline (neutralized) and stored in underground single-shell tanks. Other acid waste (which included most of the fission products) generated by this process was neutralized and stored in other single-shell tanks." (Wilson and Reep, 1991, p. B-3).

T Plant began operating in 1944 (Rockwell, 1985) as a separations plant and continued until March 1956 (Gerber, 1994a) (see Figure 4). T Plant's mission was changed in 1957 to the repair and high-level decontamination of equipment (Rockwell, 1985). T Plant was converted to a "central decontamination facility for the site. As such, failed and contaminated equipment was assessed and

either repaired or discarded there for over three decades." (Gerber, 1994a, p. 1). Early decontamination operations used steam, sand, chemicals, and detergents. "Smaller equipment pieces were immersed in decontamination solutions in 'thimble tanks,' and larger pieces were flushed with water, chemical solutions, sand-blasted, steam-blasted, high-pressure sprayed (using pressures up to 10,000 pounds per square inch), and/or scrubbed with detergents. During the initial years, a strong nitric acid flush (approximately 60%) usually began the decontamination process, followed by a caustic wash with sodium hydroxide combined with sodium phosphate, boric acid, versene, sodium dichromate, sodium tartrate, or sodium citrate. However, it was learned that versene and tartrate, in particular, adversely affected the ability of soil cribs to absorb the rinsate materials. High-pressure sprays often used 1,1,1 trichloroethane or perchloroethylene, and detergents generally were chloride-based. By the mid-1960s, commercially prepared and trademarked chemical mixtures had replaced most of the simpler chemicals used in the early years. Many commercial products were based on oxalic acid, phosphates, nitric acid-ferrous ammonium sulfate combinations, potassium permanganate, and sodium bisulfate, with some unknown additives." (Gerber, 1994a, pp. 40-42). The facility was modified in 1978 to store pressurized water reactor (PWR) core II fuel assemblies (Rockwell, 1985).

■ U Plant

U Plant (221-U) was built as one of three original bismuth phosphate process facilities, but it was not used for that purpose. U Plant was modified extensively and used for the uranium recovery process, operating from 1952 to 1958 (see Figure 4). Uranium in waste from the bismuth phosphate process initially was stored in the single-shell tanks. Later, the waste was sluiced, dissolved in nitric acid, and processed through a solvent extraction process using tributyl phosphate in kerosene to recover the uranium. The process was similar to that used later in the plutonium-uranium extraction (PUREX) process except that plutonium was not recovered. The acid waste from the uranium recovery process was made alkaline and returned to single-shell tanks. The tributyl phosphate waste was treated with potassium ferrocyanide as a cesium and strontium scavenger. The recovery process resulted in an increase in nonradioactive salts and a small increase in waste volume (Wilson and Reep, 1991).

■ Uranium Trioxide Plant

The 224-U Building was converted to a uranium trioxide (UO_3) plant which began operating in 1952 (see Figure 4). The UO_3 plant was capable of handling the uranyl nitrate hexahydrate (UNH) stream from REDOX, U Plant, and PUREX. "The basic UO_3 process, calcining, consisted of concentrating and then heating liquid UNH until it converted to a stable, orange-yellow powder. The nitric acid in the UNH solution could be recovered in the same process. The UO_3 powder was the base material needed for the manufacture of uranium hexafluoride (UF_6), the primary feed material for the United States' gaseous diffusion plants. Because the largest of these plants was located in Ohio and Tennessee, it was considered safer to ship the material across the country in powder rather than in liquid form." (Gerber, 1993c, pp. 33-34). The UO_3 plant was shut down in 1972, but restarted in 1984. Since 1984, there have been 17 campaigns at the plant averaging eight days each. Final deactivation was ordered for the plant in 1992. In April 1993, the UO_3 plant resumed operations to convert 200,000 gallons of remaining UNH to UO_3 powder. A final deactivation plan was written in the summer of 1993 (Gerber, 1993c).

■ Z Plant (Plutonium Finishing Plant)

The Plutonium Finishing Plant (PFP) or Z Plant, previously called Plutonium Recovery and Finishing Operations, processed plutonium and prepared plutonium products. "Waste from this plant

contained only minor amounts of fission products but did contain low concentration of plutonium and other transuranic elements and was high in metallic nitrates. Initially, this waste was discharged via cribs to soil columns, which absorbed the transuranic elements and retained them close to the point of discharge. Beginning in 1973, waste from PFP was stored with other waste in underground tanks." (Wilson and Reep, 1991, p. B-4). "Three types of feed materials are processed at the PFP to produce plutonium metal. Feed material types are handled differently in different process lines.... Historically, the main feed for the PFP was purified plutonium nitrate solution that was produced elsewhere in a fuel reprocessing plant. This feed was charged directly to one of the main process lines, which was initially a glovebox line. The glovebox line was replaced by remote mechanical lines, which were upgraded over the years. In time, processes were added to handle rework and scrap plutonium. These processes were used to convert the rework and scrap materials into a purified plutonium nitrate solution that could be handled by the main process." (Duncan et al., 1993, pp. 2-1-2-2).

In July 1949, PFP began operations with a glove box line (see Figure 4). The remote mechanical A line replaced the glove box line in May 1953. Installment of the Recuplex Facility at PFP was completed in April 1955. The remote mechanical C line was installed in July 1960. In September 1961, the 232-Z Building was installed with an incinerator and leaching equipment. In June 1964, the Plutonium Reclamation Facility (PRF) replaced the functions of the Recuplex Facility. Fabrication of plutonium metal nuclear weapon components ceased at the PFP in December 1965. In April 1973, the 232-Z Incinerator was shut down and the remote mechanical C line was placed on standby. The PRF was placed on standby in February 1979, and the remote mechanical A line was shutdown in December 1979. In January 1984, the PRF was restarted for a series of campaigns. The remote mechanical C line was restarted in June 1985 for a series of campaigns. In September 1986, operations at PFP were halted for nine months. This partial listing of the process history in the Plutonium Finishing Plant is from D.R. Duncan et al. (1993).

1.2.2 Waste Management Operations

This section describes the different methods used to concentrate waste in the 200 Areas. Evaporating, concentrating, and scavenging are all methods used to reduce liquid volumes or precipitate solids from supernate. Brief descriptions and histories of the operations are presented in alphabetical order. The events and dates described in the brief histories are presented on a time line (Figure 5).

■ 242-A Evaporator-Crystallizer

"The program objective was to reduce the volume of tanked waste liquors through the boiloff of water. This was accomplished by boiling the liquor in an enclosed vessel at reduced pressure. The evaporation was carried out until a slurry containing about 30 wt% solids was formed. The slurry was returned to underground waste tanks for cooling, crystallization, and settling. The principal products of waste solidification have been large volumes of sodium nitrate salt cakes and waste liquors that are rich in sodium hydroxide and sodium aluminate." (Wilson and Reep, 1991, p. B-5).

The 242-A Evaporator-Crystallizer began operating on March 18, 1977 (Anderson, 1990) (see Figure 5). In 1981, the evaporator was shut down for ten months to tie AW Tank Farm into the process (Rockwell, 1985). The evaporator was shut down in 1989 because of regulatory issues, but was restarted in 1994 after extensive modifications (Gerber, 1996).

■ 242-B Evaporator

"The first type of waste solidification facility, the 242-B and 242-T Concentrators, was originally used for concentration of bismuth phosphate process waste. In 1951, they began to concentrate cladding/first cycle waste. These concentrators were steam-heated pot evaporators operated outside the waste tanks and at atmospheric pressure. The liquors were partially boiled down and cycled to underground waste storage tanks." (Jungfleisch, 1984, p. 1-5). This evaporator ran for approximately 4 years (Anderson, 1990) (see Figure 5).

■ 242-S Evaporator-Crystallizer

The 242-S Evaporator-Crystallizer was designed to boil off water from the waste in an enclosed vessel at reduced pressure, similar to the 242-A Evaporator-Crystallizer. "The evaporation was carried out until a slurry containing about 30 wt% solids was formed. The slurry was returned to underground waste tanks for cooling, crystallization, and settling. The principal products of waste solidification have been large volumes of sodium nitrate salt cakes and waste liquors that are rich in sodium hydroxide and sodium aluminate." (Wilson and Reep, 1991, p. B-5). The evaporator began operating on November 1, 1973 (Anderson, 1990) and was shut down in 1981 (Gerber, 1996) (see Figure 5).

■ 242-T Evaporator

The 242-T Evaporator, like the 242-B Evaporator, began operating in 1951 (Gerber, 1992) to reclaim nonboiling waste storage capacity in existing tanks (see Figure 5). The evaporator was shut down in the summer of 1955 and modified for tributyl phosphate scavenging (Godfrey, 1965), although scavenging was never performed in this evaporator. The evaporator was restarted on December 3, 1965 and operated until April 15, 1976 (Anderson, 1990).

■ In-Tank Solidification

The in-tank solidification systems immobilized high level wastes, that were not self-boiling, by concentrating the waste directly inside of the tanks to form radionuclide-bearing salt cakes (Shefcik, 1964). The first in-tank solidification unit (ITS-1) and the second in-tank solidification unit (ITS-2) operated in tanks in the BY Tank Farm (Caudill, 1965 and 1967). "...one used a hot air sparge (ITS-1) and the other used an immersed electrical heater (ITS-2). The ITS-1 operations were conducted in individual tanks. The ITS-2 concentrations were performed by heating the contents of one tank and moving the heated liquor through a series of other tanks." (Wilson and Reep, 1991, p. B-5).

In-tank solidification units 1 and 2 began operating on March 19, 1965 and February 17, 1968, respectively (see Figure 5). ITS-1 was converted to a cooler for ITS-2 on August 24, 1971. Both units were shut down on June 30, 1974 (Anderson, 1990).

1.2.3 Miscellaneous Waste Sources and Equipment

Wastes from various other sources on the Hanford Site have been added to the tanks. Some wastes are from the 300 Area, 100 Area production reactors, various laboratories, and catch tanks.

■ Critical Mass Laboratories

The critical mass laboratories were used to study the physics of plutonium solutions and solids to avoid accidentally creating a criticality or self-sustained nuclear reaction. The first facility began operating in the 120 Building near 100-F in April 1950 and closed in December 1951. The second

facility, the 209-E Building, was located next to the Strontium Semiworks and began operating in July 1961 (Ballinger and Hall, 1991). The plutonium used in the lab was reprocessed in PUREX.

■ **244-AR, -BXR, and -CR Process Vaults**

Three of the process vaults are the 244-AR Vault, the 244-BXR Vault, and the 244-CR Vault. These vaults were composed of several process vessels or tanks used to prepare waste for treatment or storage. Specific wastes from tanks can be pumped temporarily to the vaults and later sent directly to desired tanks or processing facilities.

The AR Vault is located north and west of the A Tank Farm and was constructed in 1966. The vault facilities include a canyon building with process cells containing tanks. The AR Vault has been on standby since 1978 (Leach and Stahl, 1993).

The 244-BXR Vault, located south of the BX Tank Farm began operating in 1952 (Rodenhizer, 1987) and became inactive in 1956. The waste in the vault was difficult to handle, so the vault was jetted with high-pressure steam in 1976. The 244-BXR was used to process sludge in the recovery of uranium from bismuth phosphate metal waste in the tanks (Rodenhizer, 1987).

The 244-CR Vault was constructed in 1952 and is located south of the C Tank Farm (Leach and Stahl, 1993). Salt-well waste from the C Tank Farm is interimly stored in the CR Vault. The 244-CR Vaults were used to process sludge in the recovery of uranium from bismuth phosphate metal waste in the tanks (Rodenhizer, 1987).

■ **204-AR and 204-S Railroad Car Facilities**

The 204-AR rail car unloading facility was built in 1981 (Leach and Stahl, 1993) and replaced the 204-S rail car unloading facility. The facilities were built for pumping liquid radioactive waste from tank cars and sending the waste to 200 East Area tank farms (Leach and Stahl, 1993).

1.2.4 Time Lines

Time lines are presented on the following pages that represent many of the events that occurred during the history of the major plants and waste management operations on the Hanford Site. These are the same events as those described in the description of each facility. The plants, associated processes, and methods for managing waste were the main sources of the wastes currently stored in the tanks. Abbreviations are defined in the preceding text and the glossary in Appendix A.

One time line represents the history of each of the tank farms in the northeast quadrant of the 200-East Area (Figure 6). The events represented include the dates of construction, individual tank's entry into service and removal from service, and the deactivation of each tank farm.

PLANTS / PROCESS - TIME LINE

FIGURE 3

PLANTS / PROCESS - TIME LINE

FIGURE 4

WASTE MANAGEMENT - TIME LINE

FIGURE 5

NE QUADRANT TANK FARMS - TIMELINE

FIGURE 6

1.3 Waste and Level History

The Waste and Level History section of this document is presented by a combination of two methods and is represented by sketches shown in Appendix C. The first method presents a graph of waste levels versus time for each tank. The waste levels graphed include the total waste level, solid waste level, and when available the interstitial liquid level. The waste level graphs also include information on transfers, stabilization, intrusion prevention (isolation), salt-well and jet pumping activities, level adjustments, pH, photographs, and a few other miscellaneous items. The second method presents a time line showing the periods of time that different waste types were added to each tank. The time line and the waste level graphs for a given tank have been arranged so that the time axis for each method correlates with one another.

1.3.1 Source of Data

The references used to create the total waste level graph and the solid waste level graph for each level history graph are listed below in chronological order beginning with the oldest documents. Anderson (1990) was the source used for level information from when the tanks entered service until the end of 1980. Level information from 1981 to the present was taken from a series of documents that basically contain the same type of information. These documents have been given various titles over the years but they all reflect the monthly waste status (i.e., waste volumes) for all the tanks. Beginning in 1981, these "monthly waste status reports" have been authored by the following people: O.C. Mudd, O.C. Mudd & D.C. McCann, D.C. McCann, D.C. McCann & T.S. Vail, T.S. Vail, T.S. Vail & G.D. Murry, T.S. Vail & G.J. Carter, G.J. Carter, G.A. Escobar, J.M. Thurman, and B.M. Hanlon. The last "monthly waste status report" reviewed was for October 31, 1995 (Hanlon, 1996a). See Appendix B for more complete reference information.

The reference for the interstitial liquid level (ILL) graph for the applicable level history graphs is from the Westinghouse Hanford Company's Surveillance Analysis Computer System (SACS). SACS is a database that stores ILL data along with other types of surveillance data. PCSACS software on a personal computer is the user interface to the SACS database via the Hanford Local Area Network (HLAN). The SACS database was queried back to 1950 for ILL data.

The reference for the transfer information is only Anderson (1990). Anderson has information for all the tanks through 1980. Transfers that may have occurred after 1980 have not been identified on the sketches of the Waste and Level History. For more transfer information not included in this document see *Waste Status and Transaction Record Summary for the Northeast Quadrant* (Agnew et al., 1995).

The reference for stabilization information is Hanlon (1996a).

For tanks that were intrusion prevented before June 1988, the reference is Welty (1988). For tanks that were intrusion prevented after June 1988, the references are various "monthly waste status reports". For more complete reference information on intrusion prevention after June 1988, refer to the Waste and Level History sketches in Appendix C where the references for intrusion prevention have been identified.

The reference for the salt-well pumping completion dates and jet pumping completion dates is Welty (1988). Salt-well and jet pumping activities that may have occurred after the release of Welty's document have not been identified on the Waste and Level History sketches.

Level adjustment dates were taken from various "monthly waste status reports" after and including 1981 and from Anderson (1990) prior to 1981. Anderson's document did not contain a complete listing of the level adjustments prior to 1981. For more complete information on level adjustments, refer to the individual "monthly waste status reports." For more complete reference information on level adjustments after 1980, refer to the Waste and Level History sketches in Appendix C where the references for these level adjustments have been identified.

The reference for the pH information is Borsheim and Kirch (1991). The pH information after the release of Borsheim and Kirch's document has not been identified on the Waste and Level History sketches.

The photographic information was taken from Appendix G of this document.

The information on the time lines came from two sources. The reference for the Waste Types Added Time Line was Anderson (1990). The reference for the Primary Additions Time Line was Agnew et al. (1995b).

1.3.2 Development of Data

The total waste level graphs and the solids waste level graphs were developed from waste volume information from Anderson (1990) and the "monthly waste status reports." Anderson compiled a listing of total waste volumes and solids waste volumes for all the tanks on a quarterly basis prior to January 1981. Since Anderson's document is a compilation of the "monthly waste status reports" prior to January 1981, specific "monthly waste status reports" were reviewed when typographical errors were found. In order to continue on a quarterly basis after January 1981, the total waste volumes and the solids waste volumes were taken from the March, June, September, and December additions of the reports. The waste volumes were converted into equivalent waste levels based upon the following equation:

$$\frac{\text{Total Gallons}}{2750 \frac{\text{Gallons}}{\text{Inch}}} = \text{Total Inches}$$

The "0" reference point for the total waste levels and the solids waste levels are at the bottom inside of the tank. The waste levels have been rounded to the nearest thousand gallons (Kgal). In the event that the total waste level and the solids waste level were the same, the reported volumes were reviewed to determine if the reported volumes were the same. If the volumes were the same, only the solids level was graphed. If the volumes were not the same, then both the total waste level and the solids waste level were graphed. The quarterly waste volumes and associated waste levels have been arranged in tables and are titled Level History tables. The Level History tables were developed within Microsoft Excel® and are presented in Appendix C.

waste level were graphed. The quarterly waste volumes and associated waste levels have been arranged in tables and are titled Level History tables. The Level History tables were developed within Microsoft Excel® and are presented in Appendix C.

The interstitial liquid level (ILL) graphs were developed from ILL data retrieved from SACS. The ILL data from SACS were imported into Microsoft Excel® spreadsheets. The SACS database custodians labeled the ILL data as either good or suspect. Only the data labeled as good were used for the ILL graphs. The SACS data that were labeled as good were reviewed for data on a quarterly basis. The quarters were set to match the quarterly system set up for the "monthly waste status reports" (i.e., the last month for each quarter was March, June, September, and December). The last data reading available from each quarter was the data reading used for the ILL graphs. The data from SACS have been rounded off to the nearest whole number. The "0" reference point for the SACS ILL data is the bottom inside of the tank. The reviewed quarterly ILL data were added to the appropriate quarter in the Level History tables presented in Appendix C.

The total waste level graphs, the solids waste level graphs, and the interstitial liquid level graphs were all created within AutoCAD®. In order to expedite the creation of these graphs, script files were generated from the information contained within the Level History tables. The script files were generated by arranging the waste level information and the corresponding dates from the Level History tables into a Cartesian coordinate system (i.e., x,y coordinates). The script files allowed AutoCAD® to automatically generate the graphs on the Waste and Level History sketches.

Transfer information was taken from the "Remarks" column of the Waste Status Summary tables from Anderson (1990). Transfer information was available on a quarterly basis. However, due to the scale of the time axis on the Waste and Level History sketch, the transfer information was placed near the total waste level graph corresponding to the appropriate year. Because of space limitations on the sketches, not all the transfer information available within Anderson's document could be included. For more details about the transfer information, see Anderson (1990).

Intrusion prevention (isolation) dates were taken from Welty (1988) and various "monthly waste status reports". However, Welty and the various "monthly waste status reports" issued before 1993 use the old terminology of interim isolated. In 1993, the term "interim isolated" was replaced with "intrusion prevention." In order to remain consistent with current terms, the Waste and Level History sketches have used the interim isolation dates given by Welty and changed the terminology to intrusion prevention.

The Waste Types Added Time Line information was taken from the "Type Waste" column of the Waste Status Summary tables from Anderson (1990). Since Anderson's document is a compilation of the "monthly waste status reports" prior to January 1981, specific "monthly waste status reports" were reviewed when typographical errors were found. The vertical lines on the time line are boundaries between which the types of wastes identified have been added to the tanks. The vertical lines are spaced a minimum of three years apart.

The Primary Additions Time Line information was taken from the spreadsheets located in Appendix C of the *Waste Status and Transaction Record Summary for the Northeast Quadrant* (Agnew et al., 1995b). Two columns in the spreadsheet were reviewed to determine the information that would

appear on the time line. The first column reviewed was the "Type" column. The "Type" column describes the type of transaction that occurred in a tank. The type of transactions that were reviewed were the transactions that Agnew et al. labeled as "XIN" or "xin". Agnew et al. used these two labels to indicate an addition of primary waste into a tank. According to Agnew et al., "XIN" is an addition of primary waste from a plant and "xin" is a transaction that was derived. If the "Type" column indicated either an "XIN" or "xin", then the "DWXT" column was reviewed for the type of waste added to the tank. The waste types defined in the "DWXT" column that corresponded to an "XIN" or "xin" from the "Type" column were the waste types added to the time line. The vertical lines on the Primary Additions Time Line are boundaries between which the types of wastes identified have been added to the tanks. The vertical lines are spaced a minimum of three years apart.

1.3.3 Assumptions

An assumption was required in order to begin developing the total waste level graphs and the solid waste level graphs. The assumption was that the tanks did not contain waste prior to the time when Anderson (1990) started recording information.

The waste volume information taken from Anderson (1990) and the various "monthly waste status reports" required an assumption in order to apply the waste volume information to waste level formulas. The actual total waste surface and the actual solid waste surface were assumed to be flat and level.

The total waste level graphs and the solid waste level graphs required an assumption in order to make complete graphs. There were many cases within the Waste Status Summary tables (Anderson, 1990) where the tables lacked waste volume information for one or more consecutive quarters. When this occurred, it was assumed that the waste volume followed an increasing, decreasing, or horizontal linear trend across the quarters in which Anderson lacked the volume information. Because of the linear nature of the waste volume to waste level formulas used to convert waste volumes into waste levels, a linear trend in the volumes results in a linear trend of waste levels on the Waste and Level History sketches.

The solid waste level graphs required an assumption about the time period when the tanks began receiving waste. Information on the solids volume was not recorded in the Waste Status Summary tables (Anderson, 1990) until well after the tanks started receiving waste. The first accumulation of solids within the tanks was not apparent from information by Anderson. An assumption was made that the first accumulation of solids within each tank followed an increasing linear trend. The first accumulation of solids was also assumed to start at the point where the tank first started receiving waste.

The interstitial liquid within the tanks is the liquid that fills the interstitial spaces of the solid waste. The supernatant liquid within the tanks is located above the solid waste. Once the supernatant liquid has been removed from the tanks, the liquid that remains is the interstitial liquid. The interstitial liquid level (ILL) in most tanks is unknown unless a liquid observation well (LOW) was installed. The LOW allows access for instrumentation to record ILL. Unfortunately in many tanks, the LOW's were not installed and the ILL's were not recorded until sometime after the supernatant liquid was removed. Therefore, the ILL graphs required some assumptions in order to define the ILL graph from the point where the supernatant liquid was removed from the tank to the point where ILL data were started. One

assumption was that the ILL followed a decreasing linear trend from the point where the supernatant liquid was removed from the tank to the point where salt-well pumping or jet pumping was completed. Another assumption was that the ILL followed a horizontal linear trend from the point where salt-well or jet pumping was completed to the point where the first ILL data were recorded on SACS.

1.3.4 Quality of Data

The total waste level graphs and the solids waste level graphs on the Waste and Level History sketches were developed by using the waste volume to waste level formulas. There are some limitations with the formulas that affect the waste level results. The formulas do not account for construction tolerances on the tanks and the irregularities in the surface of the solid wastes.

The total waste level graphs were developed from the volume data from Anderson (1990) and the "monthly waste status reports." The frequency in which these references have their volume information updated is not consistent with the frequency in which the surface level readings of the SACS database are updated. Therefore, a discrepancy may be noticed between the total waste level graphs of the Waste and Level History sketches in Appendix C and the surface level graphs in Appendix E.

The interstitial liquid level (ILL) graphs were developed from data contained within the SACS database. The SACS custodians have qualified the data as either good or suspect. Only the data labeled as good have been plotted. However, on many tanks, the ILL data plotted exceeded the total waste level data. This situation is a contradiction to the definition of interstitial liquid. Even though the SACS custodians have labeled the data as good, the data quality seems questionable. The questionable data were graphed anyway. It was not the function of this document to judge or qualify the ILL data nor to discuss in detail this situation.

1.4 Temperatures

1.4.1 Surveillance Techniques

Interior tank temperatures of the single-shell tanks in AX Tank Farm are monitored with thermocouples. Thermocouples are simple devices that develop a millivoltage when parts of the thermocouple are exposed to temperature differentials. The millivoltage can be converted to a temperature reading based upon a specific voltage versus temperature curve inherent to the type of thermocouple being used. Thermocouples are attached to a fabricated assembly called a thermocouple tree. The number of thermocouples attached to the tree varies as a function of the depth of the tank as well as the thermocouple tree design. The thermocouples are spaced at intervals, along trees that have many thermocouples, so that a vertical temperature profile of the tank contents can be developed. The thermocouple tree is installed in a riser and left in place inside the tank. If necessary, the thermocouple tree can be removed from the tank.

1.4.2 Source of Data

The source of the interior tank temperature data presented in this document is from the Westinghouse Hanford Company's Surveillance Analysis Computer System (SACS). SACS is a database that stores temperature data along with other types of surveillance data. PCSACS software

on a personal computer is the user interface to the SACS database via the Hanford Local Area Network (HLAN). The SACS database was queried back to 1950 for temperature data. Temperature data identified by the query were categorized and located by SACS in several types of files. These files were evaluated for their usefulness in this document.

The SACS database for temperature data contained up to two types of files depending on the specific tank. One type of file contained data that were not correlated to a particular thermocouple tree or riser number. Due to the lack of information in these files, an assumption was made concerning from which riser the temperature data originated. The second type of file contained interior tank temperature data that were correlated to a particular thermocouple, thermocouple tree, and/or riser. After the SACS data files were evaluated, the files that were selected for use in this document were imported using PCSACS into spreadsheets in Microsoft Excel® software.

The 3-D surface plots of the temperature data include a 2-D total waste level graph. The data for the total waste level graph was taken from the Level History Tables of Appendix C.

1.4.3 Development of Data

Interior tank temperature data imported from SACS into spreadsheets (Microsoft Excel®) were rearranged onto separate spreadsheets depending on the data qualifier assigned by SACS custodians. The SACS database custodians label the interior tank temperature data using three data qualifiers or categories. The categories are good (G), transcribed (T), and suspect (S). The temperature data in the tables were then filtered to remove all the S data, leaving only the G and T data. The filtered data were used to develop graphs of individual thermocouple data and the three-dimensional (3-D) surface plots. The graphs were developed within Microsoft Excel®. There were two conditions about the temperature data that were evaluated before the graphs of individual thermocouple data were developed. The first condition evaluated was the number of data points from a particular thermocouple. If a thermocouple had five or less data points, then a graph was not developed for that particular thermocouple. The second condition evaluated was the time span between consecutive data points. If the time span between consecutive data points was greater than 36 months, then the graph was shown as discontinuous across the span (see Appendix D).

The 3-D surface plots of the temperature data along with the 2-D total waste level graphs were developed within SigmaPlot®. There were two conditions with the temperature data that were evaluated before the 3-D surface plots of the temperature data were developed. The first condition evaluated was the consistency of data between the thermocouples of a particular tank. The data between thermocouples of a particular tank had to have a relatively similar frequency and number of data readings. Data for an entire thermocouple may have been excluded from the 3-D surface plot of a particular tank if the frequency and number of data readings for a particular thermocouple were not relatively similar to the frequency and number of data readings of the other thermocouples. If the frequency and number of thermocouple data readings for a particular tank had no similarities between thermocouples, then a 3-D surface plot was not developed. The second condition evaluated was the time span between consecutive data points of a particular thermocouple. If there was a time span between consecutive data points for a particular thermocouple that was greater than 36 months, then the data for the entire thermocouple were not included in the 3-D surface plot. If there were too many

thermocouples for a particular tank that had time spans between consecutive data points that were greater than 36 months, then a 3-D surface plot was not developed (see Appendix D).

The thermocouple elevations that were identified on the individual thermocouple graphs were determined from design drawings listed in the narratives and from the *Thermocouple Status Single Shell and Double Shell Tanks* (Tran, 1993). Tran's document contained design drawing references along with thermocouple elevations. If the design drawings listed in Tran's document could be verified for the individual tanks, then the thermocouple elevations listed by Tran were used. If the design drawings listed in Tran's document could not be verified for an individual tank or if there was no design drawings located, then the thermocouple elevations were labeled as unknown. If Tran's document lacked information about thermocouple elevations for a particular tank and design drawings were located, then the thermocouple elevations were labeled as approximate.

1.4.4 Assumptions

The transcribed data points are data points that have not been verified or validated by Westinghouse Hanford Company. Transcribed data were assumed to be good data and were included in the individual thermocouple graphs, 3-D surface plots, and the statistics. Individual judgements were not made on particular transcribed data points even though they had a high probability of being suspect. Verification and/or validation of data is not the function of this document.

The SACS database for Tank 241-AX-103 had the two types of files described earlier. Since one type of file contained data that were not correlated to a particular thermocouple tree or riser number, an assumption was made concerning origin of the temperature data. The basis for this assumption comes from comparing the number of SACS files with a review of the historical drawings. SACS had 18 files for Tank 241-AX-103 with data that were not correlated with a thermocouple tree or riser number. These 18 files were numbered 1 through 18. The numbering of the files represented thermocouple numbers. Drawing H-2-73380, Rev. 4, indicates a temperature probe in riser 9B. Drawing H-2-69170, Rev. 1, indicates that a thermocouple tree with 18 thermocouples was installed in the tank. It is assumed that the temperature data obtained from SACS for the 18 thermocouples were recorded from the thermocouple tree located in riser 9B.

1.4.5 Quality of Data

The quality of the interior tank temperature data is noted by the three category labels assigned by the custodians of the SACS database. The good and suspect data points have been verified and/or validated by Westinghouse Hanford Company. The transcribed data points have not been reviewed by Westinghouse Hanford Company. The transcribed data could be classified as either good or suspect at a later date.

This document has treated the transcribed data as good data. However, an area where the transcribed data points have a high probability of being suspect is when the temperature data values are below 45-50°F. The approximate temperature of the surrounding soil is 45-50°F and the soil will prevent the temperature of the tank from dropping below this point. Some of the tanks have many data points below the 45-50°F range and should be evaluated carefully as to whether or not they should be considered as good data points.

The 3-D surface plots of the temperature data along with the 2-D total waste level graphs are meant to be a tool to help visualize the interior tank temperature profile over history and to help correlate the temperature profile with the total waste level. The temperature data have gone through an interpolation process before SigmaPlot® can develop the 3-D surface plots of the temperature data. Because of the interpolation process and the inaccuracies that arise from interpolation, entire thermocouples were not included in the 3-D plots. In some instances, the temperature data was so inconsistent from one thermocouple to another that the interpolation process greatly skewed the 3-D surface plot. For these cases, the 3-D surface plot of the temperature data was not created. Care should be given to extracting temperature values from the 3-D surface plots.

1.5 Waste Surface Level

1.5.1 Surveillance Techniques

Four types of waste surface level devices are used to monitor waste surface levels in a single-shell tank: a level indicating transmitter or Food Instrument Corporation gauge, a level indicator assembly or manual tape, a high-level detector (an FIC gauge in intrusion mode), and the ENRAF® 854 ATG liquid level indicator/transmitter.

The Food Instrument Corporation gauge is based on conductivity. A plummet is lowered into the tank. When the plummet contacts an electrically conducting surface that is in contact with the edge of the tank, a circuit is completed between the probe and the tank which is grounded to the instrument. This triggers the drive motor to stop and the motor brake to engage. The brake is held for 60 seconds, before the motor raises the plummet. The plummet is raised until the circuit is broken. This instrument is used as a high-level detector and an actual level detector. The high-level mode is used to detect intrusions (i.e., any unexplained addition to the tank like rainwater) within the tank. The actual level mode can be read automatically, manually, or both. The automatic FIC reading is automatically read in the field and loaded on the surveillance automated computer system (SACS). FIC readings are also read manually in the field and entered into the SACS.

The manual tape flake boxes are an access point for measuring liquid levels manually if other devices fail or do not exist. A hand crank on the flake box is used to lower the tape probe until liquid is contacted and a circuit is completed between the tank and the instruments (similar to the FIC gauge). If the circuit is not closed, the probe is lowered until the tape is slack; then a measurement is recorded.

The ENRAF® 854 ATG Liquid Level Indicator/Transmitter has been installed on several tanks and will eventually replace the old level measurement devices. The ENRAF® 854 ATG is a microprocessor controlled surface level gauge. Level detection is based on the principle of buoyancy of a non-floating polyethylene displacer. The displacer is attached to a stainless steel measuring wire. The measuring wire is attached to a measuring drum which is fixed to a riser of known elevation. The weight of the displacer is entered into the memory of a force transducer. A second weight of about 10-15 grams less than the actual weight of the displacer is entered into the transducer as the control point. An electronic servomechanism turns the measuring drum causing the displacer to move. As the displacer is put in contact with the surface in question, the displacer will exert a smaller force on the transducer due to buoyancy. The displacer is continually lowered until the force exerted on the transducer is equal to the control point. By knowing the elevations of the riser and tank bottom, and the distance from the

riser to the surface of the waste, the surface level of the waste can be determined. If the surface level changes, the displacer will be raised or lowered by the measuring drum depending on the force exerted on the transducer relative to the control point. The ENRAF® can be read automatically, manually or both. Manual ENRAF® readings, the only ENRAF® readings available for this farm, are taken at any time of day and are manually entered into the SACS.

1.5.2 Source of Data

The data recorded from January 1, 1991 to the present for the waste surface levels were obtained from the SACS. PCSACS software on a personal computer is the user interface to the SACS database. The information was parsed in a spreadsheet in Microsoft Excel® software and displayed on graphs. Since the intrusion FIC is fixed at a certain elevation, it only records that elevation unless there is an unexplained addition. The device does not truly measure the waste surface level, so the data were not displayed.

1.5.3 Development of Data

Surface level data imported from SACS into spreadsheets (Microsoft Excel®) were rearranged onto separate spreadsheets depending on the data qualifier assigned by SACS custodians. The SACS database custodians label the surface level data using three data qualifiers or categories. The categories are good (G), transcribed (T), and suspect (S). The surface level data were then filtered to remove all the S data, leaving only the G and T data. The good and transcribed data were displayed on graphs. The graphs show waste level versus time. The data are displayed using the best representative scale on the y axis. If the tank has more than one device to measure the waste surface level, an individual graph was made to display the data from each device. The safety limit maximum waste level is placed in the title of each graph (Dougherty, 1995). Current information on the waste surface levels is in Appendix E.

1.5.4 Assumptions

The data obtained from PCSACS are the best available data. The data quality designation, instrument type, and level measurement are accurate. The devices are in good condition and give accurate readings assuming the following: internal tank temperature changes do not cause the tape, wire, or probe to change length; the tape, wire, and probe are straight; the surface profile of the waste is flat; and changes in atmospheric temperature do not effect the portions of the measuring device exposed to the atmosphere.

1.5.5 Quality of Data

Surface level readings may be affected by plummet (i.e., manual tape) error, flushing water accumulation, waste surface irregularities, and gas generation. Crystalline wastes (i.e., salt cake) can build up gradually on the end of the plummet and contact the waste which indicates a false surface level increase. Significant level discrepancies occur when the encrusting waste breaks off or when the measuring instrument plummet is flushed to remove the encrusting salt cake. Flushing the Food Instrument Corporation gauge, manual tapes, or any other equipment may cause accumulated wash water to collect under the plummet which can also indicate a false increase in the overall volume of

waste within the tank. Surface level readings are often difficult to obtain from tanks with a relatively dry waste surface of salt cake. Some tanks have crystalline waste built up on internal tank equipment (e.g., pumps, thermocouples, and other protruding equipment). As the supernatant liquid is pumped from the tanks, the crystalline structure may remain attached to the equipment and be suspended above the liquid. Therefore, an accurate surface level measurement would be difficult if the breakup of the crystalline structure was inconsistent and a nonuniform waste surface was created. Steel tapes or wires that are bent or warped from operation or those discarded on the waste surface are other sources of altered surface level readings.

Data from the SACS were obtained electronically from the Westinghouse Hanford Company surveillance group and were plotted. The data are actual surface levels recorded from the surveillance equipment. If the surveillance equipment in a particular tank riser was removed from service, the readings may show a level change when a new instrument and/or riser is used, especially if the waste surface shows severe heterogeneity.

The data used to produce the plots and the data obtained from the surveillance group have been verified as identical. However, errors in the data prior to the exchange of information could still exist. The SACS data were understood to be unverified prior to the exchange. Westinghouse Hanford Company qualified the data with G, S, and T for good, suspect, and transcribed, respectively. Data that is labeled transcribed has not been validated or verified by Westinghouse Hanford Company. The criteria for determining data labeled good or suspect is unknown.

1.6 Riser Configuration

1.6.1 Source of Data

The riser configuration drawings and tables in this report were compiled from design and/or as-built drawings including engineering change notices dated before November 1, 1995, the *Riser Configuration Document for Single-Shell Waste Tanks* (Alstad, 1991), and *Waste Tank Risers Available for Sampling* (Lipnicki, 1995a).

1.6.2 Development of Data

There are two drawings and a table in Appendix F that show the approximate locations, construction materials, dimensions, and function of each tank's risers. Alstad (1991) was used as a guide; however, the design and as-built drawings and engineering change notices take precedence. The tables in Appendix F contain the riser number, diameter, sampling, and description of each riser and nozzle. The sampling column lists risers that are tentatively available for sampling (Lipnicki, 1995a). The description and comment column describes the riser's intended use and, if applicable, gives a brief explanation, date, and number of the pertaining engineering change notices in parentheses.

1.6.3 Assumptions

The design and as-built drawings are the best available data. All the engineering change notices written against the referenced drawings are released and accurate. Since figures or sources were not

listed in Lipnicki (1995), the riser numbers labeled tentatively available for sampling are assumed to be the same as riser numbers listed in Alstad (1991).

1.6.4 Quality of Data

The riser configuration section of this document is a mixture of data from three main sources: design and as-built drawings, "Riser Configuration Document for Single-Shell Waste Tanks" (Alstad, 1991), and "Waste Tank Risers Available for Sampling" (Lipnicki, 1995a). All these sources do not agree all the time. Alstad (1991) and Lipnicki (1995) reference the design and as-built drawings in their respective documents. The design and as-built drawings contain a plan view of the tank dome and a table explaining the function of each riser. Sometimes the plan view and table do not match. If there was a discrepancy, a comment was made below the table for that tank. Other design and as-built drawings show a cross-sectional view of the tank. Changes made to the structure of a tank may not have been documented by an engineering change notice. The drawings and tables are intended to give the reader information as to approximate location, number of risers, and what equipment the riser might contain. The drawings are not to scale.

1.7 Photographs and Montages

1.7.1 Source of Data

The photographs include an aerial photograph of the tank farm and a photographic montage of each tank interior, if available (see Appendix G). All of the photographs were obtained from Boeing Computer Services Richland-Photography. The aerial photographs were reviewed to determine the clearest and most recent representation of the A Tank Farm to be used in this document. The montages were created from sets of interior tank photographs. These sets were also reviewed to determine which ones were the clearest and most recent photographs available. Only interior tank photographs representing the waste surface were used. In some cases, existing montages were the clearest and most recent; therefore, a new montage was not created.

1.7.2 Development of Data

The tank farm aerial photograph was labeled to show tank orientation, identifiable equipment, and structures. Arrows were placed on the tank farm aerial photograph to indicate the cascade overflows. The clearest and most recent montage of the tank interior was labeled to show identifiable monitoring equipment, piping, and risers. A table was also developed listing aerial photograph numbers, interior tank montage numbers, photographic set numbers, and the date (see Appendix G).

1.7.3 Quality of Data

The interior tank photographs may not represent the actual colors of the waste surface due to possible alteration of colors during copying of the original photographs. To see the colors of the original montage, an original may be ordered through Boeing Computer Services Richland-Photography. Also, radiation could affect the film distorting the apparent colors of the waste. Some tanks had fogging problems in the vapor space which prevented use of the latest photographs. The montage may not reflect the current waste level and waste type due to pumping, additions, mixing, and/or settling of the

waste after the photographs were taken. Also, the equipment configuration may not reflect tank upgrades and/or maintenance.

1.8 Tank Layer Model, Supernatant Mixing Model, and Inventory Estimates

The Tank Layer Model (TLM), Supernatant Mixing Model (SMM), and Inventory Estimates developed by Los Alamos National Laboratory (LANL) are presented in Appendix H along with their approach and development sections. The TLM, SMM, and Inventory Estimates presented in this document represent an estimated waste content of the tanks in AX Tank Farm based on an inventory estimate date of December 31, 1993.

1.8.1 Source of Data

The TLM, SMM, Inventory Estimates, and their approach and development sections presented in this document are from the *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 3* (Agnew et al., 1996).

1.8.2 Development of Data

The data presented in Appendix H were selectively taken from the *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 3* (Agnew et al., 1996) document to include the TLM, SMM, and the Inventory Estimates for AX Tank Farm. The introduction for Agnew's document was included in its entirety. Any reference to appendices in Agnew's introduction and tables in Appendix H are the appendices of his document. The TLM Working Worksheet (Agnew et al., 1996, Appendix C) was included for only AX Tank Farm. The SMM and TLM Volume Tables (Agnew et al., 1996, Appendix D) was included for all tanks. The Inventory Estimates (Agnew et al., 1996, Appendix E) was included for only AX Tank Farm.

2.0 AX Tank Farm

2.0.1 AX Tank Farm Information

The AX Tank Farm is located east of Buffalo Avenue, west of Canton Avenue, and north of the A Tank Farm in the 200-East Area. The farm contains four 100 series, flat bottom design, single-shell tanks built in 1963 and 1964 (Welty, 1988). The tanks are 75-feet in diameter with an operating capacity of 1,000,000 gallons (Hanlon, 1995k) (see tank cross-section in Appendix F). The tanks are constructed of a reinforced concrete shell with a steel liner on the interior bottom and sides. These tanks were designed to hold boiling (i.e., self-concentrating) waste. The waste in each tank was allowed to boil for one to five years at a fluid temperature of 250°F. The dome of each tank is penetrated by risers varying in diameter from 4 to 42 inches. All of the tanks have at least six feet of earth cover. The tanks in AX Tank Farm do not have connecting overflow lines to cascade waste between tanks.

2.0.2 AX Tank Farm Waste and Level History

The Waste and Level History sketches in Appendix C present the waste history and level histories for AX Tank Farm.

2.0.3 AX Tank Farm Temperature History

Interior tank temperature data for AX Tank Farm is quite limited compared to the span of time in which the tanks have been operating. Information about the various temperature monitoring devices and their locations throughout history is also quite limited. The information that was available came from the Surveillance Analysis Computer System (SACS) database. The SACS database had several types of temperature data files available. Data from the useable files were available as far back as late 1976.

2.0.4 AX Tank Farm Occurrences

Only the occurrences determined as significant are included. The reports presented are incomplete because not all of the documentation on occurrences for AX Tank Farm could be located.

2.0.5 AX Tank Farm Current Status

The tanks in AX Tank Farm entered service from 1965 to 1966 (Anderson, 1990). The dates the tanks entered service are based on when the tank first received waste or test water. This date may vary in other documents. The total waste volume for all of the tanks is approximately 906,000 gallons as of November 30, 1995 (Hanlon, 1996b). All tanks are out of service. Tanks 241-AX-101 and -103 are categorized as sound and Tanks 241-AX-102 and -104 are assumed leakers. Tanks 241-AX-101, -102 and -103 are on watch lists. See Appendix E for waste surface level graphs. The risers tentatively available for sampling are listed in Appendix F.

2.0.6 AX Tank Farm Photograph and Tank Montages

The photographs for AX Tank Farm include an aerial photograph of the farm and a montage of interior tank photographs for each tank. The aerial photograph shows the tank orientation, equipment, and structures. The interior tank photographs were arranged into montages to show the waste surface, monitoring equipment, piping, and risers in each tank. The photographs and a table listing the photographs, montage numbers, photograph set numbers, and dates of the photographs in this document are in Appendix G.

2.0.7 AX Tank Farm Tank Layer Model, Supernatant Mixing Model, and Inventory Estimates

The Tank Layer Model (TLM), Supernatant Mixing Model (SMM), and Inventory Estimates developed by Los Alamos National Laboratory (Agnew et al., 1996) for AX Tank Farm are presented in Appendix H along with their introduction sections.

2.1 Tank 241-AX-101

2.1.1 Waste and Level History of Tank 241-AX-101

The Waste and Level History sketch in Appendix C presents the waste history and level history of Tank 241-AX-101. The interstitial liquid level data are questionable since they exceed the solids level and there is no supernate in the tank.

2.1.2 Temperature History of Tank 241-AX-101

Interior tank temperature data for Tank 241-AX-101 were recorded by 18 thermocouples attached to one thermocouple tree. Drawing H-2-69170, Rev. 1, indicates that the thermocouple tree is designed as shown on Drawing H-2-34304, Sht. 1 Rev. 6. The Surveillance Analysis Computer System (SACS) indicates that the thermocouple tree is located in riser 9B. The temperature data were obtained from the SACS database on October 20, 1995, and only contained data for the thermocouple tree located in riser 9B. The earliest data retrieved from SACS were from late October 1976.

Drawing H-2-73376, Rev. 4, indicates that risers 7A, 7B, 7C, 7D, 13A, 13B, 13C, 11A, 11B, and 11C were once associated with temperature monitoring. The thermocouples located within risers 11A, 11B, and 11C monitored temperatures within the structural concrete shell of the tank. It is unclear what type of information was gathered or what type of temperature monitoring equipment were used at risers 7A, 7B, 7C, 7D, 13A, 13B, and 13C. Over the history of the tank, other risers and equipment may have been used to monitor the temperatures in the tank. The thermocouple tree located in riser 9B is the only source of temperature data used in this document.

Graphs of individual thermocouple data are presented in Appendix D. There is also a three-dimensional (3-D) surface plot that combines the temperature data from all the thermocouples except for 17 and 18. Thermocouples 17 and 18 were not included in the plot due to a lack of data. The following statistical information was taken from all 18 thermocouples. The maximum temperature was 168°F taken by thermocouples 1 and 6 on January 6, 1986. The minimum temperature was 65°F taken by thermocouple No. 1 on October 24, 1976. The maximum and minimum temperatures are labeled as good data points in SACS. The average temperature for all of the thermocouples is 120°F.

2.1.3 Occurrences for Tank 241-AX-101

No significant occurrences are associated only with Tank 241-AX-101.

2.1.4 Current Status of Tank 241-AX-101

Tank 241-AX-101 entered service during the first quarter of 1965 (Anderson, 1990) and as of November 30, 1995 stores approximately 748,000 gallons of waste (Hanlon, 1996b). The waste surface level in the tank is measured with a manual ENRAF® level gauge as of September 1995. The minimum waste surface level was 267.4 inches on March 1, 1993. The maximum waste surface level was 278.2 inches on September 30, 1991. See Appendix E for details on waste surface level. Tank 241-AX-101 was added to the Hydrogen Watch List in January 1991. The tank is out of service and partial interim isolation has been completed. The tank is listed as sound and passively ventilated. A plan

view in Appendix F depicts the approximate riser locations as of November 1, 1995. Tank 241-AX-101 has 34 risers with six tentatively available for sampling: one 4-inch riser (No. 6), four 6-inch risers (Nos. 9D, 9E, 9F, and 9G), and one 16-inch riser (No. 3A) (Lipnicki, 1995a).

2.1.5 Interior Montage of Tank 241-AX-101

The clearest and most recent set of interior tank photographs was taken on August 18, 1987. Other interior tank photographs are available, but only the photographs showing the waste surface were used to create a montage. The montage has labels identifying some of the monitoring equipment, piping, and risers in the tank. The montage and photographic information are shown in Appendix G.

2.1.6 Tank Layer Model, Supernatant Mixing Model, and Inventory Estimate of Tank 241-AX-101

The Tank Layer Model(TLM), Supernatant Mixing Model(SMM), and Inventory Estimate developed by Los Alamos National Laboratory (Agnew et al., 1996) for Tank 241-AX-101 are presented in Appendix H along with their approach and development sections.

2.2 Tank 241-AX-102

2.2.1 Waste and Level History of Tank 241-AX-102

The Waste and Level History sketch in Appendix C presents the waste history and level history of Tank 241-AX-102.

2.2.2 Temperature History of Tank 241-AX-102

Interior tank temperature data for Tank 241-AX-102 were recorded by 18 thermocouples attached to one thermocouple tree. Drawing H-2-69170, Rev. 1, indicates that the thermocouple tree is designed as shown on Drawing H-2-34304, Sht. 2 Rev. 6. The Surveillance Analysis Computer System (SACS) indicates that the thermocouple tree is located in riser 9C. The temperature data were obtained from the SACS database on October 20, 1995, and only contained data for the thermocouple tree located in riser 9C. The earliest data retrieved from SACS were from late October 1976.

Drawing H-2-73378, Rev. 2, indicates that risers 7A, 7B, 7C, 7D, 13A, 13B, 13C, 11A, 11B, and 11C were once associated with temperature monitoring. The thermocouples located within risers 11A, 11B, and 11C monitored temperatures within the structural concrete shell of the tank. It is unclear what type of information was gathered or what type of temperature monitoring equipment was used at risers 7A, 7B, 7C, 7D, 13A, 13B, and 13C. Over the history of the tank, there may also have been other risers and equipment used to monitor the temperature in the tank. The thermocouple tree located in riser 9C is the only source of temperature data used in this document.

Graphs of individual thermocouple data are presented in Appendix D. A graph was created for each thermocouple, except for 13 and 15 which were not graphed due to lack of data. A three-dimensional surface plot, that combines the temperature data from different thermocouples, was not included in Appendix D due to a lack of consistent temperature data between different thermocouples. The following statistical information was taken from all 18 thermocouples. The maximum temperature was 143°F taken by thermocouple No. 2 on June 17, 1988. The minimum temperature was 42°F taken by thermocouple No. 1 on October 24, 1976. The maximum and minimum temperatures are labeled as good data points within SACS. The average temperature for all the thermocouples is 83°F.

2.2.3 Occurrences for Tank 241-AX-102

In May 1989, the decrease criteria limit was exceeded and an unusual occurrence report was issued. The decrease was attributed to solids settling in the tank after the supernate was pumped out.

2.2.4 Current Status of Tank 241-AX-102

Tank 241-AX-102 entered service during the third quarter of 1965 (Anderson, 1990) and as of November 30, 1995 stores approximately 39,000 gallons of waste (Hanlon, 1996b). The waste surface level in the tank is measured with a manual tape as of September 1995. The minimum waste surface level was 9 inches on April 2, 1992. The maximum waste surface level was 15 inches on October 10, 1992. See Appendix E for details on waste surface level. Tank 241-AX-102 was added to the Organics

Watch List in May 1994. The tank is out of service with interim stabilization and intrusion prevention completed. The tank is also listed as a assumed leaker and is passively ventilated. A plan view in Appendix F depicts the approximate riser locations as of November 1, 1995. Tank 241-AX-102 has 33 risers with five tentatively available for sampling: four 6-inch risers (Nos. 9A, 9E, 9F, and 9G) and one 16-inch riser (No. 3A) (Lipnicki, 1995a).

2.2.5 Interior Montage of Tank 241-AX-102

The clearest and most recent set of interior tank photographs was taken on June 5, 1989. Other interior tank photographs are available, but only the photographs showing the waste surface were used to create a montage. The montage has labels identifying some of the monitoring equipment, piping, and risers in the tank. The montage and photographic information are shown in Appendix G.

2.2.6 Tank Layer Model, Supernatant Mixing Model, and Inventory Estimate of Tank 241-AX-102

The Tank Layer Model(TLM), Supernatant Mixing Model(SMM), and Inventory Estimate developed by Los Alamos National Laboratory (Agnew et al., 1996) for Tank 241-AX-102 are presented in Appendix H along with their introduction sections.

2.3 Tank 241-AX-103

2.3.1 Waste and Level History of Tank 241-AX-103

The Waste and Level History sketch in Appendix C presents the waste history and level history of Tank 241-AX-103.

2.3.2 Temperature History of Tank 241-AX-103

Interior tank temperature data for Tank 241-AX-103 were recorded by two separate thermocouple tree arrangements. One thermocouple tree contained 18 thermocouples and the other tree contained only 6. Drawing H-2-69170, Rev. 1, indicates that there is a thermocouple tree designed as shown on Drawing H-2-34304, Sht. 1 Rev. 6, with 18 thermocouples located in riser 9A. Drawing H-2-73380, Rev. 4, indicates that a thermocouple tree is located in riser 9B, not riser 9A. The Surveillance Analysis Computer System (SACS) indicates that the thermocouple tree with 18 thermocouples is located in riser 9B. Therefore, it has been assumed, for information on thermocouple elevations, that the thermocouple tree with 18 thermocouples corresponds to the design on Drawing H-2-34304, Sht. 1 Rev. 6. Drawing H-2-90342, Sht. 2 Rev.2 indicates that there is a thermocouple tree designed as shown on that drawing, with 6 thermocouples located in riser 13C. The SACS indicates that the thermocouple tree with 6 thermocouples is located in riser 13C. The temperature data were obtained from the SACS database on October 20, 1995. The SACS database contained two file types for temperature data: a historical file of temperature data for 18 thermocouples without correlation to a riser number and a file of temperature data for 6 thermocouples correlated to riser 13C. The earliest data retrieved from SACS were from late October 1976.

Drawing H-2-73380, Rev. 4, indicates that risers 7A, 7B, 7C, 7D, 13A, 13B, 11A, 11B, and 11C were once associated with temperature monitoring. The thermocouples located within risers 11A, 11B, and 11C monitored temperatures within the structural concrete shell of the tank. It is unclear what type of information was gathered or what type of temperature monitoring equipment was used at risers 7A, 7B, 7C, 7D, 13A, and 13B. Over the history of the tank, other risers and equipment may have been used to monitor the temperature in the tank. The thermocouple trees located at riser 13C and assumed at riser 9C are the only sources of temperature data used in this document.

Graphs of individual thermocouple data are presented in Appendix D. A graph was created for each thermocouple, except for thermocouples 17 and 18 in riser 9B which were not graphed due to lack of data. A three-dimensional surface plot, that combines the temperature data from different thermocouples, was not included in Appendix D due to a lack of consistent temperature data between different thermocouples. The following statistical information was taken from all 24 thermocouples. The maximum temperature was 148°F taken by thermocouple No. 1 in riser 9B on February 9, 1980. The minimum temperature was 58°F taken by thermocouple No. 5 in riser 9B on June 10, 1985. The maximum and minimum temperatures are labeled as good data points within SACS. The average temperature for all the thermocouples is 93°F.

2.3.3 Occurrences for Tank 241-AX-103

An occurrence report was issued in March 1979 due to an increase in liquid level in a leak detection pit. The cause was apparently ground water seeping through the drain bellows assembly into the pit.

2.3.4 Current Status of Tank 241-AX-103

Tank 241-AX-103 entered service during the first quarter of 1965 (Anderson, 1990) and as of November 30, 1995 stores approximately 112,000 gallons of waste (Hanlon, 1996b). The waste surface level in the tank is measured with a manual ENRAF® level gauge as of September 1995. The minimum waste surface level was 38.2 inches on January 3, 1994. The maximum waste surface level was 40.72 inches on September 19, 1995. See Appendix E for details on waste surface level. Tank 241-AX-103 was added to the Hydrogen Watch List in January 1991. The tank is out of service with interim stabilization and intrusion prevention completed. The tank is listed as sound and is passively ventilated. A plan view in Appendix F depicts the approximate riser locations as of November 1, 1995. Tank 241-AX-103 has 32 risers with six tentatively available for sampling: one 4-inch riser (No. 6), four 6-inch risers (Nos. 9A, 9D, 9E, and 9G), and one 16-inch riser (No. 3A) (Lipnicki, 1995a).

2.3.5 Interior Montage of Tank 241-AX-103

The clearest and most recent set of interior tank photographs was taken on August 13, 1987. Other interior tank photographs are available, but only the photographs showing the waste surface were used to create a montage. The montage has labels identifying some of the monitoring equipment, piping, and risers in the tank. The montage and photographic information are shown in Appendix G.

2.3.6 Tank Layer Model, Supernatant Mixing Model, and Inventory Estimate of Tank 241-AX-103

The Tank Layer Model(TLM), Supernatant Mixing Model(SMM), and Inventory Estimate developed by Los Alamos National Laboratory (Agnew et al., 1996) for Tank 241-AX-103 are presented in Appendix H along with their introduction sections.

2.4 Tank 241-AX-104

2.4.1 Waste and Level History of Tank 241-AX-104

The Waste and Level History sketch in Appendix C presents the waste history and level history of Tank 241-AX-104.

2.4.2 Temperature History of Tank 241-AX-104

Interior tank temperature data for Tank 241-AX-104 were recorded by 18 thermocouples attached to one thermocouple tree. Drawing H-2-69170, Rev. 1, indicates that the thermocouple tree is designed as shown on Drawing H-2-34304, Sht. 2 Rev. 6. The Surveillance Analysis Computer System (SACS) indicates that the thermocouple tree is located in riser 9C. The temperature data were obtained from the SACS database on October 20, 1995, and only contained for the thermocouple tree located in riser 9C. The earliest data retrieved from SACS were from late October 1976.

Drawing H-2-73382, Rev. 2, indicates that risers 7A, 7B, 13A, 13B, 13C, 16A, 16B, 16C, 11A, 11B, and 11C were once associated with temperature monitoring. Drawing H-2-68240, Rev. 1, indicates that risers 7C and 7D also were associated with temperature monitoring at one time. The thermocouples located within risers 11A, 11B, and 11C monitored temperatures within the structural concrete shell of the tank. It is unclear what type of information was gathered or what type of temperature monitoring equipment were used at risers 7A, 7B, 7C, 7D, 13A, 13B, 13C, 16A, 16B, and 16C. Over the history of the tank, other risers and equipment may have been used to monitor the temperature in the tank. The thermocouple tree located at riser 9C is the only source of temperature data used in this document.

Graphs of individual thermocouple data are presented in Appendix D. There is also a three-dimensional (3-D) surface plot that combines the temperature data from all the thermocouples except for 17 and 18. Thermocouples 17 and 18 were not included in the plot due to a lack of data. The following statistical information was taken from all 18 thermocouples. The maximum temperature was 242°F taken by thermocouple No. 1 on January 11, 1977. The minimum temperature was 68°F taken by numerous thermocouples on January 11 and 28, 1976. The maximum and minimum temperatures are labeled as transcribed data points within SACS. The average temperature for all the thermocouples is 97°F.

2.4.3 Occurrences for Tank 241-AX-104

An occurrence report was issued in January 1976 due to increased radiation levels in the drywells. Evaluation indicated migration of a vapor header leak identified in a preliminary ARHCO occurrence report issued in April 1975.

2.4.4 Current Status of Tank 241-AX-104

Tank 241-AX-104 entered service during the third quarter of 1965 (Anderson, 1990) and as of November 30, 1995 stores approximately 7,000 gallons of waste (Hanlon, 1996b). The waste surface level in the tank is measured with a manual tape as of September 1995. The minimum waste surface level was 1 inch on August 31, 1992. The maximum waste surface level was 4.5 inches on October 1,

1995. See Appendix E for details on waste surface level. Tank 241-AX-104 is out of service with interim stabilization and intrusion prevention completed. The tank is listed as an assumed leaker and is passively ventilated. A plan view in Appendix F depicts the approximate riser locations as of November 1, 1995. Tank 241-AX-104 has 35 risers with seven tentatively available for sampling: four 4-inch risers (Nos. 7C, 7D, 16B, and 16C), two 6-inch risers (Nos. 9E and 9G), and one 16-inch riser (Nos. 3A) (Lipnicki, 1995a).

2.4.5 Interior Montage of Tank 241-AX-104

The clearest and most recent set of interior tank photographs was taken on August 18, 1987. Other interior tank photographs are available, but only the photographs showing the waste surface were used to create a montage. The montage has labels identifying some of the monitoring equipment, piping, and risers in the tank. The montage and photographic information are shown in Appendix G.

2.4.6 Tank Layer Model, Supernatant Mixing Model, and Inventory Estimate of Tank 241-AX-104

The Tank Layer Model(TLM), Supernatant Mixing Model(SMM), and Inventory Estimate developed by Los Alamos National Laboratory (Agnew et al., 1996) for Tank 241-AX-104 are presented in Appendix H along with their approach and development sections.

GLOSSARY

This glossary of Hanford terminology has been compiled from numerous sources. A lot of the terms have come from Anderson(1991), Jungfleisch(1984) and Agnew(1996). These definitions may conflict with other sources.

1C	First-cycle decontamination waste from the bismuth phosphate(BiPO_4) process at B and T Plants consisting of by-products co-precipitated from a solution containing plutonium (contains 10% of the original fission product activity and 2% of the products). By-product cake solution was mixed with product waste and neutralized with 50% caustic. Coating waste from removing aluminum fuel element cladding was added and comprised about 24% of the waste.
1C1	First-cycle decontamination waste from the bismuth phosphate(BiPO_4) process, 1944-49 (LANL defined waste #3)
1C2	First-cycle decontamination waste from the bismuth phosphate(BiPO_4) process, 1950-56 (LANL defined waste #4)
224	224-U Waste. LaF_3 finishing waste from BiPO_4 process and uranium recovery in the 224 buildings by T Plant and B Plant and the Plutonium Finishing Plant (LANL defined waste #7)
2C	Second-cycle decontamination waste from the bismuth phosphate(BiPO_4) process at B and T Plants (see second-cycle decontamination waste)
2C1	Second-cycle decontamination waste from the bismuth phosphate(BiPO_4) process, 1944-49 (LANL defined waste #5)
2C2	Second-cycle decontamination waste from the bismuth phosphate(BiPO_4) process, 1950-56 (LANL defined waste #6)
5-6	Waste from cell 5 tank 6 in B Plant; the hot waste collected in the bottom of cell 5 when the liquid boiled over during dissolving and neutralizing phases of the BiPO_4 process.
Active Drywell	Drywell in which radiation readings of greater than 50 counts per second are detected. The readings must be consistent as to depth and radiation level for repeated readings to be considered active.

Airlift Circulator	A device installed in aging waste tanks to promote mixing of the supernate. By maintaing motion within the body of the liquid, the circulators minimize superheat buildup and, consequently, minimize burping.
AR	Washed PUREX sludge from the 244-AR Vault (LANL defined waste #31)
Assumed Leaker	A waste storage tank for which past surveillance data has indicated a loss of liquid attributed to a breach of integrity. In 1984, the designations of "suspect leaker," "questionable integrity," "confirmed leaker," "declared leaker," "dormant", and "borderline" were merged into one category called "assumed leaker."
B	High-level waste from PUREX acidified waste processed through B Plant to extract strontium (LANL defined waste #32)
BG	Below grade
BL	B Plant low-level waste beginning 1968 (LANL defined waste #33)
BM	Bench mark
BNW	Battelle Northwest Laboratory waste
BSLTCK	Salt cake waste generated from the 242-B Evaporator, 1951-53 (LANL defined waste #41)
BYSLTCK	Salt cake waste generated from in-tank solidification units 1 and 2 in BY Tank Farm, 1965-74 (LANL defined waste #44)
Cascade	Eleven of the single-shell tank farms (all except the AX Tank Farm) were equipped with overflow lines between tanks. The tanks were connected in series and were placed at different elevations creating a downhill gradient for liquids to flow (cascade) from one tank to another. Thus, multiple tanks could be filled with one pump.
Catch Tanks	Small capacity single-shell tanks associated with diversion boxes and diverter stations. The tanks are designed to receive any transfer line clean out, spills or leakage from the boxes, or leakage from the adjacent pipe encasement.

CC	Complexant concentrate waste or concentrated complexant; concentrated product from evaporating dilute complexed waste which contained high concentrations of organic complexants, such as HEDTA, EDTA, and citric acid.
CCPLX	Complexant concentrate or concentrated complexant waste; see CC.
CCW	Concentrated customer waste; the product of concentrating waste received from 100N or the Fast Flux Test Facility having phosphate and/or sulfate concentrations which, after concentration, exhibit the characteristics of a complexed liquid.
CEM	Cement
CF	Cesium feed; a PUREX sludge supernate.
CPLX	Complexed waste; dilute waste containing relatively high concentrations of organic chelating agents such as EDTA and HEDTA from B Plant waste fractionization.
Crib	An underground structure filled with aggregate designed to receive liquid waste, usually through a perforated pipe. The filtration and ion exchange properties of the soil in and around the crib were used to contain the radionuclides.
CSR	Waste (supernate) from cesium recovery of tank supernate at B Plant (LANL defined waste #35)
CW	Coating (cladding) waste produced at PUREX from dissolution of Zircaloy or aluminum fuel cladding.
CWZR1	Coating (cladding) waste (PUREX), Zircaloy cladding; 1968-72 (LANL defined waste #23)
CWZR2	Coating (cladding) waste (PUREX), Zircaloy cladding; 1983-88 (LANL defined waste #47); see NCRW and PD; also known as CWP/ZR2
CWP	Coating (cladding) waste (PUREX)
CWP1	Coating (cladding) waste (PUREX); (LANL defined waste #21, CWP/Al, 1956-60)
CWP2	Cladding (coating) waste (PUREX), (LANL defined waste #22, CWP/Al, 1961-72)

CWP/ZR	Now called PD or NCRW
CWR1	REDOX cladding (coating) waste, (LANL defined waste #15, CWR/Al, 1952-60)
CWR2	Coating (cladding) waste (REDOX), (LANL defined waste #16, CWL/Al with some Zr, 1961-72)
DC	Dilute complexed waste characterized by organic carbon including organic complexants: EDTA, citric acid, HEDTA, and iminodiacetate.
DE	Diatomaceous Earth; Diatomite(SiO_2); a light friable siliceous material derived from diatom (algal) remains; added to some underground waste storage tanks to absorb residual liquids.
Ditch	A linear excavation often used for the temporary diversion or disposal of process waste streams.
Diversion Box	A below grade, concrete enclosure containing the remotely maintained jumpers and spare nozzles for routing waste solution to storage tank farms.
DSSF	Double-shell slurry feed; Waste concentrated in evaporators until the solution is nearly saturated with sodium aluminate without exceeding receiver tank composition limits. This form is not as concentrated as double-shell slurry.
Drywell	A steel casing, generally 6-inch internal diameter, drilled into the ground to various depths (but do not reach the water table) and used to insert monitoring instruments for measuring the presence of radioactivity or moisture content.
DW	Decontamination waste; a wash solution from equipment decontamination at T Plant (LANL defined waste #39)
EB	Evaporator bottoms; a slurry from the evaporators
EF	Evaporator feed; various supernatant liquids whose composition depends on the source
EVAP	Evaporator feed (post 1976 designation)
Evaporator Feed	Any waste liquid that can be concentrated to form salt cake; e.g., aged waste, low heat waste, dilute interstitial liquor, and other radioactive waste solutions.

FD	Feed dilute
Ferrocyanide	An ion composed of iron and cyanide with the chemical formula of $\text{Fe}(\text{CN})_6^{4-}$.
H ₂ O	Water
HDRL	Hanford defense residual liquor; late 1970s designation for terminal liquors remaining after evaporation; includes complexed and noncomplexed waste, partially neutralized waste, and DSSF (see RESID).
HLO	Hanford Laboratory Operations; also, Hanford laboratory operations waste; laboratory waste from the 300 Area
HS	Hot Semiworks (C Plant); a pilot facility with a variety of operations. Also, Hot or Strontium Semiworks waste (LANL defined waste #28); see SSW.
ILL	Interstitial liquid level
Inactive Tank	A tank that has been removed from liquid-processing service, has been pumped to less than 33,000 gallons of waste, and will be, or is in the process of being, stabilized followed by intrusion prevention. This includes all tanks not in active or active-restricted categories. Also included are inactive spare tanks that would be used if an active tank failed.
Interim Isolation	An administrative designation reflecting the completion of the physical effort required to minimize the addition of liquids into an inactive storage tank, process vault, sump, catch tank, or diversion box. (In June 1993, "interim isolation" was replaced by "intrusion prevention".)
Interim Stabilization	A tank which contains less than 50,000 gallons of drainable interstitial liquid and less than 5,000 gallons of supernate. If a jet pump was used to achieve interim stabilization, then the jet pump flowrate must have been at or below 0.05 gallons per minute before interim stabilization was completed.
Interstitial Liquid	The interstitial liquid within the tanks is the liquid that fills the interstitial(voids) spaces of the solid waste.
Intrusion Prevention	An administrative designation reflecting the completion of the physical effort required to minimize the addition of liquids into an inactive storage tank, process vault, catch tank, sump, or diversion box.

IWW	Inorganic wash waste (i.e., concentrated neutralized high-level waste from PUREX); see NCAW and P. This was also designated as 1WW because it is bottoms waste from the #1 acid concentrator.
IX	Ion exchange waste from the cesium recovery process at B Plant
Knuckle	Point where the side wall and the bottom curved surface of a tank meet.
Level Adjustment	Any update in the waste inventory (or tank level) in a tank. The adjustments usually result from surveillance observations or historical investigations.
Liquid Observation Well (LOW)	A liquid observation well is a fiber glass or tefzel-reinforced epoxy-polyester resin, 89 mm (3.5 inches) diameter pipe that is capped on the bottom end. This end is placed within 25 mm (1 inch) above the bottom portion of the steel tank liner. Three types of probes are used in the LOW to monitor changes in the interstitial liquid level: acoustic, gamma, and neutron.
LW	Laboratory waste from the 222-S Building
Mixed Waste	Waste containing both radioactive and hazardous (dangerous as defined in WAC 173-303) waste.
MW	Waste from the bismuth phosphate process (which extracted plutonium) containing all the uranium, approximately 90% of the original fission product activity, and approximately 1% of the product. This waste was brought to the neutral point with 50% caustic and then treated with an excess of sodium carbonate. This procedure yielded almost completely soluble waste at a minimum total volume. The exact composition of the carbonate compounds was not known, but was assumed to be a uranium phosphate carbonate mixture. The term "metal" was the code word for plutonium.
MW1	Metal waste from BiPO ₄ , 1944-49 (LANL defined waste #1, same as MW)
MW2	Metal waste from BiPO ₄ , 1950-56 (LANL defined waste #2, same as MW)
N	Phosphate decontamination waste from N Reactor (LANL defined waste #40)

NCAW	Neutralized current acid waste, primary high-level waste stream from PUREX process (LANL defined waste #45, formerly P3, 1983-88)
NCPLX	Non-complexed waste; general term for supernates and salt well liquors that did not contain organic complexants.
NCRW	Neutralized cladding removal waste, same as CWP/Zr.
NIT	HNO ₃ /KMNO ₄ solution added during evaporator operation
Non-Complexed	General waste term applied to all Hanford Site liquors not identified as complexed (containing organics).
Out-of-Service-Tank	A tank that does not meet the definition of an in-service tank. Before September 1988, these tanks were defined as inactive. (Note: All single-shell tanks are out of service.)
OWW	Organic Wash Waste; The solvent used in PUREX was treated before reuse by washing with potassium permanganate and sodium carbonate, followed by dilute nitric acid.
OWW1	Organic wash waste, 1956-62, also known as CARB (LANL defined waste #24)
OWW2	Organic wash waste, 1963-67 (LANL defined waste #25)
OWW3	Organic wash waste, 1968-72 (LANL defined waste #26)
P	High-level neutralized acid waste from PUREX
P1	PUREX high-level waste, 1956-62 (LANL defined waste #17)
P2	PUREX high-level waste, 1963-67 (LANL defined waste #18)
P2'	1968-1972, assigned to P2.
P3	1983-1988, now called PXNAW or NCAW.
Partial Interim Isolation	The administrative designation for completing the physical effort required for interim isolation, except for isolating the risers and piping that will be required for jet pumping or for other methods of stabilization.
PASF	PUREX ammonia scrubber feed (LANL defined waste #48)
PD	PUREX decladding waste

PFeCN1	Ferrocyanide sludge produced by in-plant scavenging (using 0.005 M ferrocyanide) of waste from uranium recovery (LANL defined waste #9)
PFeCN2	Same as PFeCN1 except 0.0025 M ferrocyanide used (LANL defined waste #10)
pH	A measure of the hydrogen ion concentration in solution.
PL	Low-level waste from PUREX
PL1	PUREX low-level waste (LANL defined waste #20)
PL2	1983-88, now called PXMSC, among other things.
Primary Addition	An addition of waste from a specific plant or process vault.
PSS	PUREX sludge supernate; produced by leaching PUREX sludge
PXMSC	Dilute, non-complexed waste from PUREX misc. streams
PXNAW	Aging waste from PUREX high level waste; see NCAW (LANL defined waste #45, formerly P3, 1983-88)
R	High-level waste from REDOX
R1	REDOX waste, 1952-57 (LANL defined waste #13)
R2	REDOX waste, 1958-66 (LANL defined waste #14)
RESID	Hanford defense residual liquor (see HDRL)
Riser	A vertical pipe through a tank dome (access to the tank interior).
RIX	REDOX ion exchange waste produced at B Plant by extracting cesium from REDOX supernate
RSLTCK	Salt-cake waste from the REDOX concentrator (LANL defined waste #43)
RSN	REDOX supernate
SACS	Surveillance analysis computer system

Salt Cake	Crystallized nitrate and other salts deposited in waste tanks, usually after the waste is concentrated by evaporation.
Salt Well	A hole drilled or sluiced into salt cake and lined with a cylindrical screen to permit drainage and jet pumping of interstitial liquids.
Scavenged Waste	Waste which has been treated with ferrocyanide to remove cesium from the supernate by precipitating it into a sludge.
Self-Concentrating Waste	Liquid, high-level radioactive waste whose decaying radionuclides heat the solution sufficiently to boil off (i.e., evaporate) the water, thus concentrating the waste.
SIX	Waste from removing cesium from PUREX sludge supernate by ion exchange at B Plant
Suicing, or sluiced	To wash with water. At Hanford, this has meant to dissolve or suspend waste in solution using a high pressure water stream.
Slurry	Insoluble material suspended in water or aqueous solution.
SMM	Supernatant Mixing Model (created at LANL) that calculates the composition of tank liquids and concentrates as linear combinations of supernates from the <i>Hanford Defined Wastes: Chemical and Radionuclide Compositions</i> (Agnew, 1995a)
SMP	Sludge measuring port
SMMA1	Solids from concentrate calculated by SMM. Waste type is tank dependent.
SMMA2	Solids from concentrate calculated by SMM. Waste type is tank dependent.
Sound	The integrity classification of a waste storage tank for which surveillance data indicate no loss of liquid attributed to a breach of integrity.
SRR	Sluiced PUREX sludge from A and AX Tank Farms sent to B Plant to recover strontium from 1967-76 (LANL defined waste #34). The sludge returned from B Plant was sent to the AR Vault and the supernate was sent to 241-C-105.

SRS	Strontium sludge; PUREX sludges sluiced for strontium recovery at B Plant were washed in the AR Vault with supernate from 241-C-105, and the resulting supernates were sent to CSR.
SST	Single-shell tank
SSW	Strontium Semiworks waste; produced from the strontium extraction process at the Strontium Semiworks after 1961
Stabilization	The removal or immobilization, as completely as possible, of the liquid contained in a radioactive waste storage tank by pumping via a salt well, adding diatomaceous earth, etc.
Supernatant or Supernate	Liquid floating above the solids in the waste storage tanks. Supernate is usually derived by subtracting the solids level measurement from the liquid level measurement.
T1SLTCK	Salt-cake waste generated from the 242-T Evaporator, 1951-56 (LANL defined waste #42)
T2SLTCK	Salt-cake waste generated from the 242-T Evaporator, 1965-76
Tank Farm	An area containing underground storage tanks for storing waste.
TBP	Tributyl phosphate, a solvent used in the uranium extraction process at U Plant; also, a waste which is sometimes called uranium recovery waste (UR).
Terminal Liquor	The concentrated supernatant liquid decanted from the evaporator bottoms (produced by the evaporators), which may not be concentrated further without forming solids that was unacceptable for storage in single-shell tanks (see HDRL). Terminal liquor is characterized by a caustic concentration of approximately 5.5 M (the caustic molarity was lower if the aluminum salt saturation was reached first).
TFeCN	Ferrocyanide sludge produced by in-tank or in-farm scavenging (LANL defined waste #11)
TH1	Thoria high-level or cladding waste, 1966 (LANL defined waste #29, formerly TH66)
TH2	Thoria high-level or cladding waste, 1970 (LANL defined waste #30, formerly TH70)

TH66	See TH1.
TH70	Thoria 1970.
Thermocouple	Thermocouples are simple devices that develop a millivoltage when parts of the thermocouple are exposed to temperature differentials. The millivoltage can be converted to a temperature reading based upon a specific voltage versus temperature curve inherent to the type of thermocouple being used. Thermocouples are attached to a fabricated assembly called a thermocouple tree.
Thermocouple Tree	Thermocouples are attached to a fabricated assembly called a thermocouple tree. The number of thermocouples attached to the tree varies as a function of the depth of the tank as well as the thermocouple tree design. The thermocouples are spaced at intervals, along trees that have many thermocouples, so that a vertical temperature profile of the tank contents can be developed. The thermocouple tree is installed in a riser and left in place inside the tank.
Thorium	A chemical element which is fertile material. Fertile means that when it is subjected to radiation in a nuclear reactor, it will be converted, in this case, to ²³³ U, a potential fuel.
TLM	Tank Layer Model (created at LANL and derived from <i>Waste Status and Transaction Record Summary</i> database) models the volumes of wastes in the tanks.
Trench	A linear excavation used for the disposal of solid waste.
TRUEX	Transuranic extraction process
UNK	Unknown waste type (LANL defined waste)
UR	Uranium recovery operation in U Plant, 1952-57. Created uranium recovery waste (UR) (LANL defined waste #8), also known as tributyl phosphate (TBP) waste, and FeCN (scavenging wastes). See TFeCN and PFeCN.

Watch List Tank	An underground storage tank requiring special safety precautions because the tank potentially could release high-level radioactive waste if uncontrolled increases in pressure or temperature occur. Special restrictions have been placed on the tanks by "Safety Measures for Waste Tanks at Hanford Nuclear Reservation," Section 3137, National Defense Authorization Act for Fiscal Year 1991, November 5, 1990, Public Law 101-501 (also called the Wyden Amendment).
WC	Weather cover
WESF	Waste Encapsulation and Storage Facility
WTR	Water; flush water from miscellaneous sources.
Wyden Amendment	See watch list tank.
Z	Waste discharged from Z Plant (PFP) (LANL defined waste #27)

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WASTE TYPES ADDED
TIME LINE
(ANDERSON 1990)

PRIMARY ADDITIONS
TIME LINE
(AGNEW 1995b)

P:
OWW:
FP:

B:
P2:
PL1:

B:
PSS:
WATER:

WATER:
EVAP:
RESID:
DSSF:

DSSF:
NCPLX:
CPLX:

TANK INFO:

CONSTRUCTED 1963-1964
NOMINAL CAPACITY: 1,000,000 GAL
FLAT BOTTOM TANK
6 INCH RADIUS KNUCKLE
75 FOOT DIAMETER TANK

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NOTES:

- 1) TRANSFER SOURCES AND DESTINATIONS ARE NOT AVAILABLE FOR ALL LEVEL CHANGES. FOR MORE DETAILS ABOUT TRANSFER INFORMATION SEE ANDERSON 1990.
- 2) INTERSTITIAL LIQUID LEVEL IS UNKNOWN

GLOSSARY OF WASTE TERMS:

FOR MORE COMPLETE DEFINITIONS
SEE APPENDIX A

B: B-PLANT HIGH LEVEL WASTE
CPLX: COMPLEXED WASTE
DSSF: DOUBLE SHELL SLURRY FEED
EVAP: EVAPORATOR FEED
FP: FISSION PRODUCT WASTE
NCPLX: NON-COMPLEXED WASTE
OWW: ORGANIC WASH WASTE
OWW2: ORGANIC WASH WASTE 1962-67
P: PUREX HIGH-LEVEL WASTE
P2: PUREX HIGH-LEVEL WASTE 1963-67
PL1: PUREX LOW-LEVEL WASTE
PSS: PUREX SLUDGE SUPERNATE
RESID: HANFORD DEFENSE RESIDUAL LIQUOR
SRR: STRONTIUM RECOVERY WASTE
WTR: WATER

LEGEND

- TOTAL WASTE LEVEL (SUPERNATE)
- - - TOTAL WASTE LEVEL (SOLIDS)
- - - SOLIDS LEVEL
- □ □ □ INTERSTITIAL LIQUID LEVEL (QUESTIONABLE DATA)
- +++++ ASSUMED SOLIDS LEVEL
- ▨ SOLIDS

AX TANK FARM
NO CASCADE

U.S. DEPARTMENT OF ENERGY
RICHLAND FIELD OFFICE
ICF KAISER HANFORD

241-AX-101 SINGLE-SHELL TANK
WASTE & LEVEL HISTORY 1965-1995
SOUND/NON-STABILIZED TANK
WATCH LIST: HYDROGEN

SIZE	BLDG NO.	DWG NO.	DATE
B	241	ES-TKS-E7	5/96
SCALE	NONE	JOB NO.	SHEET 1 OF 1

TANK INFO:
CONSTRUCTED 1963-1964
NOMINAL CAPACITY: 1,000,000 GAL
FLAT BOTTOM TANK,
6 INCH RADIUS KNUCKLE,
75 FOOT DIAMETER TANK.

THURMAN 1988k

2) IN JUNE 1993,THE TERM INTERIM ISOLATION

RESID: HANFO
WTR WATER SOLIDS

1000

WASTE & LEVEL HISTORY 1965-1995

WATCH LIST: ORGANICS				
SIZE	BLDG NO.	DWG NO.	DATE	
B	241	ES-TKS-E8	5/96	
SCALE	NONE	JOB NO.	SHEET	1 OF 1

WASTE TYPES ADDED
TIME LINE
(ANDERSON 1990)

PRIMARY ADDITIONS
TIME LINE
(AGNEW 1995b)

P:

PSS:

WATER:
EVAP:
CC:
NCPLX:

TANK INFO:

CONSTRUCTED 1963-1964
NOMINAL CAPACITY: 1,000,000 GAL
FLAT BOTTOM TANK,
6 INCH RADIUS KNUCKLE,
75 FOOT DIAMETER TANK

REFERENCES

- * ANDERSON 1990
- ** WELTY 1988
- *** BORSHEIM AND KIRCH 1991
- ◇ HANLON 1996a
- ◆ THURMAN 1987f

NOTES:

- 1) TRANSFER SOURCES AND DESTINATIONS ARE NOT AVAILABLE FOR ALL LEVEL CHANGES. FOR MORE DETAILS ABOUT TRANSFER INFORMATION SEE ANDERSON 1990.
- 2) INTERSTITIAL LIQUID LEVEL IS UNKNOWN
- 3) IN JUNE 1993, INTERIM ISOLATION WAS REPLACED BY INTRUSION PREVENTION.

GLOSSARY OF WASTE TERMS:

FOR MORE COMPLETE DEFINITIONS SEE APPENDIX A

- AR: WASHED PUREX SLUDGE
B: B-PLANT HIGH-LEVEL WASTE
BL: B-PLANT LOW-LEVEL WASTE
CC: COMPLEXANT CONCENTRATE WASTE
CCPLX: COMPLEXANT CONCENTRATE
CPLX: COMPLEXED WASTE
DSSF: DOUBLE-SHELL SLURRY FEED
EVAP: EVAPORATOR FEED
NCPLX: NON-COMPLEXED WASTE
OWW2: ORGANIC WASH WASTE 1963-67
OWW3: ORGANIC WASH WASTE 1968-72
P: PUREX HIGH-LEVEL WASTE
P2: PUREX HIGH-LEVEL WASTE 1963-1967
PL1: PUREX LOW-LEVEL WASTE
PSS: PUREX SLUDGE SUPERNATE
WTR: WATER

LEGEND

- TOTAL WASTE LEVEL (SUPERNATE)
- - - TOTAL WASTE LEVEL (SOLIDS)
- - - SOLIDS LEVEL
- ++++ ASSUMED SOLIDS LEVEL
- ▨ SOLIDS

AX TANK FARM
NO CASCADE

U.S. DEPARTMENT OF ENERGY
RICHLAND FIELD OFFICE
ICF KAISER HANFORD

241-AX-103 SINGLE-SHELL TANK
WASTE & LEVEL HISTORY 1965-1995
SOUND/STABILIZED TANK
WATCH LIST: HYDROGEN

SIZE	BLOG NO.	DWG NO.	DATE
B	241	ES-TKS-E9	5/96
SCALE	NONE	JOB NO.	SHEET 1 OF 1

LEVEL IN
FEET
LEVEL IN
INCHES

NO OVERFLOW
INSTALLED

6 INCH
KNUCKLE TOP

VOLUME
(GALLONS)

INTRUSION PREVENTION (82)
LEVEL ADJUSTMENT (14/82)

PHOTO (8/87), LEVEL ADJUSTMENT (8/87)
INTERIM STABILIZED (8/87)

SEE NOTE 2

FLAT BOTTOM

WASTE TYPES ADDED
TIME LINE
(ANDERSON 1990)

PRIMARY ADDITIONS
TIME LINE
(AGNEW 1995b)

P:		PSS:	PSS: EVAP: NCPLX:	NCPLX:
WTR: P2:	B: OWW3: P2: PL1: WTR:	WTR: AR:		

TANK INFO:

CONSTRUCTED 1963-1964
NOMINAL CAPACITY: 1,000,000 GAL
FLAT BOTTOM TANK,
6 INCH RADIUS KNUCKLE,
75 FOOT DIAMETER TANK

REFERENCES

- * ANDERSON 1990
- ** WELTY 1988
- *** BORSHEIM AND KIRCH 1991
- ◇ HANLON 1996a
- ◇◇ McCANN 1982a

NOTES:

- 1) TRANSFER SOURCES AND DESTINATIONS ARE NOT AVAILABLE FOR ALL LEVEL CHANGES. FOR MORE DETAILS ABOUT TRANSFER INFORMATION SEE ANDERSON 1990.
- 2) INTERSTITIAL LIQUID LEVEL IS UNKNOWN.
- 3) IN JUNE 1993, INTERIM ISOLATION WAS REPLACED BY INTRUSION PREVENTION.

GLOSSARY OF WASTE TERMS:

FOR MORE COMPLETE DEFINITIONS
SEE APPENDIX A

AR: WASHED PUREX SLUDGE
B: B-PLANT HIGH-LEVEL WASTE
EVAP: EVAPORATOR FEED
NCPLX: NON-COMPLEXED WASTE
OWW3: ORGANIC WASH WASTE 1968-1972
P: PUREX HIGH-LEVEL WASTE
P2: PUREX HIGH-LEVEL WASTE 1963-1967
PL1: PUREX LOW-LEVEL WASTE
PSS: PUREX SLUDGE SUPERNATE
WTR: WATER

LEGEND

— TOTAL WASTE LEVEL (SUPERNATE)
- - - TOTAL WASTE LEVEL (SOLIDS)
- - - SOLIDS LEVEL
+++++ ASSUMED SOLIDS LEVEL
▨ SOLIDS

AX TANK FARM
NO CASCADE

U.S. DEPARTMENT OF ENERGY
RICHLAND FIELD OFFICE
ICF KAISER HANFORD

241-AX-104 SINGLE-SHELL TANK
WASTE & LEVEL HISTORY 1965-1995
ASSUMED LEAKER/STABILIZED TANK
WATCH LIST: N/A

SIZE	BLDG NO.	DWG NO.	DATE
B	241	ES-TKS-E10	5/96
SCALE	NONE	JOB NO.	SHEET 1 OF 1

241-AX-101 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)	ILL (in)
1-1965	847	308			
2					
3	646	235			
4	459	167			
1-1966	490	178			
2	820	298			
3	990	360			
4	682	248			
1-1967	674	245			
2	672	244			
3	666	242			
4	743	270			
1-1968	839	305			
2	839	305			
3	831	302			
4	833	303	41	15	
1-1969	985	358	39	14	
2	985	358	25	9	
3	990	360	26	9	
4	985	358	30	11	
1-1970	976	355	41	15	
2	987	359	69	25	
3	985	358	69	25	
4	989	360	69	25	
1-1971	985	358	56	20	
2	990	360	56	20	
3	990	360	56	20	
4	990	360	56	20	
1-1972	987	359	56	20	
2	984	358	56	20	
3	976	355	56	20	
4	111	40	58	21	
1-1973	110	40	58	21	
2	111	40	58	21	
3	132	48	58	21	
4	329	120	77	28	
1-1974	796	289	77	28	
2	714	260	77	28	
3	784	285	77	28	
4	787	286	69	25	
1-1975	495	180	69	25	
2	330	120	69	25	
3	74	27	61	22	
4	80	29	45	16	
1-1976	28	10	8	3	
2	8	3	4	1	

241-AX-101 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)	ILL (in)
3	3	1	3	1	
4	66	24	3	1	
1-1977	286	104	3	1	
2	960	349	184	67	
3	954	347	578	210	
4	963	350	627	228	
1-1978	963	350	627	228	
2	963	350	627	228	
3	723	263	627	228	
4	723	263	627	228	
1-1979	723	263	627	228	
2	723	263	627	228	
3	723	263	627	228	
4	627	228	627	228	
1-1980	613	223	600	218	
2	605	220	600	218	
3	831	302	289	105	
4	762	277	525	191	
1-1981	762	277	762	277	
2	762	277	762	277	
3	762	277	762	277	
4	762	277	762	277	
1-1982	762	277	762	277	
2	748	272	748	272	
3	748	272	748	272	
4	748	272	748	272	
1-1983	748	272	748	272	
2	748	272	748	272	
3	748	272	748	272	
4	748	272	748	272	
1-1984	748	272	748	272	
2	748	272	748	272	
3	748	272	748	272	
4	748	272	748	272	
1-1985	748	272	748	272	
2	748	272	748	272	
3	748	272	748	272	
4	748	272	748	272	
1-1986	748	272	748	272	281
2	748	272	748	272	282
3	748	272	748	272	281
4	748	272	748	272	282
1-1987	748	272	748	272	281
2	748	272	748	272	282
3	748	272	748	272	280
4	748	272	748	272	281

241-AX-101 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)	ILL (in)
1-1988	748	272	748	272	282
2	748	272	748	272	281
3	748	272	748	272	282
4	748	272	748	272	282
1-1989	748	272	748	272	282
2	748	272	748	272	282
3	748	272	748	272	281
4	748	272	748	272	280
1-1990	748	272	748	272	282
2	748	272	748	272	
3	748	272	748	272	281
4	748	272	748	272	281
1-1991	748	272	748	272	282
2	748	272	748	272	280
3	748	272	748	272	281
4	748	272	748	272	
1-1992	748	272	748	272	
2	748	272	748	272	
3	748	272	748	272	280
4	748	272	748	272	281
1-1993	748	272	748	272	
2	748	272	748	272	280
3	748	272	748	272	280
4	748	272	748	272	280
1-1994	748	272	748	272	279
2	748	272	748	272	280
3	748	272	748	272	279
4	748	272	748	272	279
1-1995	748	272	748	272	278
2	748	272	748	272	278
3	748	272	748	272	

241-AX-102 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)
1-1965				
2				
3	179	65		
4	184	67		
1-1966	184	67		
2	184	67		
3	330	120		
4	883	321		
1-1967	578	210		
2	359	131		
3	135	49		
4	594	216		
1-1968	648	236		
2	964	351		
3	704	256		
4	294	107	14	5
1-1969	663	241	0	0
2	820	298	17	6
3	895	325	19	7
4	858	312	10	4
1-1970	880	320	12	4
2	946	344	17	6
3	954	347	11	4
4	954	347	28	10
1-1971	954	347	38	14
2	954	347	32	12
3	963	350	38	14
4	960	349	38	14
1-1972	953	347	38	14
2	957	348	50	18
3	952	346	63	23
4	954	347	47	17
1-1973	113	41	50	18
2	113	41	50	18
3	126	46	50	18
4	129	47	50	18
1-1974	132	48	50	18
2	151	55	50	18
3	238	87	50	18
4	314	114	50	18
1-1975	349	127	50	18
2	50	18	50	18
3	77	28	50	18
4	66	24	47	17
1-1976	248	90	22	8
2	583	212	17	6

241-AX-102 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)
3	767	279	17	6
4	72	26	19	7
1-1977	11	4	11	4
2	6	2	6	2
3	30	11	6	2
4	28	10	6	2
1-1978	28	10	6	2
2	149	54	6	2
3	94	34	6	2
4	91	33	6	2
1-1979	105	38	6	2
2	168	61	39	14
3	388	141	39	14
4	539	196	39	14
1-1980	740	269	39	14
2	87	32	39	14
3	54	20	29	11
4	54	20	29	11
1-1981	54	20	29	11
2	54	20	29	11
3	54	20	29	11
4	54	20	29	11
1-1982	54	20	29	11
2	54	20	29	11
3	54	20	29	11
4	54	20	29	11
1-1983	54	20	29	11
2	54	20	29	11
3	54	20	29	11
4	52	19	29	11
1-1984	52	19	29	11
2	52	19	29	11
3	52	19	29	11
4	52	19	29	11
1-1985	52	19	29	11
2	52	19	29	11
3	52	19	29	11
4	52	19	29	11
1-1986	52	19	29	11
2	52	19	29	11
3	52	19	29	11
4	52	19	29	11
1-1987	52	19	29	11
2	52	19	29	11
3	52	19	29	11
4	52	19	29	11

241-AX-102 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)
1-1988	52	19	29	11
2	52	19	29	11
3	39	14	32	12
4	39	14	32	12
1-1989	39	14	36	13
2	39	14	36	13
3	39	14	36	13
4	39	14	36	13
1-1990	39	14	36	13
2	39	14	36	13
3	39	14	36	13
4	39	14	36	13
1-1991	39	14	36	13
2	39	14	36	13
3	39	14	36	13
4	39	14	36	13
1-1992	39	14	36	13
2	39	14	36	13
3	39	14	36	13
4	39	14	36	13
1-1993	39	14	36	13
2	39	14	36	13
3	39	14	36	13
4	39	14	36	13
1-1994	39	14	36	13
2	39	14	36	13
3	39	14	36	13
4	39	14	36	13
1-1995	39	14	36	13
2	39	14	36	13
3	39	14	36	13

241-AX-103 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)
1-1965	844	307		
2				
3	913	332		
4	883	321		
1-1966	888	323		
2	996	362		
3	987	359		
4	985	358		
1-1967	967	352		
2	917	333		
3	908	330	14	5
4	946	344		
1-1968	985	358		
2	976	355		
3	932	339		
4	946	344	77	28
1-1969	974	354	83	30
2	1000	364	76	28
3	986	359	83	30
4	965	351	83	30
1-1970	985	358	80	29
2	986	359	83	30
3	971	353	69	25
4	971	353	69	25
1-1971	974	354	66	24
2	974	354	66	24
3	974	354	66	24
4	971	353	66	24
1-1972	976	355	66	24
2	976	355	66	24
3	685	249	66	24
4	567	206	69	25
1-1973	654	238	69	25
2	558	203	69	25
3	556	202	69	25
4	575	209	69	25
1-1974	568	207	69	25
2	653	237	69	25
3	870	316	72	26
4	822	299	88	32
1-1975	987	359	88	32
2	828	301	88	32
3	622	226	88	32
4	173	63	88	32
1-1976	88	32	88	32
2	72	26	70	25

241-AX-103 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)
3	52	19	17	6
4	17	6	6	2
1-1977	11	4	11	4
2	6	2	6	2
3	25	9	6	2
4	17	6	6	2
1-1978	39	14	6	2
2	28	10	6	2
3	33	12	6	2
4	44	16	6	2
1-1979	547	199	6	2
2	545	198	6	2
3	888	323	6	2
4	888	323	6	2
1-1980	891	324	6	2
2	944	343	10	4
3	879	320	0	0
4	121	44	121	44
1-1981	121	44	121	44
2	121	44	121	44
3	121	44	121	44
4	121	44	121	44
1-1982	121	44	121	44
2	120	44	120	44
3	120	44	120	44
4	120	44	120	44
1-1983	120	44	120	44
2	120	44	120	44
3	120	44	120	44
4	120	44	120	44
1-1984	120	44	120	44
2	120	44	120	44
3	120	44	120	44
4	120	44	120	44
1-1985	120	44	120	44
2	120	44	120	44
3	120	44	120	44
4	120	44	120	44
1-1986	120	44	120	44
2	120	44	120	44
3	120	44	120	44
4	120	44	120	44
1-1987	120	44	120	44
2	120	44	120	44
3	112	41	112	41
4	112	41	112	41

241-AX-103 LEVEL HISTORY

Year	Total (K gal)	Solids (K gal)	Solids (in)
1-1988	112	41	41
2	112	41	41
3	112	41	41
4	112	41	41
1-1989	112	41	41
2	112	41	41
3	112	41	41
4	112	41	41
1-1990	112	41	41
2	112	41	41
3	112	41	41
4	112	41	41
1-1991	112	41	41
2	112	41	41
3	112	41	41
4	112	41	41
1-1992	112	41	41
2	112	41	41
3	112	41	41
4	112	41	41
1-1993	112	41	41
2	112	41	41
3	112	41	41
4	112	41	41
1-1994	112	41	41
2	112	41	41
3	112	41	41
4	112	41	41
1-1995	112	41	41
2	112	41	41
3	112	41	41

241-AX-104 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)
1-1965				
2				
3	344	125		
4	355	129		
1-1966	355	129		
2	400	145		
3	762	277		
4	886	322		
1-1967	872	317		
2	872	317		
3	869	316		
4	869	316		
1-1968	952	346		
2	979	356		
3	985	358		
4	979	356	10	4
1-1969	957	348	8	3
2	953	347	8	3
3	964	351	11	4
4	987	359	27	10
1-1970	998	363	58	21
2	998	363	48	17
3	1000	364	44	16
4	1000	364	52	19
1-1971	1001	364	47	17
2	1001	364	47	17
3	989	360	47	17
4	990	360	47	17
1-1972	984	358	47	17
2	984	358	47	17
3	245	89	47	17
4	677	246	55	20
1-1973	825	300	55	20
2	109	40	55	20
3	105	38	55	20
4	126	46	44	16
1-1974	114	41	44	16
2	111	40	44	16
3	763	277	44	16
4	732	266	47	17
1-1975	690	251	47	17
2	644	234	47	17
3	586	213	47	17
4	547	199	47	17
1-1976	352	128	44	16
2	325	118	44	16

241-AX-104 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)
3	261	95	47	17
4	789	287	47	17
1-1977	171	62	55	20
2	61	22	22	8
3	17	6	11	4
4	25	9	3	1
1-1978	22	8	8	3
2	11	4	3	1
3	3	1	3	1
4	3	1	3	1
1-1979	6	2	3	1
2	6	2	3	1
3	6	2	3	1
4	6	2	3	1
1-1980	6	2	3	1
2	6	2	3	1
3	6	2	3	1
4	6	2	3	1
1-1981	6	2	3	1
2	6	2	3	1
3	5	2	5	2
4	5	2	5	2
1-1982	5	2	5	2
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1983	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1984	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1985	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1986	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1987	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3

241-AX-104 LEVEL HISTORY

Year	Total (K gal)	Total (in)	Solids (K gal)	Solids (in)
1-1988	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1989	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1990	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1991	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1992	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1993	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1994	7	3	7	3
2	7	3	7	3
3	7	3	7	3
4	7	3	7	3
1-1995	7	3	7	3
2	7	3	7	3
3	7	3	7	3

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

241-AX-101
Thermocouple 13
 Elevation 25.33 ft.

241-AX-101
Thermocouple 14
 Elevation 27.33 ft.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

241-AX-101
Thermocouple 15
Elevation 29.33 ft.

241-AX-101
Thermocouple 16
Elevation 31.33 ft.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

241-AX-102
Thermocouple 1
Elevation 1.09 ft.

241-AX-102
Thermocouple 2
Elevation 3.09 ft.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

241-AX-102
Thermocouple 7
 Elevation 13.09 ft.

241-AX-102
Thermocouple 8
 Elevation 15.09 ft.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

241-AX-102
Thermocouple 11
Elevation 21.09 ft.

241-AX-102
Thermocouple 12
Elevation 23.09 ft.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

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Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

241-AX-104
Thermocouple 13
 Elevation 25.07 ft.

241-AX-104
Thermocouple 14
 Elevation 27.07 ft.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

241-AX-104
Thermocouple 15
 Elevation 29.07 ft.

241-AX-104
Thermocouple 16
 Elevation 31.07 ft.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

241-AX-104
Thermocouple 17
Elevation 35.07 ft.

241-AX-104
Thermocouple 18
Elevation 39.07 ft.

Data obtained from WHC Surveillance Analysis Computer System (SACS), Oct 20, 1995.

Tank AX-101

Thermocouples 1-16

D-38

Tank AX-104

Thermocouples 1-16

Data obtained from WHC Surveillance Analysis Computer System (SACS), November 21, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), November 21, 1995.

E-4

Data obtained from WHC Surveillance Analysis Computer System (SACS), November 21, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), November 21, 1995.

Data obtained from WHC Surveillance Analysis Computer System (SACS), November 21, 1995.

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241-AX-101

3,790,000 Liters
[1,000,000 Gallons]

TANK RISER LOCATION

NOT TO SCALE

241-AX-101			
NO.	DIA.	SAMPLING*	DESCRIPTION AND COMMENTS
1A	34"****		STEAM COIL
1B	34"****		PUMP PIT 01B SLUDGE SLUICE
3A	16"*****	X	OBSRV PORT B-222
4	20"		U.G. VENT LINE - BG
5A	12"		SALTWELL SCREEN
5B	12"		PUMP MOUNT
6	4"	X	FLANGE, WC [BM CEO-22975 12/11/86]
7A	4"		PROFILE TEMPERATURE, WC
7B	4"		PROFILE TEMPERATURE, WC
7C	4"		PROFILE TEMPERATURE, WC
7D	4"		PROFILE TEMPERATURE, WC
8A	6"		DRY WELL
8B	6"		DRY WELL
8C	6"		DRY WELL, [ENRAF ECN-619368 4/4/95]
8D	6"		DRY WELL
8E	6"		DRY WELL
8F	6"		BLIND FLANGE, [BM CEO-22975 12/11/86]
8G	6"		DRY WELL
9A	6"		LOW
9B	6"		TEMPERATURE PROBE
9C	6"		FIC
9D	6"	X	SMP
9E	6"	X	SMP
9F	6"	X	BLANK, [HYDROGEN MONITOR W396-006 9/13/94]
9G	6"	X	SMP
10	4"		DISTRIBUTOR PIT 01A DRAIN
11A	**		STRUCTURAL TEMPERATURE - CONCRETE PLUG
11B	**		STRUCTURAL TEMPERATURE - BG
11C	**		STRUCTURAL TEMPERATURE - BG
12	4"		LEAK DETECTION PIT DRAIN - BG
13A	4"		TEMPERATURE PROFILE, WC
13B	4"		TEMPERATURE PROFILE, WC
13C	4"		TEMPERATURE PROFILE, WC
14	42"		STEAM COIL
15	4"		FUTURE CONDENSATE, BG
23	12"		(SLUICING NOZZLE)
24	12"		(SLUICING NOZZLE)
AC1-22	6"		22 AIR CIRCULATORS CAPPED IN INSTRUMENT ENCLOSURE
A*****	4"		FILL LINE SEALED IN DIVERSION BOX 241-AX-152
B*****	4"		FILL LINE SEALED IN DIVERSION BOX 241-AX-152
C*****	4"		FILL LINE CAPPED

241-AX-101			
NO.	DIA.	SAMPLING*	DESCRIPTION AND COMMENTS
D*****	4"		FILL LINE CAPPED

Ref: WHC-SD-RE-TI-053, Rev.8 *WHC-SD-WM-TI-710, Rev.1
 WHC-SD-WM-TI-553, Rev.0 H-2-73376, Rev.4
 H-2-68237, Rev.1 H-2-44560, Rev.6
 H-2-44562, Rev.4 H-2-69148, Rev.1

If there was a discrepancy between the documents and the drawings, two drawings with concurring information shall take precedence.
 Comments placed in [] denote Engineering Change Notices (ECN) made against the reference drawings.

- Denotes risers tentatively available for sampling
- ** 7 conduits 3/4" DIA. that do not penetrate the dome.
- *** Denotes dimensions are I.D. with 3/8" walls
- **** H-2-73376 refers to this riser dimension as 14".
- ***** These nozzles penetrate the tank, but not from the top of a tank like risers.

Intentionally left blank.

241-AX-102

3,790,000 Liters
[1,000,000 Gallons]

TANK RISER LOCATION

NOT TO SCALE

241-AX-102			
NO.	DIA.	SAMPLING*	DESCRIPTION AND COMMENTS
1A	34"***		SLUICE PIT, WC
1B	34"***		PUMP PIT, WC
1C	12"		PUMP PIT, WC
3A	16"****	X	OBSRV PORT B-222, [BM CE0-36397 12/08/86]
4	20"		VAPOR OUTLET, BG
5A	12"		SALTWELL SCREEN, WC
5B	12"		PUMP ACCESS, WC
6	4"		TANK PRESSURE, BG
7A	4"		PROFILE TEMPERATURE
7B	4"		PROFILE TEMPERATURE
7C	4"		PROFILE TEMPERATURE, [BM CE0-36397 12/08/86]
7D	4"		PROFILE TEMPERATURE
8A	6"		DRY WELL
8B	6"		DRY WELL
8C	6"		DRY WELL
8D	6"		DRY WELL
8E	6"		DRY WELL
8F	6"		DRY WELL
8G	6"		DRY WELL
9A	6"	X	SMP
9B	6"		FIC
9C	6"		TEMPERATURE
9D	6"		ILR
9E	6"	X	BREATHER FILTER
9F	6"	X	FLANGE
9G	6"	X	SMP
10	4"		DISTRIBUTOR PIT O2A DRAIN
11A	**		STRUCTURAL TEMPERATURE - BG
11B	**		STRUCTURAL TEMPERATURE - BG
11C	**		STRUCTURAL TEMPERATURE - BG
12	4"		LEAK DETECTION PIT DRAIN - BG
13A	4"		TEMPERATURE PROFILE, WC
13B	4"		TEMPERATURE PROFILE, WC
13C	4"		TEMPERATURE PROFILE, WC
14	42"		SLUDGE SLUICE
15	4"		FUTURE CONDENSATE, BG
AC1-22	6"		22 AIRLIFT CIRCULATORS
N1*****	4"		SPARE
A*****	4"		FILL LINE SEALED IN DIVERSION BOX 241-AX-152
B*****	4"		FILL LINE SEALED IN DIVERSION BOX 241-AX-152
C*****	4"		FILL LINE SEALED IN DIVERSION BOX 241-AX-152

241-AX-102			
NO.	DIA.	SAMPLING*	DESCRIPTION AND COMMENTS

Ref: WHC-SD-RE-TI-053, Rev.8 *WHC-SD-WM-TI-710, Rev.1
 WHC-SD-WM-TI-553, Rev.0 H-2-73378, Rev.2
 H-2-68238, Rev.1 H-2-44560, Rev.6
 H-2-44562, Rev.4 H-2-69148, Rev.1

If there was a discrepancy between the documents and the drawings, two drawings with concurring information shall take precedence.

Comments placed in [] denote Engineering Change Notices (ECN) made against the reference drawings.

- * Denotes risers tentatively available for sampling
- ** 7 conduits 3/4" DIA. that do not penetrate the dome.
- *** Denotes dimensions are I.D. with 3/8" walls
- **** H-2-73378 refers to this riser dimension as 14".
- ***** These nozzles penetrate the tank, but not from the top of a tank like risers.

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241-AX-103

3,790,000 Liters
[1,000,000 Gallons]

TANK RISER LOCATION

Ref: H-2-44562, Rev. 4
H-2-69148, Rev. 1

NOT TO SCALE

241-AX-103			
NO.	DIA.	SAMPLING*	DESCRIPTION AND COMMENTS
1A	34****		SLUDGE SLUICE
1B	34****		SLUDGE SLUICE
3A	16*****	X	B-222 OBSRV PORT
4	20"		VAPOR OUTLET - BG
5A	12"		SALTWELL SCREEN
5B	12"		PUMP MOUNT
6	4"	X	SPARE, [BM CEO-36398 12/11/86]
7A	4"		PROFILE TEMPERATURE
7B	4"		PROFILE TEMPERATURE
7C	4"		PROFILE TEMPERATURE
7D	4"		PROFILE TEMPERATURE
8A	6"		DRYWELL
8B	6"		DRYWELL
8C	6"		DRYWELL
8D	6"		DRYWELL
8E	6"		DRYWELL
8F	6"		DRYWELL, [BM CEO-36398 12/11/86]
8G	6"		DRYWELL
9A	6"	X	SMP
9B	6"		TEMPERATURE
9C	6"		FIC, [ENRAF ECN-619368 4/4/95]
9D	6"	X	SMP
9E	6"	X	BREATHING FILTER
9F	6"		FLANGE
9G	6"	X	FLANGE, [HYDROGEN MONITOR W396-006 9/13/94]
10	4"		DISTRIBUTOR PIT 03A DRAIN, WC
11A	**		STRUCTURAL TEMPERATURE, BG
11B	**		STRUCTURAL TEMPERATURE, BG
11C	**		STRUCTURAL TEMPERATURE, BG
12	4"		LEAK DETECTION PIT DRAIN, BG
13A	4"		TEMPERATURE PROFILE, WC
13B	4"		TEMPERATURE PROFILE, WC
13C	4"		TEMPERATURE PROFILE, WC
14	42"		STEAM COIL
15	4"		FUTURE CONDENSATE
AC1-22	6"		22 AIR CIRCULATORS CAPPED IN INSTRUMENT ENCLOSURE
N1*****	4"		FILL, CAPPED
A*****	4"		FILL LINE SEALED IN DIVERSION BOX 241-C-151
B*****	4"		FILL LINE SEALED IN DIVERSION BOX 241-C-151
C*****	4"		FILL, CAPPED

241-AX-103			
NO.	DIA.	SAMPLING*	DESCRIPTION AND COMMENTS

Ref: WHC-SD-RE-TI-053, Rev.8 *WHC-SD-WM-TI-710, Rev.1
 WHC-SD-WM-TI-553, Rev.0 H-2-73380, Rev.4
 H-2-68239, Rev.1 H-2-44560, Rev.6
 H-2-44562, Rev.4 H-2-69148, Rev.1

If there was a discrepancy between the documents and the drawings, two drawings with concurring information shall take precedence.

Comments placed in [] denote Engineering Change Notices (ECN) made against the reference drawings.

- * Denotes risers tentatively available for sampling
- ** 7 conduits 3/4" DIA. that do not penetrate the dome.
- *** Denotes dimensions are I.D. with 3/8" walls
- **** H-2-73380 refers to this riser dimension as 14".
- ***** These nozzles penetrate the tank, but not from the top of a tank like risers.

Intentionally left blank.

241-AX-104

3,790,000 Liters
[1,000,000 Gallons]

TANK RISER LOCATION

Ref: H-2-44562, Rev. 4
H-2-69148, Rev. 1

NOT TO SCALE

241-AX-104			
NO.	DIA.	SAMPLING*	DESCRIPTION AND COMMENTS
1A	34"****		SLUICE PIT 04C
1B	34"****		SLUICE PIT 04D
3A	16"*****	X	OBSV PORT B-222, [BM CE0-36399 12/08/86]
4	20"		VAPOR OUTLET
5A	12"		PUMP MOUNT, WC
5B	12"		PUMP MOUNT, WC
6	4"		TANK PRESSURE
7A	4"		PROFILE TEMPERATURE
7B	4"		PROFILE TEMPERATURE
7C	4"	X	DRAIN COB, [BM CE0-36399 12/08/86]
7D	4"	X	DRAIN VALVE PITS
8A	6"		DRYWELL
8B	6"		DRYWELL
8C	6"		DRYWELL
8D	6"		DRYWELL
8E	6"		DRYWELL
8F	6"		DRYWELL
8G	6"		DRYWELL
9A	6"		LIQUID LEVEL REEL
9B	6"		FIC
9C	6"		TEMPERATURE
9D	6"		DRAIN COB-AX-21 & 22
9E	6"	X	BREATHER FILTER
9F	6"		SMP
9G	6"	X	SMP
10	4"		DISTRIBUTOR PIT 04A DRAIN, WC
11A	**		STRUCTURAL TEMPERATURE, BG
11B	**		STRUCTURAL TEMPERATURE, BG
11C	**		STRUCTURAL TEMPERATURE, BG
12	4"		LEAK DETECTION PIT DRAIN, BG
13A	4"		TEMPERATURE PROFILE, WC
13B	4"		TEMPERATURE PROFILE, WC
13C	4"		TEMPERATURE PROFILE, WC
14	42"		SLUDGE SLUICE
15	4"		CONDENSATE ADDITION
16A	4"		BLIND FLANGE
16B	4"	X	BLIND FLANGE
16C	4"	X	BLIND FLANGE
AC1-22	6"		AIRLIFT CIRCULATORS
N1*****	4"		SPARE
A*****	4"		FILL, ISOLATED IN DIVERTER STATION 241-AX-152

241-AX-104			
NO.	DIA.	SAMPLING*	DESCRIPTION AND COMMENTS
B*****	4"		FILL, ISOLATED IN DIVERTER STATION 241-AX-152
C*****	4"		FILL, ISOLATED IN DIVERTER STATION 241-AX-152

Ref: WHC-SD-RE-TI-053, Rev.8 *WHC-SD-WM-TI-710, Rev.1
 WHC-SD-WM-TI-553, Rev.0 H-2-73382, Rev.2
 H-2-68240, Rev.1 H-2-44560, Rev.6
 H-2-44562, Rev.4 H-2-69148, Rev.1

If there was a discrepancy between the documents and the drawings, two drawings with concurring information shall take precedence.

Comments placed in [] denote Engineering Change Notices (ECN) made against the reference drawings.

- * Denotes risers tentatively available for sampling
- ** 7 conduits 3/4" DIA. that do not penetrate the dome.
- *** Denotes dimensions are I.D. with 3/8" walls
- **** H-2-73382 refers to this riser dimension as 14".
- ***** These nozzles penetrate the tank, but not from the top of a tank like risers.

TANK #	MONTAGE #	ORIGINAL PHOTO SET #	DATE
AX Farm Aerial Photo	N/A	93030994-278CN	N/A
241-AX-101	94011379-47CN	87-04668	8/18/87
241-AX-102	94011379-48CN	89-060541	6/5/89
241-AX-103	94011379-49CN	87-04639	8/13/87
241-AX-104	96030717-3CN	87-04696	8/18/87

AX TANK FARM PHOTOS

AX Tank Farm

BEST AVAILABLE COPY

241-AX-101

Photo date: 8-18-87

BEST AVAILABLE COPY

241-AX-102

Photo date: 6-5-89

BEST AVAILABLE COPY

241-AX-103

Photo date: 8-13-87

BEST AVAILABLE COPY

241-AX-104

Photo date: 8-18-87

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Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 3

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May 1996

Executive Summary

This estimate for the chemical and radionuclide compositions of the 177 Hanford High Level Waste storage tanks is the third major revision in a developing model called the Hanford Defined Waste (HDW) model. This model is composed of four parts:

- 1) a compilation of transaction records for all the tanks called the Waste Status and Transaction Record Summary (WSTRS);
- 2) a derivation called the Tank Layer Model (TLM) of solids histories for each tank based on primary additions of waste;
- 3) a calculation of supernatant blending and concentration with the Supernatant Mixing Model (SMM); and
- 4) a combination of process information along with some transaction information to derive compositions for about fifty Hanford Defined Wastes (HDW's), each of which has both sludge and supernatant layers.

All of this information is combined together in a spreadsheet to produce total chemical and radionuclide compositions for each tank's waste as well as a composition for its TLM and SMM blends. Furthermore, each tank's inventory is also represented by a linear combination of TLM sludges and SMM supernatants, each expressed in kgal of original waste. Thus, the genealogy of each tank's waste can be traced back to the plant and process from which it derived. These estimates comprise some 33 non-radioactive species and 4 radionuclides, Pu-239, U-238, Cs-137, and Sr-90. The 33 non-radioactive species in the model are Na, Al, Fe, Cr, Bi, La, Hg, Zr, Pb, Ni, Sr(stable), Mn, Ca, K, OH, nitrate, nitrite, carbonate, phosphate, sulfate, silicate, F, Cl, citrate, EDTA, HEDTA, glycolate, acetate, oxalate, DBP, butanol, ammonia, and ferrocyanide.

Also reported are total site inventories for DST's, SST's, as well as the total inventory of waste placed into cribs and trenches from the waste tanks during the history of Hanford. These estimates do not cover all waste additions to cribs since many streams went into the cribs directly from the plants. Such streams as stack scrubbing and process condensates were often sent directly to cribs from the plants.

Tank leaks represent a very small amount of the total waste. Many "leaks" are not actually measured volumes and are only assumed to have occurred at some nominal value. This is because ground activity occurred in the vicinity of a tank even though there was no measurable change in its inventory. HDW estimated leak inventory, then, does not provide for leaks that did not have a measurable effect on inventory. Only those leaks that actually resulted in a measurable volume loss from a tank are included in the leak estimate.

I. Background

One of the most important tasks involving the Hanford waste tanks is the estimation of those tank's content. Such estimates are very important for three reasons: first, to establish safety limits during intrusive activities associated with these tanks; second, to establish a planning basis for future disposal; and third, to allow assays from one tank's waste to be used to validate, compare, and assess hazards among other tank's with similar waste inventories.

It is clear that direct assays of tank wastes will always be an important and ongoing need for the Hanford tanks. However, it is equally clear that it will be very difficult if not impossible to adequately address all issues with respect to waste tanks by sampling and assay alone. Representative sampling is undoubtedly the most difficult aspect of deriving tank inventories from assays alone. Both the extremely heterogeneous nature of tank waste and the limited access provided by riser pathways to waste in these seventy-five foot diameter underground tanks contribute to difficulties in using assays alone to derive tank inventories. Furthermore, there are safety issues, such as elevated amounts of soluble organic in dry nitrate waste, that are difficult to address by sampling alone since they could involve relatively small inaccessible regions of waste within a tank.

Finally, in order to make sense out of the highly variable results that often come from a tank's waste assays, it is necessary to couch those results in terms of the particular process and storage history of that tank. The HDW model estimates provide just such a needed sitewide framework for each of the 177 Hanford tanks.

II. Approach

The HDW model is described schematically in Fig. 1. The model begins with a process and transaction dataset that derives from a variety of sources. From this dataset, a balanced tank-by-tank quarterly summary transaction spreadsheet is derived called the Waste Status and Transaction Record Summary (WSTRS). At the end of each quarter, all tanks' volumes are reconciled with their reported status at that time and in the process, unknown transactions are recorded to accommodate otherwise unexplained gains or losses at the end of each quarter.

Using these fill records, the Tank Layer Model (TLM) provides a definition of the sludge and salt cake layers within each tank. The TLM is a volumetric and chronological description of tank inventory based on a defined set of waste solids layers. Each solids layer is attributed to a particular waste addition or process, and any solids layers that have unknown origin are assigned as such and contribute to the uncertainty of that tank's inventory. The TLM simply associates each layer of sludge within a tank with a process waste addition. As indicated in Fig. 1, the TLM analysis depends only on information fromWSTRS.

The Supernatant Mixing Model (SMM) is an algorithm written in C++ and installed as a spreadsheet macro that describes the supernatant and concentrates within each of the tanks. The SMM uses information from bothWSTRS and the TLM and describes supernatants and concentrates in terms of kgal (1 kgal = 1,000 gal) of each of the process waste additions.

Together theWSTRS, TLM, and SMM define each tank's waste in terms of a linear combination of HDW sludges and supernatants. In order to provide information on the elemental composition of each tank, the Hanford Defined Wastes (HDW's) compositions describes each of the HDW's based on process historical information. Each HDW has both supernatant and sludge layers, its total amount of waste set byWSTRS, and its sludge volume determined by the TLM. Thus, the HDW compositions depend on all prior model components—process/transaction dataset,WSTRS, TLM, and SMM.

Each tank's total inventory is calculated as

$$\text{tank}_i = \frac{\sum_j \text{tlm}_{ij} \text{hdw}_j^{\text{sl}}}{\text{slVol}_i} + \frac{\sum_j \text{smm}_{ij} \text{hdw}_j^{\text{su}}}{\text{suVol}_i}$$

Fig. 1. Schematic of overall strategy.

where

tank_i = composition vector for tank i
 hdw_j^{sl} = composition vector for HDW sludge j
 hdw_j^{su} = composition vector for HDW supernatant j
 tlm_{ij} = kgal of hdw sludge j for tank i
 smm_{ij} = kgal of hdw supernatant j for tank i
 slVol_i = sludge kgal for tank i
 suVol_i = supernatant concentrate kgal for tank i .

The first term is the TLM solids inventory and is reported as

$$\text{tank}_i^{\text{sl}} = \frac{\sum_j \text{tlm}_{ij} \text{hdw}_j^{\text{sl}}}{\text{slVol}_i}$$

while the second term is the SMM inventory reported as

$$\text{tank}_i^{\text{su}} = \frac{\sum_j \text{smm}_{ij} \text{hdw}_j^{\text{su}}}{\text{suVol}_i}$$

These inventory estimates for each tank also appear in the Historical Tank Content Estimate reports for each of four quadrants.¹

Ila. Approach—Waste Status and Transaction Record Summary

The WSTRS is a spreadsheet of qualified fill records² with information extracted from Jungfleisch-83³ and Anderson-91⁴, and checked by Ogden Environmental and LANL against quarterly summary reports. The WSTRS reports, although largely representative of the waste histories of the tanks, are nevertheless incomplete in that there are a number of unrecorded transactions that have occurred for many tanks. Included within the WSTRS report, then, is a comparison of the tank volume that is calculated based on the fill records that are present in WSTRS with the measured volume of each tank. This comparison is made for each quarter to record any unknown waste additions or removals that may have occurred during that quarter.

The Rev. 3 estimates include new information from the Logbook Dataset⁵ and have extensive revisions in the latter four evaporator campaigns: 242-S (S1 and S2) and 242-A (A1 and A2). The Logbook Dataset contains extremely detailed tank level information from about 1975 to 1992 and has allowed Rev. 3 to accommodate the blending that occurred during these campaigns. In Rev. 1, each campaign's waste was blended over many years of operation, then concentrated in one single step and distributed over all the bottoms receivers. In contrast, Rev. 3 blends the evaporator concentrates on about a quarterly basis thereby providing much better representation of these evaporator campaigns.

¹Brevick, C. H., et al., "Historical Tank Content Estimate of the Northeast (Southwest, Northwest, Southeast) Quadrant of the Hanford 200 East Area," WHC-SD-WM-ER-349 thru 352, Rev. 0, June 1994.

²(a) Agnew, S. F., et al., "Waste Status and Transaction Record Summary for the NE Quadrant" WHC-SD-WM-TI-615, Rev. 1, October 1994. (b) Agnew, S. F., et al. "Waste Status and Transaction Record Summary for the SW Quadrant," WHC-SD-WM-TI-614, Rev. 1, October 1994. (c) Agnew, S. F., et al. "Waste Status and Transaction Record Summary for the NW Quadrant," WHC-SD-WM-TI-669, Rev. 1, October 1994.

³(a) Jungfleisch, F. M. "Hanford High-Level Defense Waste Characterization—A Status Report," RH-CD-1019, July 1980. (b) Jungfleisch, F. M. "Supplementary Information for the Preliminary Estimation of Waste Tank Inventories in Hanford Tanks through 1980," SD-WM-TI-058, June 1983. (c) Jungfleisch, F. M. "Preliminary Estimation of Waste Tank Inventories in Hanford Tanks through 1980," SD-WM-TI-057, March 1984.

⁴Anderson, J. D. "A History of the 200 Area Tank Farms," WHC-MR-0132, June 1990.

⁵Brevick and Gaddis, "Tank Farm Logbook Dataset," in preparation.

Transactions were added to WSTRS to resolve the many unknown level changes for each quarter according to a set of rules resulting in an updated WSTRS that is known as Rev. 3. This unknown transaction resolution was only completed for all unknowns larger than 50 kgal, although many smaller transaction unknowns were accommodated as well. The following rules were used for unknown transaction resolution for the various tank categories.

Evaporator feed and bottoms receivers:

During an evaporator campaign, unknown waste transfers at the end of each quarter are resolved by sending wastes to or receiving wastes from an evaporator feed tank for tanks identified as either bottoms receivers or feed tanks for those campaigns.

Self-concentrating tanks:

Certain tanks in S, SX, A, and AX farms were allowed to self concentrate. Any losses or additions to these tanks are assigned to condensate or water, respectively.

Sluicing receivers:

For tanks associated with a sluicing campaign (either UR or SRR), unknown transactions are resolved by either sending or receiving from the sluicing receiver tank for that campaign. Unassigned losses from the sluicing receivers, then, are sent directly to the process.

Salt-well pumping and stabilization:

If an unknown loss occurs during salt well pumping stabilization of a tank, then the unknown is resolved by sending waste to the active salt well receiver at that time.

Historical use of tank:

If none of the above rules apply, then the historical use of the tank is used to assign the transaction. For example, C-105 was used as a supernatant feed tank for the CSR campaign and supplied ~1,500 kgal per quarter for several years. However, there is one quarter (1971q2) where C-105 loses 1,748 kgal without an assigned transaction. Because of C-105's process history, this transaction is assigned to CSR feed. Likewise, there are a number of large supernatant losses in A and AX Farms during sluicing for sludge recovery. These supernatant losses are assigned as feed to AR, which are the slurries transferred to AR Vault for solids separation, washing, dissolution, and feed to SRR.

The transaction data set has sometimes an arbitrary and non-unique order for transactions within each quarter. This transaction order has been largely resolved for the period 1975-present, but not for all of the remaining tanks for this estimate. Thus, a certain "historical" error is present in these DST estimates that is largely related to transaction ordering errors from 1945-1975. These errors are not very serious for the DST's, since much blending has occurred since 1981, but this transaction ordering should be completed for the entire history of Hanford in order to determine how it will affect tank inventories.

IIb. Approach—Tank Layer Model (TLM)

The TLM a solids layer model that uses the past fill history of each tank to derive an estimate of the types of solids that reside within those tanks. The TLM^{6,7} is generated by reconciling the reported solids levels from WSTRS

⁶(a) Brevick, C. H., et al., "Supporting Document for the Historical Tank Content Estimate for A Tank Farm," WHC-SD-WM-ER-308, Rev. 0, June 1994. Likewise, reports and numbers for each farm are as follows: AX is 309, B is 310, BX is 311, BY is 312, C is 313, S is 323, SX is 324, and U is 325. These supporting documents contain much of the detailed information for each tank farm in a concise format, all released as Rev. 0 in June 1994.

⁷Agnew, S. F., et al. "Tank Layer Model (TLM) for Northeast, Southwest, and Northwest Quadrants," LA-UR-94-4269, February 1995.

for each tank (as shown in App. C) with the solids volume per cent expected for each primary waste addition (see App. A). Note that a solid's model has already been extensively used at Hanford to estimate sludge and salt cake accumulation, the results of which are reported⁸ monthly.

There are some tanks that the HDW model assumes a different waste inventory than that reported in Hanlon. These differences come about because of the difficulties that are often encountered in determining the remaining inventory in tanks with large surface heterogeneities. Also shown in App. C, then, are a list of tanks for which their Hanlon volumes and their adjusted volumes used for the HDW estimates. The sources of these discrepancies are a series of reports about stabilized tanks.⁹

The TLM is a volumetric and chronological description of tank inventory based on the HDW sludges and salt cakes. Each solids layer is attributed to a particular waste addition or process, and any solids layers that have unknown origin are assigned as such and contribute to the uncertainty of that tank's inventory. The TLM simply associates layers of solids within each tank with a waste addition or a process campaign.

The TLM uses the information obtained from the transaction history for each tank to predict solids accumulations. These predictions are made for three categories of waste tanks. The first category involves primary waste additions, which are the waste additions from process plants directly into a waste tank. The primary waste transactions are used along with solids volume reports for each tank to derive an average volume per cent solids for each HDW type. The solids accumulations are, then, also assigned to a particular HDW for the tanks where the solids information is missing or inconsistent.

A second category of waste is that where solids accumulate as a result of evaporative concentration of supernatants. All solids that accumulate in such tanks occur after they have been designated as "bottoms" receivers. These solids are assigned to one of four salt cakes, which are defined as blends over entire evaporator campaigns. The four salt cakes are BSltCk, T1SltCk, BYSltCk and RSltCk, are all defined as HDW's. The latter five evaporator campaigns T2, S1, S2, A1, and A2 all result in waste concentrates that are defined differently for each tank within the SMM.

The third category of waste is that where solids accumulate due to tank to tank transfers of solids. This category allows solids to cascade from tank to tank, for example, or accounts for solids lost during routine transfers, as was common with decladding wastes CWR and CWP, 1C, or FeCN sludges.

The results of the TLM analysis are a description of each tank's solids in terms of sludge and salt cake layers. Although interstitial liquid is incorporated within the composition for sludges and salt cakes, any residual supernatants that reside in these tanks above the solids are described by the SMM. The output of the TLM, then, can only be used to predict the inventory of the sludges and each of four salt cakes that reside within waste tanks. These TLM results are inserted into the WSTRS record and are used by the SMM in considering excluded volumes for mixing of waste supernatants.

Not all of the transactions that have occurred in the past are faithfully recorded by the WSTRS data set. Therefore, WSTRS is an incomplete document with many missing transactions. However, the two critical pieces of

⁸Hanlon, B. M. "Tank Farm Surveillance and Waste Status and Summary Report for November 1993," WHC-EP-0182-68, February 1994, published monthly.

⁹ (a) Swaney, S. L. "Waste Level Discrepancies between Manual Level Readings and Current Waste Inventory for Single-Shell Tanks," Internal Memo 7C242-93-038, Dec. 10, 1993. (b) Boyles, V. C. Boyles "Single Shell Tank Stabilization Record," SD-RE-TI-178 Rev. 3, July 1992. (c) Welty, R. K. "Waste Storage Tank Status and Leak Detection Criteria," SD-WM-TI-356, September 1988.

information that are used in the TLM analysis are the primary waste additions and the solids level measurements, both of which are well represented in WSTRS.

The missing transactions largely involve tank-to-tank transfers within WSTRS. These missing transactions, which are salt cake, salt slurry, and supernatant, do lead to a larger uncertainty for the compositions of the concentrated products from evaporator operations. As many as 25% of all transactions may be missing from this data set, perhaps as many as 60-80% of these missing transactions are associated with the evaporator operations. Although this information might be recovered in the future, the HDW model strategy at this time resolves as many of these unknown transactions as possible with the rules stated above.

Sludge Accumulation from Primary Waste

The TLM analysis associates a solids volume percent (vol%) with each primary waste stream. These solids vol% are those that are consistent with the solids volumes reported in Anderson-91 by comparing those solids accumulations with the primary waste additions that are recorded in WSTRS. The result of this analysis is a solids volume percent for each waste type with a range of uncertainty associated with the inherent variability of the process.

Not all of the waste types have adequate solids reports associated with them. For these waste types, a nominal value is assigned based on similarity to other waste types where there exists a solids vol%. For example, a total of 810 kgal of Hot Semi-Works waste (HS) was added to several tanks in C Farm, but these additions only constituted a small fraction of the total solids present in any of these tanks. Therefore, a nominal 5 vol% solids is assigned for that waste type.

Each TLM spreadsheet table shows the primary waste additions and the solids from those additions based on the characteristic vol% for that waste type. The TLM compares this prediction with the solids level reported for the tank and indicates either an unknown gain or loss for this tank. Once a layer is "set" in the tank, its volume appears in "Pred. layer" and type in "Layer type", thus comprising a chronological layer order from the bottom of a tank to the top, where each layer is described in terms of a volume and a type. Note that lateral variations are not accounted for in this model, and therefore this model only derives an average layer thickness. The TLM does not include any lateral distribution of those layers, which can in some cases can be quite extreme.

There are two main sources for variations in the solids vol% for each waste type. First, there is an inherent variability in each process stream, which is largely attributable to process variations. Second, solids can be added to or removed from tanks by inadvertent (or purposeful) entrainment during other supernatant transfers. In addition to these sources of variation, there are a number of other minor sources of solids changes such as compaction, subsidence following removal of salt well liquid, and dissolution of soluble salts by later dilute waste additions. Other solids variations may be due to metathesis and other chemical reactions within the tanks, such as degradation of organic complexants over time.

The TLM assigns solids changes to variability when they fall within the range established. If a change in solids falls outside of this range, the TLM associates the gain or loss of solids with a waste transfer to or from another tank or to dissolution of soluble salts in the upper existing solids layers.

Diatomaceous Earth/Cement

Diatomaceous Earth, an effective and efficient waste sorbent material, was added to the following waste storage tanks BX-102 (1971), SX-113 (1972), TX-116 (1970), TX-117 (1970), TY-106 (1972), and U-104 (1972). The additions of diatomaceous earth were used to immobilize residual supernatant liquid in tanks where the liquid removal by pumping was not feasible. The conversion factor in the TLM for Diatomaceous Earth (DE) is 0.16 kgal/ton and Cement (CEM) or (CON) is 0.12 kgal/ton. The CEM waste was only added to one tank, BY-105 (1977).

Salt Cake Accumulation

Once a tank becomes a "bottoms" receiver, the TLM assumes from that point on that any solids that accumulate are salt cake or salt slurry. Salt cake can be any one of four different types, depending on which evaporator campaign created it. These are B (242-B), T1 (early 242-T), BY (ITS #1 and #2 in BY Farm), and R (Redox self-concentrating tanks). Table 2 describes the various evaporator campaigns that resulted in concentration of waste and precipitation of solids at Hanford. For salt cake accumulation, the TLM assumes that all of the solids reported are salt cake. Two other minor evaporation campaigns involved use of Redox and B Plant evaporators for tank wastes. These minor campaigns have been associated with T2 or S1 campaigns, respectively.

The HDW model assigns waste of the five later campaigns for 242-T, 242-S, and 242-A evaporators as concentrates within the SMM. These later concentrates correspond roughly to what is known as double-shell slurry (DSS) or double-shell slurry feed (DSSF), although their early concentrates are often referred to as salt cake as well.

IIc. Approach—Supernatant Mixing Model (SMM)

The third step is to describe the composition of supernatants and concentrates within each of the tanks (note that interstitial liquid is part of the TLM sludge and salt cake definitions, not the supernatant). To accomplish this, an ideal mixing model has been developed, called the Supernatant Mixing Model. This model describes supernatants in terms of original kgal (1 kgal = 1,000 gal) of each of the HDW supernatants. The SMM is a very critical part of the definition of waste in double-shell tanks (DST's) where a large fraction of the waste supernatants now reside. For single-shell tanks, the SMM contributes largely to the composition of concentrated wastes. A block diagram of the SMM approach is shown in Fig. 2. The fundamental assumptions used for this model are ideal mixing of each tank's free supernatant volume throughout its history. In particular, the volume of solids layers within each tank defined by the TLM are excluded from mixing with any supernatant additions. In addition, all evaporator feed to and from 242-A, 242-S, and the latter 242-T operations are treated as free supernatant in all tank transactions.

The SMM calculation reads transaction information from WSTRS, sorts it to a date order, and performs a transaction by transaction accounting of all of the tank waste transactions for the history of Hanford. This algorithm accounts for residual solids accumulation as per the TLM above.

The SMM provides a description of each tank's free supernatant and supernatant concentrate based on a linear combination of Hanford Defined Waste (HDW) supernatants. The HDW supernatants have been reported in the Waste Status and Transaction Record Summaries for that tank. This linear combination of HDW supernatants represents a total volume that is usually larger (sometimes smaller) than the actual volume of free supernatant within each tank. This is because active evaporation (or dilution) of the waste during its history.

Each tank's SMM waste vector is expressed in terms of a linear combination of HDW supernatants, which in turn are used to predict a chemical and radionuclide inventory with compositions provided by the HDW (or other sources). The SMM does not allow mixing with TLM solids that have precipitated from primary waste streams. However, those solids that resulted from the later concentrator operations 242-A, 242-S, and latter 242-T, are treated as supernatants within the SMM.

SMM and TLM Output Tables

The output of the Supernatant Mixing Model is a table whose column headings are the HDW's and auxiliary wastes and whose rows are the waste tanks and processes. The auxiliary wastes are water, unk, swliq, and gas and do not appear on the HDW waste list. These auxiliary wastes are used for tracking of unknowns, evaporator runs, and gas retention in waste concentrates. The SMM table's columns (see App. D) show the HDW distribution among the tanks and processes for a particular time. These are given in kgal of original HDW supernatant. The linear combination of HDW supernatants represent a total volume that is usually larger (but sometimes smaller)

than the actual volume of free supernatant or concentrate within each tank. The reason that the SMM volume differs from the tank volume is because of active evaporation or dilution of a tank's waste.

The TLM tables are also shown in App. C and follow roughly the same format as the SMM tables. There is no concentration effect with the TLM solids and so the row sum of the TLM for each tank is equal to the TLM volume for that tank.

IId. Approach—Hanford Defined Wastes (HDW)

The fourth step in the strategy is to provide chemical and radionuclide concentrations for each of the Hanford Defined Wastes¹⁰ (HDW's). The HDW's begin with inputs of radionuclide and stable chemicals, both of which are used to define the total species in each waste stream (see Fig. 3, campaign and chemicals added). These total species are then separated into two layers, a sludge and a supernatant, that result in different concentrations of species for the two layers.

Each species is precipitated according to a single point solubility and ions precipitated in more than one salt are simply successively precipitated. Thus, the solids that precipitate are merely representative of the actual solids and are not meant to reflect the actual solids distribution. Because the supernatant is also present in the interstices of the sludge layer, this "supernatant" is included within the sludge composition. The solubility of each species is set by a macro that, when run on the HDW spreadsheet, adjusts the fraction precipitated parameter so that the supernatant concentration is equal to or less than the target solubility.

The sludge and supernatant compositions are each expressed in mol/L for the stable chemicals, with water and TOC as wt% and radionuclides in $\mu\text{Ci/g}$ and Ci/L , respectively. Each waste is kept in ion balance according to the oxidation states assumed for that species. The sludge and supernatant layers are also expressed in terms of ppm composition, for which are kept a mass balance as well. However, the

¹⁰Agnew, S. F., et al., "Hanford Defined Wastes: Chemical and Radionuclide Compositions," LA-UR-94-2657, Rev. 2, September 1995.

Supernatant Mixing Model Block Diagram

Fig. 2. Block Diagram of SMM algorithm.

mass balances are limited by differences among water, oxide, and hydroxide with the various solids to only within $\pm 2\%$.

Block Diagram of HDW Spreadsheet

Fig. 3. Block Diagram of HDW spreadsheet .

III. Results and History of Revisions

Appendix E shows the composition and inventory for each of the 177 Hanford Waste tanks. Each tank is described by three tables and each table comprises three columns of information. Two columns describe the analyte concentrations as mol/L and ppm and the third column expresses the tank inventory in kg or MCi (1 MCi = 1×10^6 Ci). The three tables represent TLM solids blend, SMM liquids blend, and total composite tank concentrations and inventories. The TLM solids composition and inventory represents the volume average blend of all of the TLM solids layers. Note that among the TLM solids definitions are four salt cake concentrates: B, T1, R, and BY. Therefore, the TLM solids inventory definition includes sludges and some salt cake.

The second table for each tank represents the SMM composite inventory for liquids and concentrates. This table represents inventories from evaporator concentrates termed T2, S1, S2, A1, and A2. Note that these concentrates actually include a lot of solids but are treated nevertheless as homogeneous mixtures that can be pumped, blended, and moved to other tanks as though they were liquid.

The HDW model provided its first estimates in June of 1994 as Rev. 0 for the NE and SW quadrants. This early revision was based on single waste types for salt cake and salt slurry for the entire site. Revision 1 was actually the first complete site inventory and was completed in Fall of 1994 for the three SST quadrants, NE, SW, and NW, while Rev. 1 for the DST SE quadrant was completed in March 1995. These estimates included many bug fixes and other corrections and also included additions for process vessel corrosion source terms (adds Fe, Cr, and Ni) as well as a hard water Ca source term. However, the Cs-137 and Sr-90 inventories were calculated too high by about 20% and all evaporator campaigns were blended into multi-year composites. These evaporator blends were an improvement over the single waste types for salt cake and salt slurry in Rev. 0, but still represented an approximation for individual tanks. Essentially, these evaporator blends were excellent representations of the total waste into a campaign and its total volume reduction, but were distributed across perhaps ten or twenty different slurry receivers that were involved in each campaign.

The next step with the HDW Estimates, Rev. 2, was an attempt to express the five later evaporator campaigns on a tank by tank basis. The SMM provided the waste concentrate history step by step throughout each of the evaporator campaigns. Revision 2.1 represents a bug fix in the spreadsheet that incorrectly calculated water and TOC and another problem with miscalculation in SX Farm. This revision was based on the HDW Rev. 2 compositions, which had improved the Cs-137 and Sr-90 inventory calculation and had included chloride and potassium source terms that piggyback on the NaOH additions. Various other bug fixes and changes and additions were a mercury source term used in the decladding process, adjustments on the wastes from UR (Uranium Recovery), slight realignments of 1C and 2C waste campaigns, and other minor changes. Revision 2 also reduced the process vessel corrosion source term (Fe, Ni, Cr) for early BiPO₄ wastes and decladding wastes consistent with the fact that these processes were much less corrosive than either Purex or Redox.

The Rev. 2.1 estimates nevertheless had some problems. The most significant problem was the incomplete transaction records for the later evaporator campaigns caused incorrect distribution of waste concentrates. In particular, some tanks were impossibly over concentrated (Na in excess of 16-17 mol/L), while other slurry receivers were more dilute than they should have been. It was clear that there were severe problems in waste misdirection with Rev. 2.

To correct these problems, the Rev. 3 estimates have extensively modified WSTRS by adjusting the evaporator transactions to blend on a per quarter basis and for some quarters, wastes have been blended on an even finer time scale. This improvement in the transaction record was largely accomplished by use of a draft version of the Logbook Dataset⁶, constructed by ICF Kaiser for WHC and not yet published. Also used is an extensive set of reports from evaporator operations for 242-S and 242-T. Unfortunately, there was a lack of detailed information about the 242-T evaporator operation.

The overall inventories for the analytes have not changed significantly except for lead, manganese, and oxalate. Lead site inventories increased dramatically in Rev. 3 since these estimates included the lead coating that

covered each fuel slug. This turns out to be a major source of lead in the waste tanks and the total lead inventory increased from 3 to 280 mT. There was also an error in the concentration of manganese in OWW2, which upon correction lowered the manganese site inventory from 219 to 39 mT. The oxalate inventory increased from 23 to 69 mT because of a decrease in its solubility limit. Since 224 waste supernatant was all cribbed, decreasing oxalate solubility retains more in the waste tanks and this was the only oxalate source term.

IV. Uses and Limitations of HDW Model Estimates

The HDW Model Rev. 3 estimates represent a Hanford site inventory based on process history that is compatible with the waste types, compositions, and processing history of the site. The total site estimates will not change appreciably in the future unless the waste source terms for the various waste streams change, but it is still possible that changes in the transaction record will alter the inventory estimates of individual tanks. All estimates are valid as of 1-1-94 and Sr-90 and Cs-137 are both decayed to the same date. Therefore, these estimates do not account for the latest evaporator campaign in '95-'96, which moved and blended large amounts of waste supernatants in the DST's.

The HDW estimates are the first complete, total, ion and mass balanced inventory estimates yet provided on a per tank basis. As such, they have immediately shown that: site sodium inventory has been traditionally overestimated by about one third. Whereas previous site estimates for sodium were around 71,000 mT (mT = metric tonnes), the HDW estimate show only 40,000 mT are actually now in either the DST's or the SST's. This difference is largely due to the large amount of waste supernatant that was sent to crib, some 20,000 mT, but is also due to more subtle double counting of waste stream chemicals that has occurred in the past.

These estimates have also shown an increase in the iron inventory, which the HDW model now estimates at 1,830 mT (1,610 in the SST's and 220 in the DST's) as compared to previous estimates of 710-730 mT. These total site estimates are shown in App. E along with estimates for individual tanks.

The site inventory estimates include totals for waste sent to the cribs as well as totals for leaks with measurable volume losses. Note that the leaks from waste tanks are only a small fraction of the total inventory sent to the ground, constituting only 10% of the 2.2 MCi of Cs/Sr activity and only 2% of the 48 kg of Pu that was sent to the soil column. Thus, the amount of activity intentionally sent to the soil column dwarfs the activity inadvertently placed into the ground by leaks and spills.

There are still problems with these estimates. The evaporator blending and SMM approach naturally produce blending averages for waste supernatants that were processed during each quarter. The actual blending that occurred during these quarters may not be exactly represented in this approximation. This blending error then contributes to the overall variability in the waste predictions.

Another problem with the HDW model is that precipitated solids from waste concentration do not remain in the slurry receiver during evaporator runs. That is, liquid that is drawn from each bottoms tank following cooling is always removed as a blend of the total concentrate. This leads to an under concentration of the bottoms receiver and correspondingly an over concentration of tanks that receive and further blend and concentrate the recycled liquors. This effect systematically shifts concentrate from early receivers to later receivers and therefore increases the variability of the estimates by introducing a systematic bias in early versus late concentrates.

V. Uncertainty for the HDW Estimates

There are two main origins of variability within the HDW model—process variability (results in variability of hdw's) and transaction variability (results in variability in tlm and srm factors). Since process variability affects the HDW compositions and transaction variability affects the SMM/TLM factors, these two variabilities will be additive in the final inventory estimates.

Quantification of Process Variability

Starting with the hypothesis that the waste rate variability is the most direct measure of process variability and therefore of HDW compositional variability, the two sources of waste rate variability are:

- 1) Rework processing. For a given amount of fuel processed during a campaign, early batches needed to be reworked more often than later batches because the separations failed to achieve the necessary decontamination or separation factors. Note that for rework, the chemicals in the waste scale linearly with the waste volume but the radionuclides will be diluted by increasing rework;
- 2) Ancillary processing resulting in primary waste dilution. There are many ancillary waste streams that derive from various cell cleanup and vessel cleanout activities. These activities by and large add very little or no chemicals or radionuclides to the waste stream. Therefore, to a first approximation, this variability simply dilutes or concentrates the waste stream. This dilution or concentration simply changes the relative supernatant and sludge inventories of each component.

This approach completely neglects chemical source term variability, which derives from measurement errors during processing. This variability is in the range 3-5% and will therefore be bounded by the two main sources noted above.

The variability of every process waste rate will actually be a combination of rework and ancillary processing and there is little information about what this combination is. Assuming that the amount of chemicals used scales linearly with the volume of the waste produced for rework processing, the waste compositions within each tank will actually be independent of the amount of process rework (radionuclides, however, will be reduced in concentration by the increase in rework.)

This approach subtracts a linear trend from each waste rate due to rework over the period of a campaign and makes the assumption that the resultant variability of the waste composition is wholly attributable to ancillary processing. This results in waste composition variabilities that should be equal to or greater than the true waste composition variabilities. In principle, the HDW model would need more information to assign the correct fraction of waste rate variability to process rework.

With these assumptions in hand, an uncertainty for each HDW (Hanford Defined Waste) can be derived by resolving each HDW analyte for its upper and lower limits. An RSD (Relative Standard Deviation) for each HDW results in a set of upper and lower compositions for each component of each HDW. Note that these relative variabilities will be different in general from the overall RSD for each HDW. This is because of the fact that the solution concentrations of semi-soluble species are directly linked to their sludge inventories.

Finally, there is a fundamental correspondence that relates a tank's waste volume to a corresponding waste stream variability. That is, if a tank contains 75 kgal of a waste sludge, then the waste rate variability must be calculated for the time that it took to deposit that 75 kgal of sludge.

This is a very important point. A manifestation of waste heterogeneity within a tank is that the larger the waste sample taken from a tank, the more representative that sample will be to the mean value for that waste type. The waste rate variability quantitates that relationship. It means that the smaller the sample of waste in an assay, the less representative that assay will be for the tank contents and therefore a larger margin will occur for comparison of that assay to the HDW estimates. Conversely, the larger the amount of waste sampled, the better it will represent the tank's waste and the smaller will be the margin for HDW estimate comparisons.

There are fourteen tanks in S and SX Farms that hold nearly all of the R1 sludge, averaging 75 kgal each. Thus, each tank's sludge represents about two quarters worth of accumulation, and the variability is 12%, ranging from 10-16% depending on exactly how much sludge is in a given tank.

Most of the R2 waste sludge is on average distributed 30 kgal each among 7 tanks. At 30 kgal, the variability will be 13%, and will range from 10-16% for that set of tanks as well. It is interesting to note that despite the very different Redox campaigns, the waste rate variabilities are very similar.

There are two basic parameters from this variability analysis; a waste rate variability and a waste rate trend. The waste rate variability represents a dilution of all species while the waste rate trend does not change the chemical composition at all, since chemicals added remain proportional to waste volume. On the other hand, there will be a bias in the radionuclide concentration through a campaign as a result of the waste rate trend. Radionuclides will be more dilute early in the campaign and more concentrated late in the campaign. Thus, there is an extra source of variability for radionuclides within each campaign that is tied to the waste rate trend parameter.

For example, the waste rate trend for R1 is $\pm 73\%$ of the mean over the campaign, which places an effective RSD for the radionuclides at $\pm 50\%$. Thus, while the chemical composition variability for these tanks is within an RSD of $\pm 12\%$, the radionuclides vary with an RSD of $\pm 50\%$.

Quantification of Transaction Variability

There are three contributions to transaction variability; evaporator blending, concentrate carryover, and of course, inaccurate transaction information. As regards to inaccurate information, it is not possible to derive meaningful uncertainty estimates about what is not known. Therefore, variability estimates are only possible for the first two contributions.

Evaporator blending and concentrate carryover are now both approximations used within the HDW model. Evaporator blending assumes that all of the waste feed for a given time can be blended together and reduced in volume as a blend and then transferred to a bottoms receiver. In reality, this process was continuous feed and continuous volume reduction.

Concentrate carryover is an approximation within the HDW model whereby all liquids that are removed and recycled to the evaporator from a bottoms receiver are assumed to be homogeneous mixtures of the entire concentrate inventory of each tank. This approximation is valid for dilute wastes but increasingly invalid as wastes are concentrated. That is, waste concentrates are returned to the tanks from the evaporator and allowed to cool, sediment, and gel. Then, residual liquid is removed from these tanks and often reblended and further concentrated. The HDW model allows concentrated waste to be "carried over" into later receivers because of its assumptions and limitations. This represents a second major source of variability within the model, but it only affects concentrates.

Although these arguments provide a basis for transaction variability estimates, the task is not yet completed and therefore are not yet included in HDW Rev. 3 estimates.

VI. Summary

The HDW Rev. 3 estimates are the latest in a developing model of the tank waste inventories at Hanford. The HDW model variability estimates are not yet complete and the comparison of HDW estimates with analytical assays is also in progress. Both of these tasks are ongoing and represent the "bottom line" for the model validity.

Note, though, that comparison of HDW model results with assay data is more complex than just comparing one estimate with another. To derive a tank inventory from assay data for waste samples from within a tank is not a trivial task in and of itself. The extremely heterogeneous wastes within each tank make representative sampling problematic and this is compounded by limited access to the tank waste. Therefore, when comparing inventory estimates based on waste assays with the HDW model, one is actually comparing one model with another model and both models have significant uncertainties. Therefore, comparisons are often more effective if they are made among tank groups with similar process histories. Such grouping strategies can be very important in comparisons between assay data and HDW predictions.

Appendix C.

TLM Working Spreadsheet May 1996

The TLM (Tank Layer Model) is a volumetric and chronological description of tank inventory based on the HDW sludges and salt cakes. Each solids layer is attributed to a particular waste addition or process, and any solids layers that have unknown origin are assigned as such and contribute to the uncertainty of that tank's inventory. Many of these unknown layers are assigned as per the history of each tank and such assignments are included in the TLM table in parentheses. The TLM for each tank simply associates layers of solids within each tank with a waste addition or a process campaign. Each tank's history is summarized by rows and its primary waste additions are all indicated.

The bolded entry in the Pred. layer column is the volume in kgal of each residual layer and the Layer Type column has information on the HDW assignment for that layer. This is the information that is used in WSTRS, which adds TLM solids layers to each tank accordingly. These result, then, also appear in the SMM/TLM tables in App. D. The TLM working spreadsheets are grouped by quadrant, which is a roughly geographical grouping of tanks that has been useful in the HDW model development.

The level discrepancies between the HDW Model-TLM and the Hanlon report are listed at the end of the appendix. These are given for volume differences greater than 10 kgals. Volume differences greater than 50 kgals were changed in the HDW Model and the new value is listed. This is further described in the Approach section (TLM) of the main text.

NE Quadrant (A, AX, B, BX, BY, C)

Table C1. TLM Working Spreadsheet Column Descriptions.

Column Headings	Descriptions
Tank	tank number
Year	year of transaction
Qtr	quarter of transaction
Meas. solids	reported solids from Anderson-91 in kgal
Solids change	calculated solids based on primary fill record or difference between solids records
Pred. layer	kgal predicted layer now in tank
Layer type	Defined Waste Type for that layer
Waste volume	summation of primary waste additions calculated for this time period
Comments	various details of each calculation

Tank	Year	Qtr	Meas. solids	Solids change	Pred layer	Layer type	Waste volume	comments
AX-101	1965	1		10		P2	263	3.9 vol %
AX-101	1966	1						poss solids in from A-103 1964-66 ?
AX-101	1967	4		20		OWW2	1860	1.1 vol%
AX-101	1968	2		2		P2	40	3.9 vol %
AX-101	1968	4		14		B	2738	0.5 vol %
AX-101	1968	4		7		PL	302	2.2 vol %
AX-101	1968	4	41	-12				unk gain
AX-101	1969	1		1		B	294	0.5 vol %
AX-101	1969	1		2		PL	84	2.2 vol %
AX-101	1969	1	39	-5				unk loss
AX-101	1969	2		0		PL	3	2.2 vol %
AX-101	1969	2	25					
AX-101	1969	3	26					
AX-101	1969	4	30					
AX-101	1970	1	41					
AX-101	1970	2	69					
AX-101	1971	1	56					
AX-101	1972	4	58					
AX-101	1973	4	77					
AX-101	1974	4	69	30				unk gain
AX-101	1975	3					-8	SL C-105 , SRR
AX-101	1975	3		0		SRR	6	5.0 vol %
AX-101	1975	3	61					
AX-101	1975	4					-16	SL C-105 , SRR
AX-101	1975	4	45					
AX-101	1976	1					-37	SL C-105 , SRR
AX-101	1976	1		7		SRR	140	5.0 vol %
AX-101	1976	1	8					
AX-101	1976	2					-4	SL C-105 , SRR
AX-101	1976	2		3		SRR	56	5.0 vol %
AX-101	1976	2	4					sluiced
AX-101	1976	3	3	-76	3	SRR		Residual after sluicing
AX-101	1977	2	184					242-A1 Evap Camp.
AX-101	1977	3	578					Slurry Receiver
AX-101	1977	4	627					
AX-101	1980	1	600					
AX-101	1980	3		10	10	P2		3.9 vol % washed out? to A-102, no temp variance in upper TCs
AX-101	1980	3	289					adj in salt cake due to pumping to A-102
AX-101	1980	4	525	512	512	SMMA1		Solids from concentrate calculated by SMM.
AX-101	1993	2	748					

Tank	Year	Qtr	Mess. solids	Solids change	Pred layer	Layer type	Waste volume	comments
AX-101	1993	4	748	223	223	SMMA2		242-A2 Evap., Solids from concentrate calculated by SMM.
AX-102	1987	3		5		OWW2	491	1.1 vol%
AX-102	1988	4	14	9				unk gain
AX-102	1989	1	0	-14				flushed tank
AX-102	1989	2		9		B	1834	0.5 vol %
AX-102	1989	2		1		PL	43	2.2 vol %
AX-102	1989	2	17	7				unk gain
AX-102	1989	3		3		B	515	0.5 vol %
AX-102	1989	3		1		PL	35	2.2 vol %
AX-102	1989	3	19	-2				unk loss
AX-102	1989	4		5		B	998	0.5 vol%
AX-102	1989	4	10					
AX-102	1970	1		3		B	568	0.5 vol %
AX-102	1970	1	12					
AX-102	1970	2		2		B	436	0.5 vol %
AX-102	1970	2	17					
AX-102	1970	3		0		B	20	0.5 vol %
AX-102	1970	3	11					
AX-102	1970	4		0		B	7	0.5 vol %
AX-102	1970	4	28					
AX-102	1971	1		0		B	14	0.5 vol %
AX-102	1971	1	38	9				
AX-102	1971	2	32	-6				unk loss
AX-102	1971	2		1		AR	15	4.0 vol %
AX-102	1971	3	38	5				unk gain
AX-102	1972	2	50					
AX-102	1972	3	63					
AX-102	1972	4	47					
AX-102	1973	1	50	12				unk gain
AX-102	1975	3		1		AR	19	4.0 vol %
AX-102	1975	3		0		B	8	0.5 vol%
AX-102	1975	4	47	-4			-3	SL C-105,SRR
AX-102	1976	1	22	-25			-25	SL C-105,SRR
AX-102	1976	2	17	-5			-5	SL C-105,SRR
AX-102	1976	4	19	2				unk gain
AX-102	1977	1	11	-8	5	B	-8	SL C-105,SRR, Sr sludge sluicing
AX-102	1977	2	6	-5	1	PL		heels after sluicing
AX-102	1979	2	39					

Tank	Year	Qtr	Meas. solids	Solids change	Pred layer	Layer type	Waste volume	comments
AX-102	1980	3	29		23	SMMA1		slurry rec 242-A1 Evap., Solids from concentrate calculated by SMM.
AX-102	1993	2	36		4	(SMMA1)		unk assign to A1StCk, Solids from concentrate calculated by SMM.
AX-102	1993	4	36	30	3	(SMMA2)		unk assign to A2sitsrv, Solids from concentrate calculated by SMM.
AX-103	1986	2		93		P2	2371	3.9 vol %
AX-103	1987	3	14					ignore, unk loss
AX-103	1987	4		10		OWW2	916	1.1 vol%
AX-103	1988	2		1		OWW3	143	0.6 vol%
AX-103	1988	2		0		BL	10	2.50 vol %
AX-103	1988	4		3		PL	162	2.2 vol %
AX-103	1988	4	77	-30				unknown loss
AX-103	1989	1		0		B	11	0.5 vol %
AX-103	1989	1		1		PL	45	2.2 vol %
AX-103	1989	1	83	5				unk gain
AX-103	1989	2	76					
AX-103	1989	3	83					
AX-103	1970	1	80					
AX-103	1970	2	83					
AX-103	1970	4	69					
AX-103	1971	3	66					
AX-103	1972	4	0			B		30.5 vol %
AX-103	1972	4	69					
AX-103	1974	3	72					
AX-103	1974	4	88	5				unk gain
AX-103	1975	3	14			AR	342	4.0 vol %
AX-103	1975	4		2		AR	51	4.0 vol %
AX-103	1976	2					-18	SL C-105, SRR
AX-103	1976	2	70					
AX-103	1976	3					-63	SL C-105, SRR
AX-103	1976	3	17					
AX-103	1976	4	6					
AX-103	1977	1	11					
AX-103	1977	3	6	-98	6	P2	-11	SL C-105, SRR, sluiced Sr sludge
AX-103	1980	2	10	4	4	SMMA1		Solids from concentrate calculated by SMM.
AX-103	1980	3		8	8	P2	198	3.9 vol %
AX-103	1980	4	121	103				
AX-103	1993	2	112					
AX-103	1993	4	112	-9	94	SMMA1		Solids from concentrate calculated by SMM.

Tank	Year	Qtr	Meas. solids	Solids change	Pred layer	Layer type	Waste volume	comments
AX-104	1965	3	0					
AX-104	1967	4		77		P2	1969	3.9 vol %
AX-104	1968	2		0		B	12	0.5 vol %
AX-104	1968	2		1		P2	18	3.9 vol %
AX-104	1968	2		2		PL	88	2.2 vol %
AX-104	1968	2		1		OWW3	237	0.6 vol%
AX-104	1968	4	10					Error due to boiling.
AX-104	1969	1		0		B	37	0.5 vol %
AX-104	1969	1		1		PL	37	2.2 vol %
AX-104	1969	1	8					Error due to boiling.
AX-104	1969	2		0		PL	3	2.2 vol %
AX-104	1969	3	11					Error due to boiling.
AX-104	1969	4	27					early readings seem low
AX-104	1970	1	58					no reason for increase
AX-104	1970	2	48					
AX-104	1970	3	44					
AX-104	1970	4	52					
AX-104	1971	2	47					
AX-104	1972	4	55					
AX-104	1973	4	44					
AX-104	1974	4	47					
AX-104	1976	1	44	-37				unk loss
AX-104	1976	1		0		AR	9	4.0 vol %
AX-104	1976	3	47					
AX-104	1977	1	55					
AX-104	1977	2	22					
AX-104	1977	3	11					
AX-104	1977	4	3					
AX-104	1978	1	8					sluiced
AX-104	1978	2	3					
AX-104	1993	2	7					
AX-104	1993	4	7	-37	7	P2		residual heel after sluicing

Appendix D.

SMM / TLM Volumes Tables

March 1996

The SMM (Supernatant Mixing Model) provides a description of each tank's free supernatant and supernatant concentrate based on a linear combination of Hanford Defined Waste (HDW) supernatants. The output of the SMM is an table whose column are the HDW's and whose rows are the tanks and processes that hold HDW inventory. The fill of the array are composition row vectors for each tank or process and are all given in kgal (1 kgal = 1,000 gal) of original HDW. The row sum of this table represents a total volume that is usually greater than the actual volume of free supernatant or concentrate within each tank. This difference is because of active evaporation or dilution of waste sometime during its history.

The TLM table correspondingly provides composition row vectors for the TLM sludges for each tank. In contrast to the SMM, the row sum of a tank's HDW sludges does equal the total volume of the sludges predicted by the TLM. This value may be still be different from the actual solids level reported for a tank because the salt cakes from later evaporator campaigns are treated as concentrates and therefore predicted by the SMM.

The tank composition table provides a description of each tank's SMM composition in terms of per cent of HDW supernatants in rows that sum to 100%. The HDW distribution table gives per cent distribution of each HDW supernatant in columns summing to 100%.

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Table D1. Descriptions of SMM Tables' Columns

Column Headings	Descriptions
Columns 2-67 (B-BO)	assigned to Defined Waste Columns
Columns 68-71 (BP-BS)	auxiliary waste definitions
<i>assume</i>	original concentration volume of waste from assumed transactions
<i>smmvol</i>	original concentration volume of HDW wastes in the tank or that went to a secondary process or crib
<i>supvol</i>	kgals of supernatant in the tank or that went to process or crib
<i>tlmvol</i>	kgals of TLM residual solids predicted in the tank
<i>tankvol</i>	total volume in kgals of waste in the tank
<i>traffic</i>	total traffic for a tank or process year to date
<i>assume trfc</i>	total traffic from assumed transactions for a tank or process year to date
<i>Max. TOC wt%</i>	maximum TOC wt% experienced by the tank for all of its history
<i>date of Max. TOC</i>	date when maximum TOC wt% occurred
<i>TOC wt% now</i>	present TOC wt% in the tank
<i>Max. Haz. Index</i>	maximum Hazard Index experienced by the tank for all of its history
<i>Haz. Ind. now</i>	present Hazard Index now

WSTR53.45b	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2
A-101	0.6	0.2	3.2	13.8	0.0	4.5	2.8	43.6	5.0	5.8	3.8	1.8	226.4	26.0	42.3	25.7	59.1	30.6	8.1	33.3	144.4	
A-102	0.0	0.0	0.1	0.2	0.0	0.1	0.1	0.8	0.1	0.1	0.1	0.0	4.1	0.5	0.8	0.5	1.0	0.5	0.2	0.6	2.8	
A-103	0.2	0.1	1.2	5.1	0.0	1.7	1.1	16.5	1.9	2.3	1.5	0.7	84.3	9.7	15.7	9.6	21.8	11.5	3.1	13.3	56.8	
A-104																						
A-105	0.0		0.0	0.0	0.0	0.0		0.0	0.0		0.0						0.0	0.0	0.0	0.0	0.0	
A-106	0.1	0.0	0.4	1.8	0.0	0.6	0.4	5.8	0.6	0.6	0.4	0.2	32.1	3.5	6.0	3.5	8.4	4.1	0.9	3.5	16.0	
AX-101	0.5	0.1	2.5	10.7	0.0	3.5	2.2	34.4	3.9	4.8	3.1	1.4	176.2	20.2	32.8	20.0	45.8	23.9	6.5	27.6	118.3	
AX-102	0.0	0.0	0.2	0.7	0.0	0.2	0.1	2.1	0.2	0.2	0.2	0.1	12.2	1.3	2.3	1.3	3.2	1.6	0.3	1.4	6.3	
AX-103	0.1	0.0	0.3	1.4	0.0	0.5	0.3	4.4	0.5	0.6	0.4	0.2	23.0	2.8	4.4	2.6	6.3	3.2	0.7	3.4	14.5	
AX-104																						
B-101																						
B-102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	
B-103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	
B-104			0.0	0.0	0.0	0.0		0.0														
B-105	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
B-106	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	
B-107	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0						0.0	0.0	0.0	0.0	0.2	
B-108	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
B-109																						
B-110																						
B-111	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
B-112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
B-201								7.7														
B-202								0.0														
B-203								0.0														
B-204								0.0														
BK-101																						
BK-102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2						0.0	0.0		1.7	4.9	
BK-103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	
BK-104	0.1	0.0	0.3	1.3	0.0	0.4	0.3	4.0	0.5	0.4	0.3	0.2	21.9	2.6	4.0	2.5	4.2	2.2	0.8	2.3	10.6	
BK-105	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.8	0.2	0.3	0.2	0.3	0.2	0.1	0.2	
BK-106	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.3	
BK-107	0.0	0.0	0.0	0.0	0.0	0.0		0.2	0.0	0.0	0.0						0.0	0.0		0.0	0.0	
BK-108																						
BK-109	0.0		0.0	0.0				0.0	0.0	0.0	0.0						0.0			0.0	0.0	
BK-110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
BK-111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	
BK-112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	
BY-101																						
BY-102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.5	
BY-103																						
BY-104																						
BY-105																						
BY-106																						
BY-107	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
BY-108	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
BY-109																						
BY-110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
BY-111																						
BY-112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
C-101																						

WSTRS3.45b	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFcN1	PFcN2	TFcN	1CFcN	R1	R2	CWR1	CWR2	P1	P2	P2	PL1	CWP1	CWP2
C-102	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0						0.0	0.0			0.0	0.0
C-103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.4	0.0	0.1	0.0	0.3	0.0	0.0	0.4		0.1	2.0	8.4
C-104	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	1.0	0.1	0.2	0.1	0.3	0.1		0.0	0.1	0.0
C-106	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
C-106	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0						0.0	0.0		0.0	0.0	0.0
C-107																						
C-108																						
C-109																						
C-110	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0						0.0	0.0		0.0	0.0	0.0
C-111			0.0	0.0				0.0			0.0										0.0	0.0
C-112	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0						0.0	0.0		0.0	0.0	0.0
C-201																						
C-202																						
C-203																						
C-204																						
E-101	0.3	0.1	1.3	5.1	0.0	1.8	1.0	18.0	1.8	1.9	1.2	0.7	100.4	11.0	18.5	10.1	15.7	8.4		2.6	10.0	45.8
E-102	0.6	0.2	2.8	13.5	0.0	4.7	2.7	39.3	4.5	3.8	2.6	1.8	230.8	25.8	42.7	25.9	38.0	20.0		5.5	20.8	100.7
E-103	0.4	0.1	1.8	9.4	0.0	3.4	2.0	26.5	3.0	2.5	1.7	1.2	140.2	16.6	28.4	17.2	25.2	13.4		3.6	13.8	87.0
E-104													0.0		0.0	0.0						
E-106	0.3	0.1	1.3	6.4	0.0	4.8	0.0	21.5	2.7	1.1	1.0	1.2	506.8	18.8	68.7	18.6	19.1	10.8		1.9	6.7	41.7
E-106	0.3	0.1	1.2	5.6	0.0	4.7	0.0	18.7	2.5	1.2	1.0	1.1	459.4	24.2	58.5	17.8	24.5	10.8		5.0	7.4	48.6
E-107	0.1	0.0	0.5	2.4	0.0	0.7	0.5	7.0	0.8	0.7	0.5	0.3	36.7	4.5	8.8	4.4	7.5	3.8		1.4	4.1	18.2
E-108	0.4	0.1	1.7	8.1	0.0	6.5	0.0	28.0	3.5	1.4	1.3	1.6	632.2	31.7	85.7	25.5	24.7	14.7		2.1	8.8	55.4
E-108	0.4	0.1	1.8	7.7	0.0	6.2	0.0	26.7	3.3	1.5	1.3	1.5	585.8	32.2	80.3	24.3	23.7	14.2		4.1	9.1	56.8
E-110	0.2	0.1	1.0	4.1	0.0	2.2	0.4	14.4	1.9	2.4	1.3	0.7	182.1	12.9	24.9	10.2	18.0	8.0		3.5	12.8	58.4
E-111	0.4	0.1	1.9	8.1	0.0	5.2	1.1	28.0	3.4	2.5	1.8	1.4	464.7	29.0	82.2	22.1	32.4	15.4		6.5	15.0	76.7
E-112	0.4	0.1	1.8	8.8	0.0	6.8	0.0	28.6	3.7	1.5	1.4	1.7	664.6	33.5	90.1	26.8	26.2	15.5		3.3	9.8	58.4
EX-101	0.1	0.0	0.4	2.0	0.0	0.7	0.4	6.0	0.7	0.8	0.4	0.3	38.9	4.0	6.9	3.9	5.8	3.1		0.9	3.2	15.4
EX-102	0.8	0.2	3.9	18.4	0.0	5.5	4.8	57.0	6.5	6.5	4.3	2.5	276.1	36.6	51.3	34.8	54.4	30.1		8.9	36.1	195.2
EX-103	0.9	0.3	4.2	22.9	0.0	6.7	7.2	66.7	7.6	6.5	4.4	3.0	271.6	39.2	53.8	41.3	62.4	33.4		8.2	38.1	187.7
EX-104	0.7	0.2	3.4	14.2	0.0	4.7	2.9	44.0	5.1	4.9	3.3	2.0	258.7	29.3	47.6	27.5	49.9	23.1		7.3	27.7	128.8
EX-106	1.0	0.2	4.8	19.7	0.0	6.7	5.2	62.0	7.1	7.2	4.8	2.7	370.7	42.3	66.8	38.2	60.8	32.9		10.9	41.5	188.2
EX-106	0.8	0.2	3.6	19.3	0.0	6.0	4.0	54.0	6.2	6.2	3.6	2.5	281.6	33.7	53.4	35.0	51.4	27.3		7.1	28.0	136.2
EX-107													2.3	5.3	0.0							
EX-108													10.1	13.5	0.0							
EX-109													7.6	6.0								
EX-110																						
EX-111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0		0.0	0.0	0.3
EX-112													0.5	47.2	0.0							
EX-113													13.4									
EX-114	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.0	0.0	0.0	0.0	0.0		0.0	0.0	0.4
EX-115																						
U-101																						
U-102	0.6	0.2	2.7	13.6	0.0	3.9	3.2	40.3	4.7	3.8	2.6	1.9	156.4	23.4	35.8	27.7	40.3	21.2		5.1	20.4	102.0
U-103	0.9	0.2	4.0	17.3	0.0	4.5	3.2	51.3	5.8	4.8	3.3	2.3	205.8	29.7	48.5	31.7	47.4	25.3		6.4	26.1	125.5
U-104	0.1	0.3	0.4	2.1	0.0	2.3	0.0	9.3	2.2	0.4	0.1	1.4	21.7	6.2	24.7	29.1	33.2	14.9			2.4	45.5
U-106	0.8	0.2	3.7	16.5	0.0	4.4	3.4	48.8	5.5	4.7	3.2	2.2	199.1	28.5	45.0	30.1	45.4	24.3		6.5	25.5	122.0
U-106	0.3	0.1	1.4	5.8	0.0	2.0	2.0	19.0	2.2	2.5	1.6	0.8	114.0	13.1	19.1	11.3	18.7	10.6		4.7	14.5	63.3
U-107	0.5	0.1	2.3	12.2	0.0	4.3	2.6	34.4	4.0	3.3	2.3	1.6	178.8	21.5	33.9	22.2	32.8	17.4		4.6	18.0	87.2
U-108	0.6	0.2	3.1	11.8	0.0	4.2	3.3	39.3	4.5	5.1	3.3	1.7	257.9	28.7	43.4	23.8	39.6	21.6		7.9	30.0	126.9
U-109	0.9	0.2	3.9	12.6	0.0	4.5	2.9	42.8	4.9	5.4	3.5	2.0	273.1	34.4	46.7	26.6	45.2	24.4		9.4	31.6	137.6

WSTRS3.456	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFcN1	PFcN2	TFcN	1CFcN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2
U-110																						
U-111	0.3	0.1	1.4	7.0	0.0	2.4	1.5	20.5	2.4	2.0	1.3	0.9	116.9	13.2	21.9	13.4	19.8	10.5		2.9	10.7	52.0
U-112																						
U-201	0.0		0.0											0.0		0.0						
U-202																						
U-203	0.0		0.1											1.5		1.0						
U-204																						
T-101	0.0	0.0	0.1	1.4	0.0	0.9	3.1	2.8	0.3	0.2	0.1	0.1	4.0	1.3	1.4	1.6	2.2	1.1		0.2	0.8	4.7
T-102																						
T-103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
T-104	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.8	0.1	0.1	0.1	0.1	0.1		0.0	0.1	0.3
T-105																						
T-106																						
T-107																						
T-108																						
T-109																						
T-110					0.0	1.7	0.0															
T-111					0.0	0.5	0.0															
T-112																						
T-201																						
T-202																						
T-203																						
T-204																						
TX-101	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.8	0.1	0.1	0.0	0.0	4.4	0.4	0.7	0.4	0.6	0.3		0.1	0.3	1.5
TX-102	0.3	0.1	1.6	11.4	0.0	1.9	0.0	32.1	3.6	2.1	1.6	1.4	43.3	14.2	16.1	19.9	26.2	14.1		1.6	10.0	56.6
TX-103	0.1	0.1	0.6	5.5	0.0	2.1	1.6	12.5	1.4	0.8	0.6	0.6	19.3	5.7	6.7	8.2	10.8	5.8		0.7	4.0	23.0
TX-104	0.1	0.0	0.3	2.3	0.0	0.4	0.0	6.5	0.7	0.4	0.3	0.3	10.3	2.9	3.3	4.0	5.6	2.9		0.5	2.0	11.5
TX-105	1.1	0.5	5.1	34.7	0.0	5.9	0.0	98.9	11.5	7.0	5.3	4.6	136.9	45.5	51.4	63.7	81.1	43.5		2.9	32.7	183.5
TX-106	0.6	0.2	2.5	17.7	0.0	3.0	0.0	50.1	5.6	3.3	2.5	2.3	74.9	22.4	25.4	31.3	42.2	21.9		2.8	15.6	86.6
TX-107	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.7	0.1	0.0	0.0	0.0	1.2	0.3	0.4	0.5	0.6	0.3		0.1	0.2	1.3
TX-108	0.2	0.1	0.8	5.3	0.0	0.9	0.0	15.1	1.7	1.0	0.8	0.7	22.3	6.8	7.8	9.7	12.8	6.6		0.6	4.7	27.1
TX-109	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
TX-110	0.7	0.3	3.2	23.0	0.0	3.8	0.0	64.9	7.2	4.3	3.3	2.9	83.6	28.6	32.6	40.5	53.5	26.2		3.3	20.3	115.1
TX-111	0.5	0.2	2.4	17.5	0.0	2.9	0.0	49.3	5.5	3.2	2.5	2.2	72.5	21.9	24.9	30.7	41.0	21.5		2.8	15.3	87.1
TX-112	1.2	0.5	5.7	36.5	0.0	6.4	0.0	102.5	12.6	8.4	6.5	5.0	144.5	46.0	57.5	70.9	86.6	46.5		2.6	39.2	214.7
TX-113	1.1	0.5	4.7	28.3	0.0	5.8	0.0	74.2	8.6	4.6	3.4	4.1	106.5	28.7	36.1	47.3	61.1	39.9		1.7	22.3	155.5
TX-114	1.2	0.5	5.4	34.4	0.0	5.8	0.0	89.4	9.7	5.9	4.5	4.3	119.4	34.3	43.8	55.2	79.7	40.5		2.1	26.2	172.2
TX-115	1.2	0.6	5.4	35.4	0.0	7.0	0.0	97.3	11.5	8.4	4.7	5.1	137.6	41.6	54.6	78.8	97.5	49.6		2.5	30.5	194.0
TX-116	0.2	0.3	1.0	7.9	0.0	7.4	0.0	29.3	5.1	0.6	0.1	4.2	45.9	15.0	16.5	20.8	26.4	13.8		3.2	51.7	
TX-117	0.4	0.5	1.7	12.4	0.0	12.3	0.0	49.8	8.8	1.4	0.3	7.2	83.4	26.6	32.1	40.5	53.5	26.2		0.3	7.8	105.0
TX-118	0.2	0.1	0.8	6.7	0.0	2.7	0.7	15.4	1.8	1.1	0.8	0.7	47.3	8.0	11.4	10.4	13.8	7.2		1.2	6.7	31.4
TY-101	0.0		0.0	0.0	0.0			0.0	0.0				0.0	0.0	0.0	0.0	0.0					
TY-102	0.1	0.0	0.2	1.8	0.0	0.3	0.0	5.0	0.5	0.3	0.2	0.2	7.3	2.2	2.5	3.1	4.1	2.1		0.2	1.5	8.7
TY-103	0.1	0.0	0.4	2.2	0.0	0.4	0.0	6.3	0.8	0.4	0.3	0.3	8.9	2.6	2.7	4.5	5.5	2.9		0.2	2.0	12.1
TY-104																						
TY-105								97.3														
TY-106																						
AN-101	0.2	0.1	0.9	3.8	0.0	10.0	0.3	13.9	1.7	1.3	0.8	0.7	258.0	12.4	34.9	11.0	13.0	7.8		1.6	7.8	42.8
AN-102	1.0	0.3	5.0	22.3	0.0	15.5	4.1	71.4	8.3	8.9	5.8	3.3	380.3	42.8	73.1	46.4	94.9	49.1		12.1	50.9	229.7
AN-103	0.6	0.3	3.3	16.0	0.0	22.8	2.0	82.0	6.8	7.8	4.8	2.9	283.6	30.7	58.5	41.2	65.8	35.8		6.4	43.0	208.1
AN-104	0.7	0.2	3.2	16.8	0.0	8.5	2.1	51.3	6.0	5.4	3.6	2.5	219.7	28.5	47.2	35.4	60.7	31.3		8.4	28.8	142.0

WSTRS3.45b	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PfFeCN1	PfFeCN2	TfFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2
AM-105	1.4	0.8	6.8	37.9	0.0	22.9	3.5	116.2	13.8	10.5	7.0	6.3	414.7	60.9	102.5	98.4	135.2	68.9		11.4	56.8	293.6
AM-106	0.0	0.0	0.1	0.3	0.0	0.1	0.1	1.0	0.1	0.1	0.1	0.0	5.5	0.6	1.1	0.7	1.8	0.7		0.2	0.6	2.9
AM-107	0.5	0.2	2.9	13.1	0.0	4.0	1.7	43.8	5.0	6.5	4.1	1.8	144.3	20.7	32.9	25.5	58.4	31.4		8.2	37.3	157.7
AP-101	0.0	0.0	0.2	0.7	0.0	0.4	0.2	3.1	0.3	0.3	0.2	0.1	10.0	1.2	2.0	1.3	2.4	1.3		0.3	1.9	8.4
AP-102	0.6	0.2	2.7	12.5	0.0	4.1	2.3	38.8	4.4	4.1	2.6	1.7	204.5	23.3	39.0	24.2	55.2	28.9		5.7	22.9	106.9
AP-103	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.7	0.1	0.1	0.0	0.0	2.5	0.3	0.6	0.3	0.6	0.3		0.1	0.4	1.9
AP-104																						
AP-105	0.3	0.1	1.5	8.7	0.0	4.0	1.8	31.3	2.8	3.4	2.0	1.0	102.7	11.8	20.3	13.8	24.0	13.4		2.9	18.9	84.7
AP-106	0.1	0.0	0.8	2.4	0.0	1.5	0.8	11.3	0.8	1.2	0.7	0.4	37.3	4.3	7.4	5.0	8.7	4.9		1.1	6.8	30.4
AP-107																						
AP-108	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.5	0.1	0.1	0.1	0.1	0.1		0.0	0.1	0.3
AW-101	0.7	0.3	3.9	17.7	0.0	14.8	2.7	82.6	7.5	10.8	6.1	2.8	292.2	32.5	58.5	40.4	69.7	39.6		7.8	58.0	263.6
AW-102	0.2	0.1	1.2	14.0	0.0	2.9	1.3	23.7	2.0	2.4	1.5	0.8	87.5	10.8	18.4	10.8	18.2	10.1		2.4	13.7	81.9
AW-103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.1
AW-104	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.1
AW-105	0.1	0.0	0.5	2.2	0.0	1.5	0.4	11.5	0.9	1.1	0.7	0.3	33.9	3.9	6.8	4.8	8.1	4.5		0.9	8.4	28.6
AW-106	0.2	0.1	1.3	5.7	0.0	3.2	1.4	28.2	2.2	2.5	1.8	0.9	99.5	14.3	18.3	11.9	19.8	11.0		2.2	14.8	67.2
AY-101	0.0	0.0	0.3	1.0	0.0	0.5	0.5	8.0	0.5	1.0	0.5	0.3	16.1	7.3	3.2	2.2	4.8	3.3		0.5	5.1	21.5
AY-102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.1
AZ-101	0.0	0.0	0.2	0.7	0.0	0.2	0.1	2.3	0.3	0.3	0.2	0.1	11.5	1.4	2.2	0.9	1.6	0.4		0.4	1.8	7.0
AZ-102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.1	0.1	0.1		0.0	0.1	0.3
BY-101	2.1	0.8	9.9	47.9	0.0	14.7	11.2	141.8	18.2	14.7	9.9	6.3	872.7	87.7	132.4	88.1	137.0	73.5		21.8	80.4	377.7
BY-102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
BY-103	1.0	0.3	4.8	23.1	0.0	8.0	4.7	86.8	7.8	6.8	4.6	3.0	352.2	41.7	68.2	42.4	66.9	35.5		8.9	37.7	178.2
COWD																						
COWP	343.2	1.2	5818.7	6365.9	8174.2	21083.5	1463.9	1684.0	11343.2	18165.3	10413.3	2531.8										
COR	0.0	0.0	4.7	3.4	0.4	71.1	0.0	270.1	55.9	23.5	5.7	3.9	2738.9	1818.2	15.7	25.1	20288.0	6854.9		825.3	258.8	1431.0
GROUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.1	0.0		0.0	0.1	0.3
LEAF	92.0	0.0	14.1	5.4	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	132.5	68.0	6.0	38.0	0.9	0.4		0.0	0.0	0.6
PCOWD																						
R202S														364.5	236.3	4.5	15.3					
RCOWD																						
RNR	0.0	0.0	0.2	0.0	0.0	1.9		3.8	0.8	2.0	0.3											
TfFeCN	41.9		313.8	152.0	6.5	413.3		5349.3	1142.8		576.7											
UNK	0.0		0.5	0.3	0.1	13.3		25.8	2.4		0.0											
UR	22823.5	12048.5	165.7	656.7	7.5			1007.3	787.8	106.8												
VENT																						
A1COND																						
A2COND																						
BCOND																						
BYCOND																						
B1COND																						
B2COND																						
T1COND																						
T2COND																						
A1-in	21.4	6.6	166.7	629.4	0.2	181.8	81.7	2230.3	240.1	493.1	267.4	67.5	6085.8	852.4	1314.1	960.2	3485.7	1842.4		383.5	2702.2	10649.6
A2-in																						
B-in			23872.7	9449.4	1112.5	1317.3		9560.0														
BY-in	4.7	1.1	235.7	82.5	0.4	44.6	3.3	1187.4	444.8	2152.9	1527.0	0.8	18.9	6.8	10.9	13.3	1952.2	1546.0		75.4	8071.9	28008.0
B1-in	154.3	45.7	706.0	3125.3	0.6	1830.5	338.4	10549.2	1282.8	943.5	678.1	541.4	189954.1	8895.0	24305.1	8555.9	10884.4	5759.5		1780.6	5583.4	28012.5
B2-in	84.1	21.9	375.3	1784.6	0.3	515.8	247.4	5150.9	586.0	485.3	324.9	231.6	23425.8	3075.8	4949.8	3248.9	4821.1	2568.6		872.6	2615.9	12686.5

WSTRS3.45b	MW1	MW2	1C1	1C2	2C1	2C2	224	UR/TBP	PFeCN1	PFeCN2	TFaCN	1CFaCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2
T1-in	1434.8		20847.2	10846.9	982.5			9005.8				180.5										
T2-in	613.1	294.7	2813.3	19138.2	2.2	5259.5	2.2	57788.1	8049.4	3451.0	2500.0	3608.1	86582.6	27489.5	39863.7	49900.8	66816.5	33258.9		1249.0	18559.5	104431.9
STATLOSS																						
B-bot	6.7		1848.1	1143.9	78.5	384.3		4481.8	172.2													
BY-bot	1.6	0.5	73.9	38.0	0.2	19.8	5.5	513.2	145.4	711.0	417.5	2.4	123.9	29.7	38.5	37.1	579.8	712.4		159.8	3714.8	13313.3
S1-bot																						
S2-bot																						
T1-bot	319.3		1848.8	2246.0	78.7			6473.1				1033.4										
T2-bot																						
A1-bot																						
R-bot	0.0	0.0	0.7	0.8	0.0	0.1		5.7	1.8	6.2	6.2	0.1	8534.6	6712.3	480.1	435.3	7.6	3.7		1.8	30.4	243.8
swpump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0

WSTRS3.45h	CWZ1	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SNR	SNR'	CSR	DE	CEM	NIT	Sat Shury	DW	N	B'	B-SRCh	BL'	T1-SRCh
A-101	8.5	12.4	24.9	52.4	37.1	8.8	2.5	5.8	93.8	33.0	217.7	163.3		426.3			14.7		127.3	44.2		12.5		78.2
A-102	0.2	0.2	0.4	1.0	0.7	0.2	0.0	0.1	2.0	0.6	4.2	3.4		8.0			0.3		2.3	0.8		0.3		1.4
A-103	3.2	4.7	9.1	20.7	13.8	3.6	1.0	2.2	40.6	13.2	86.9	69.7		185.3			5.5		47.4	16.6		5.3		29.4
A-104																								
A-105		0.0	0.0	0.0						0.0	0.0			0.0					0.0			0.0		
A-106	1.2	1.7	3.6	5.8	4.8	0.9	0.3	0.6	5.5	3.0	21.8	12.0		50.8			2.3		16.5	5.5		1.4		10.7
AZ-101	8.6	9.7	19.0	43.0	28.8	7.3	2.0	4.8	85.0	25.3	178.8	142.2		342.8			11.5		99.3	34.7		11.0		61.5
AZ-102	0.4	0.6	1.4	2.3	1.8	0.4	0.1	0.2	2.5	2.7	8.8	5.3		19.8			0.9		8.3	2.1		0.6		4.0
AZ-103	0.9	1.3	2.7	5.3	3.7	0.9	0.2	0.6	6.1	2.5	28.2	15.5		43.4			1.6		12.6	4.2		1.3		8.1
AZ-104																								
B-101																								
B-102	0.0	0.0	0.0	0.2		0.0	0.0	0.0	0.0	0.0	0.0			0.3					0.0	0.0		0.4		0.0
B-103	0.0	0.0	0.0	0.1		0.0	0.0	0.0	0.0	0.0	0.1			0.3					0.0	0.0		0.2		0.0
B-104																						5.2		
B-105	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0			0.0					0.0	0.0		0.0		0.0
B-106	0.0	0.0	0.0	0.1		0.0	0.0	0.0	0.0	0.0	0.0			0.1					0.0	0.0		0.3		0.0
B-107		0.0																				0.0		
B-108	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0			0.0					0.0	0.0		0.0		0.0
B-109																								
B-110																								
B-111		0.0	0.0	0.0		0.0	0.0			0.0	0.0			0.0					0.0			0.0		
B-112	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0			0.0					0.0	0.0		0.0		0.0
B-201																								
B-202										7.2										21.3				
B-203																				0.0				
B-204																				0.9				
BX-101																								
BX-102		0.0	0.0	3.8		1.0	0.0			1.7	0.2			2.3					0.0			0.0		
BX-103	0.0	0.0	0.0	0.1		0.0	0.0	0.0	0.2	0.0	0.2	0.1		1.1					0.0	0.0		0.0		0.0
BX-104	0.8	0.8	1.8	3.8		3.8	0.5	0.2	0.4	4.8	0.9	15.0	8.4	35.7			1.3		12.7	4.8		1.1		7.8
BX-105	0.1	0.1	0.1	0.3		0.3	0.0	0.0	0.0	0.4	0.1	1.1	0.7	2.6			0.1		0.9	0.3		0.1		0.5
BX-106	0.0	0.0	0.1	0.4		0.1	0.0	0.0	0.8	0.1	0.6	0.4		0.6					0.0	0.0		0.1		0.0
BX-107		0.0	0.0			0.0	0.0							0.7					0.0			0.0		
BX-108																								
BX-109		0.0												0.0					0.0			0.0		
BX-110	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0			0.0					0.0	0.0		0.0		0.0
BX-111	0.0	0.0	0.0	0.2		0.0	0.0	0.0	0.1	0.0	0.1	0.1		0.3					0.0	0.0		0.0		0.0
BX-112	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.1	0.0	0.1	0.1		0.1					0.0	0.0		0.0		0.0
BY-101																								
BY-102	0.0	0.0	0.1	0.2		0.0	0.0	0.0	0.9	0.1	0.7	1.1		0.9					0.0	0.0		0.0		0.0
BY-103																								
BY-104																								
BY-105																								
BY-106																								
BY-107	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0			0.0					0.0	0.0		0.0		0.0
BY-108	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0			0.0					0.0	0.0		0.0		0.0
BY-109																								
BY-110	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0		0.0	0.0		0.0		0.0
BY-111																								
BY-112	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0			0.0					0.0	0.0		0.0		0.0
C-101																								

WSTRE3.45b	CWZr1	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	B	BL	SRR	SRR'	CSR	DE	CEM	NIT	Sat Slurry	DW	N	B'	B-SnCr	M'	T1-SnCr
C-102		0.0	0.0	0.0		0.0	0.0																	
C-103	0.0	0.2	0.3	2.8	0.0	2.2	0.1	0.1	3.9	0.4	4.5	37.0	9.3				0.0		0.5	0.8	0.2		0.1	
C-104	0.0	0.1	0.1	0.2	0.2	0.1	0.0	0.0	0.2	0.1	0.8	0.8	1.7				0.1		0.5	0.2			0.3	
C-105	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				0.0		0.0	0.0			0.0	
C-106		0.0	0.0	0.0		0.0	0.0			0.0	5.0			0.0					0.0					
C-107												1.1												
C-108																								
C-109																								
C-110		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0			0.0					0.0			0.0		
C-111		0.0				0.0																		
C-112		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0			0.0					0.0			0.0		
C-201						0.9																		
C-202						38.5																		
C-203																								
C-204																								
S-101	3.3	3.5	5.8	18.2	13.4	2.5	0.7	1.7	3.8	2.5	52.8	16.5		160.3			6.0		48.6	20.7		5.0		30.7
S-102	8.6	8.1	14.1	36.4	35.4	4.7	1.8	3.9	11.3	5.8	115.5	39.1		336.7			58.4		118.8	39.3		9.1		76.1
S-103	5.7	5.4	9.5	24.2	24.9	3.0	1.0	2.6	6.8	3.8	75.1	25.1		215.2			34.4		78.6	24.3		6.1		52.8
S-104																								
S-105	5.6	3.5	8.7	15.3	0.8	1.9	0.4	1.8	0.1	1.8	41.1	3.4		222.8					76.8	32.2		0.6		48.1
S-106	5.0	4.5	8.1	18.0	0.5	2.1	0.6	1.7	0.7	2.1	82.9	4.0		323.5					82.1	50.8		0.7		42.2
S-107	1.5	1.8	2.9	6.8	6.8	1.0	0.3	0.7	9.1	1.8	27.5	16.1		82.8			2.2		22.8	7.9		2.0		13.7
S-108	7.2	4.6	11.2	20.8	0.8	2.8	0.6	2.3	0.2	2.6	65.6	5.3		349.6					113.5	58.5		0.8		60.0
S-109	6.8	4.4	10.7	21.8	0.7	2.6	0.6	2.3	0.2	2.6	75.1	5.0		385.7					116.0	64.7		0.8		57.1
S-110	3.1	4.0	5.3	21.1	8.4	2.6	1.0	2.2	1.8	2.9	70.8	12.8		235.6					83.2	25.3		7.4		27.1
S-111	6.5	6.6	10.8	28.4	8.3	4.1	1.0	2.8	4.9	3.8	117.0	17.7		415.6					117.0	82.7		8.2		56.4
S-112	7.8	4.9	11.8	22.3	0.9	2.9	0.6	2.4	0.2	2.7	70.3	5.8		372.4					118.8	82.3		1.0		63.2
SX-101	1.3	1.2	2.2	5.6	5.2	0.7	0.2	0.6	1.6	0.9	18.1	5.9		53.4			2.7		15.5	6.4		1.4		11.5
SX-102	11.7	12.3	18.7	58.3	51.3	8.5	2.7	6.2	16.2	9.4	187.6	83.3		542.9			0.1		171.2	84.4		22.2		108.8
SX-103	14.0	13.5	23.4	80.2	66.2	7.7	2.7	8.5	19.6	9.9	196.5	73.4		508.8			1.5		183.1	87.0		18.0		131.8
SX-104	9.1	9.8	15.4	44.4	38.1	6.9	2.0	4.7	11.1	6.9	152.4	49.2		433.1			5.5		136.0	56.8		14.1		84.3
SX-105	12.8	13.8	21.4	64.7	51.6	10.8	3.0	6.8	15.9	10.0	228.3	72.6		659.8			4.8		198.0	90.0		21.7		116.7
SX-106	11.8	11.0	19.3	49.3	51.2	6.1	2.1	5.3	13.8	7.8	152.3	51.0		435.0			73.8		159.7	48.7		12.4		107.9
SX-107																								
SX-108																								
SX-109																								
SX-110																								
SX-111	0.0	0.0	0.0	0.2		0.0	0.0	0.0		0.0	0.2			5.5					0.0			0.0		0.0
SX-112																								
SX-113																								
SX-114	0.0	0.0	0.0	0.3		0.0	0.0	0.0		0.0	3.5			27.2					0.0			0.0		0.0
SX-115																								
U-101																								
U-102	8.1	8.5	15.6	36.9	39.7	4.4	1.6	3.8	10.9	5.7	109.5	41.4		283.9			14.3		118.0	30.9		9.0		82.2
U-103	10.8	10.2	17.9	45.3	52.8	5.6	2.0	4.9	11.6	7.2	137.5	51.4		383.3			17.9		142.8	39.5		11.2		101.9
U-104	7.1	5.6	15.8	17.6		0.2	0.3			0.1				0.0					62.4			0.2		37.2
U-105	10.3	8.8	17.0	43.9	49.9	5.6	1.9	4.8	12.0	7.1	138.5	52.0		358.6			2.6		137.7	39.8		11.6		86.6
U-106	3.7	4.5	6.4	21.9	16.1	3.8	1.1	2.3	6.1	3.5	93.5	29.9		223.1					81.8	30.0		9.7		34.5
U-107	7.4	7.0	12.3	31.5	32.6	4.0	1.4	3.4	9.0	5.0	97.8	33.0		278.8			39.3		101.8	31.4		8.1		68.6
U-108	7.8	8.4	13.5	44.2	28.6	8.4	2.1	4.6	12.5	6.8	163.2	51.4		483.9					155.6	80.0		18.6		71.4
U-109	9.0	10.8	15.9	47.0	31.6	9.0	2.2	4.8	14.0	7.2	181.1	62.9		508.8					136.4	71.7		17.1		78.4

[illegible]

WSTRS3.45b	CWZr1	OWW1	OWW2	OWW3	Z	HS	TH1	TH2	AR	S	BL	SRR	SRR'	CSR	DE	CEM	NIT	Salt Shury	DW	N	B'	S-SrCk	BL'	T1-SrCk
AN-106	27.6	28.8	58.1	113.1	357.1	12.1	4.4	10.9	102.2	58.1	1079.6	200.3		676.2			28.8		961.6	87.4		17.5		236.4
AN-106	0.2	0.3	0.6	1.1	1.3	0.2	0.0	0.1	1.0	0.6	4.9	2.1		8.8			0.4		4.3	17.6		0.2		2.0
AN-107	8.4	12.4	25.6	59.1	87.9	9.9	2.8	6.3	135.3	46.3	337.0	222.0		362.1			12.3		262.6	26.2		11.9		76.3
AP-101	0.4	0.5	0.9	3.2	13.5	0.4	0.1	0.3	2.2	0.9	75.1	4.4		17.8			0.9		29.7	2.7		1.2		3.8
AP-102	8.0	10.9	23.9	39.0	46.7	5.6	1.7	4.1	36.5	20.8	182.4	79.2		326.6			14.7		159.3	703.9		8.9		73.6
AP-103	0.1	0.1	0.2	0.7	68.1	0.1	0.0	0.1	0.6	0.2	371.9	1.2		4.3			0.2		221.3	0.6		0.3		1.0
AP-104																			15.6					
AP-105	4.4	5.4	9.9	32.3	140.1	4.3	1.5	3.2	22.5	8.8	788.3	45.3		179.9			8.9		310.2	27.2		12.4		39.2
AP-106	1.6	2.0	3.5	11.6	71.7	1.5	0.5	1.2	8.1	3.2	519.2	16.4		84.8			3.3		182.0	8.9		4.4		14.3
AP-107																								
AP-108	0.0	0.0	0.0	0.1	8.1	0.0	0.0	0.0	0.1	0.0	457.6	0.2		0.8			0.0		90.9	0.1		0.0		0.2
AW-101	12.7	16.0	28.5	105.1	304.4	13.3	4.6	10.2	84.8	26.9	961.9	126.9		474.5			13.1		579.4	91.5		39.9		110.1
AW-102	3.5	4.1	7.2	23.4	80.8	3.2	1.0	2.4	15.1	6.0	513.2	32.7		143.4			5.7		204.4	20.9		8.6		31.3
AW-103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0		0.1			0.0		0.1	0.0		0.0		0.0
AW-104	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.1		0.2			0.0		0.2	0.0		0.0		0.0
AW-105	1.5	1.8	3.3	11.2	50.9	1.5	0.5	1.1	7.9	3.1	221.0	15.8		57.2			2.1		99.9	9.7		4.1		13.0
AW-108	3.8	4.4	7.9	25.5	102.9	3.4	1.1	2.6	16.6	6.7	647.6	34.7		153.0			7.8		232.7	22.7		9.4		34.6
AY-101	0.7	1.2	1.9	7.8	6.4	1.1	0.4	0.8	7.5	4.6	42.6	153.9		369.5			0.9		19.6	3.6		6.4		7.5
AY-102	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	290.9	0.1		0.2			0.0		78.8	0.0		0.0		0.0
AZ-101	0.5	0.6	1.2	2.5	2.2	0.4	0.1	0.3	4.0	1.6	20.8	7.1		20.8			0.8		7.2	2.2		0.6		4.2
AZ-102	0.0	0.0	0.0	0.1	2.2	0.0	0.0	0.0	0.2	0.0	25.4	0.2		0.6			0.0		2.6	0.2		0.0		0.2
SY-101	29.7	29.9	51.0	134.6	134.8	18.5	6.0	14.4	85.2	23.6	450.9	181.6		1201.1			114.8		423.7	142.1		40.4		278.4
SY-102	0.0	0.0	0.0	0.0	100.6	0.0	0.0	0.0	0.0	0.0	0.2	0.0		0.1			0.0		317.0	0.0		0.0		0.0
SY-103	14.1	14.4	25.6	64.2	61.9	8.7	2.8	6.9	39.6	14.8	218.9	96.3		568.2			83.3		200.4	65.1		18.9		130.5
COND																			280.6					417.3
CRB		12.9																						
CSR	7.4	3094.4	7982.0	652.2	0.0	3.4	11.3	0.4	4100.8	5435.2	588.7	88.4		892.9			0.0		697.2	0.2		124.9		228.6
GROUT	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.1	0.0	2.8	0.2		0.7			0.0		1.2	726.0		0.0		0.1
LEAK	0.6	0.1	0.4	0.0		0.0	0.0	0.0		0.0	20.2			67.3					7.6			0.0		0.5
PCOND																								
R202S																								
RCOND																								
SRR		86.7	263.3	20.9		0.1	0.7		84.6	280.7	1.1	35.6		62.8					12.8			2.6		
TFsCN																			7.5			2290.7		
UNK		461.8	1685.7	154.0					159.1	4715.3	1.2	42.0		58.1					95.2			18.2		
UR																			106.2					
VENT																								
A1COND																								
A2COND																								
BCOND																								
BYCOND																								
S1COND																								
S2COND																								
T1COND																								
T2COND																								
A1-4n	321.0	776.4	1575.4	3956.2	1551.8	634.1	215.5	457.4	12217.4	2533.5	13236.4	15709.1		21710.6			433.4		4470.2	1207.6		846.6		2966.9
A2-4n																								
B-4n																								
BY-4n	3.9	975.6	91.8	4772.6		815.0	930.6	375.8	11.1	392.8	331.9			4878.2					536.4	115.4		1107.6		29.1
S1-4n	2475.0	2269.9	4138.7	10190.8	2417.9	1529.5	393.8	1059.4	2421.5	1481.7	36875.0	8067.3		135272.5					40143.5	21821.3		2083.1		21185.4
S2-4n	1097.9	1029.6	1818.0	4587.4	6107.3	563.4	198.1	496.3	1312.9	739.1	14291.4	6218.1		28360.6			1319.3		14748.5	4219.1		1140.4		10285.8

WSTRES.458	CWZ/1	QWW1	QWW2	QWW3	Z	H8	TH1	TH2	AR	B	ML	SPR	BRN	CSR	DE	CEM	HIT	3-4d Shurt	DW	N	B	P-SRCH	ML	T1-SRCH
T1-4	18035.0	12132.2	30170.6	43135.1	25278.4	1650.2	180.1	3781.2	355.2	4874.0	36287.3	2888.1	117057.8	180486.3	68.1									70.0
T2-4																								134318.8
STATLOSS																								
8-bet																								
91-bet	11.1	385.8	84.0	4741.4	1.3	858.4	303.6	432.2	21.0	471.5	504.1	4.4	8758.7	481.7	328.5							701.9		82.9
91-bet																								
92-bet																								
T1-bet																								
T2-bet																								
A1-bet																								
R1-bet	0.5	3.9	0.2	180.8		3.2	2.1	8.9		4.9	89.8		358.8									3.5		8.2
compump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

WSTRS3.45b	R in	RSRCh	T2 in	T2-SHCh	BY in	BY-SHCh	S1 in	S1-SHCh	S2 in	S2-SHCh	A1 in	A1-SHCh	A2 in	A2-SHCh	P3	PL2	CWZr2	BP /Cpds	BP /RCpds	PASf	WTR	GAS
A-101		70.5				317.4															1266.0	8.1
A-102		1.3				7.1															23.3	0.1
A-103		28.3				146.1															497.2	2.0
A-104																						
A-105																					0.0	
A-106		9.9				19.4															150.8	0.0
AX-101		55.0				300.2															1003.9	4.4
AX-102		3.7				8.6															80.8	0.0
AX-103		7.0				33.3															180.5	0.0
AX-104																						
B-101																						
B-102		0.0				0.1															0.2	
B-103		0.0																			0.2	
B-104																					0.8	
B-105		0.0																			0.0	
B-106		0.0																			0.6	
B-107																					0.1	
B-108		0.0																			0.0	
B-109						35.2																
B-110						0.0																
B-111						1.0															0.0	
B-112		0.0				2.3															0.0	
B-201																						
B-202																						
B-203																						
B-204																						
EX-101						0.8																
EX-102																					0.5	
EX-103		0.0				1.6															0.9	
EX-104		7.0				0.5															75.8	1.0
EX-105		0.8				0.7															8.3	0.1
EX-106		0.0				7.0															3.3	
EX-107																					0.0	
EX-108																						
EX-109																					0.0	
EX-110		0.0				0.0															0.0	
EX-111		0.0				0.9															0.8	
EX-112		0.0				0.7															0.4	
BY-101																						
BY-102		0.0				8.8															3.1	
BY-103						0.0																
BY-104																						
BY-105						0.0																
BY-106																						
BY-107		0.0				0.0															0.0	
BY-108		0.0				0.0															0.0	
BY-109																						
BY-110		0.0				0.0															0.0	
BY-111																						
BY-112		0.0				0.0															0.0	
C-101																						

WSTRE3.45b	R In	RShCh	T2 In	T2-ShCh	BY In	BY-ShCh	S1 In	S1-ShCh	S2 In	S2-ShStr	A1 In	A1-ShCh	A2 In	A2-ShStr	P3	PL2	CWZ/2	BP /Cpln	BP /NCpln	PASF	WTR	GAS
C-102							0.0														0.0	
C-103		0.0					18.2														54.8	
C-104		0.3					0.9														5.5	
C-105		0.0					0.0														0.0	
C-106																					0.0	
C-107																						
C-108																						
C-109																						
C-110																					0.0	
C-111																					0.0	
C-112																					0.0	
C-201																						
C-202																						
C-203																						
C-204																						
S-101		32.4					1.3														340.7	0.0
S-102		70.7					2.7														734.2	0.1
S-103		42.9					2.2														504.7	0.3
S-104		0.6																			0.0	
S-105		54.1																			375.3	
S-106		129.4																			862.8	
S-107		11.9					0.7														124.9	2.4
S-108		80.8																			848.7	
S-109		79.4																			745.6	
S-110		62.3					0.4														355.3	
S-111		136.0					2.7														778.4	
S-112		85.7																			686.7	
SX-101		11.6					0.4														129.2	
SX-102		94.5					13.9														809.9	
SX-103		90.9					6.1														828.9	
SX-104		83.1					4.7														808.4	
SX-105		123.3					5.7														1167.8	
SX-106		86.3					4.5														1070.6	0.8
SX-107		42.4																			60.8	
SX-108		131.9																			24.0	
SX-109		38.9																			7.4	
SX-110																					30.0	
SX-111		0.3																			0.4	
SX-112		12.6																			27.8	
SX-113																					32.8	
SX-114		4.2																			16.8	
SX-115																						
U-101																						
U-102		50.7					3.3														480.0	
U-103		65.3					3.8														804.2	
U-104		3.0																			38.8	
U-105		63.8					4.4														682.3	
U-106		38.5					6.0														354.0	
U-107		55.1					3.0														638.6	0.4
U-108		89.5					3.9														786.6	
U-109		84.7					1.5														817.5	

WSTRS3.45b	R in	RSnCh	T2 in	T2-SnCh	BY in	BY-SnCh	S1 in	S1-SnCh	S2 in	S2-SnCh	A1 in	A1-SnCh	A2 in	A2-SnCh	P3	PL2	CWZr2	BP /Cpts	BP /NCpts	PASF	WTR	GAS
U-110																						
U-111		35.8				1.5															388.1	0.1
U-112																						
U-201																					0.0	
U-202																						
U-203																					0.8	
U-204																						
T-101		1.4																			13.8	
T-102																						
T-103		0.0																			0.2	
T-104		0.2																			1.8	
T-105																						
T-106																						
T-107																						
T-108																						
T-109																						
T-110																					0.9	
T-111																					0.2	
T-112																						
T-201																						
T-202																						
T-203																						
T-204																						
TX-101		1.2				0.0															12.7	
TX-102		14.3																			121.2	
TX-103		8.1																			64.9	
TX-104		2.9																			25.6	
TX-105		45.1																			354.1	
TX-106		22.8																			192.8	
TX-107		0.3																			2.9	
TX-108		6.9																			55.0	
TX-109		0.0																			0.0	
TX-110		29.2																			244.2	
TX-111		22.2																			186.3	
TX-112		46.8																			314.2	
TX-113		32.2																			183.5	
TX-114		39.8																			226.1	
TX-115		43.2																			295.0	
TX-116		8.0																			76.9	
TX-117		14.0																			144.0	
TX-118		14.1				0.2															168.5	
TY-101		0.0																			0.0	
TY-102		2.3																			18.5	
TY-103		3.0																			20.6	
TY-104																						
TY-105																						
TY-106																						
AN-101		36.4				46.1										0.0	47.8	22.8			610.6	0.1
AN-102		113.0				502.3										0.5	161.4	4.5			2393.5	2.6
AN-103		72.8				242.0										1.3	956.5	498.0			2705.4	8.0
AN-104		65.2				293.3										1.0	856.5	217.3			2003.7	5.0

WTR	S3.45b	R In	RS&Ck	T2 In	T2-S&Ck	BY In	BY-S&Ck	S1 In	S1-S&Ck	S2 In	S2-S&Ck	A1 In	A1-S&Ck	A2 In	A2-S&Ck	P3	PL2	CWZ/2	BP /Cgls	BP /NCgls	F&SF	WTR	GAS
AN-105			120.2					560.9									2.4	786.3	42.3			3933.8	13.0
AN-106			1.7					3.7									0.0	0.1	0.1			37.7	0.0
AN-107			44.7					662.4									0.5	71.4	1.1			1555.7	
AP-101			2.9					8.8									0.0	129.0	70.8			993.7	481.8
AP-102			82.9					135.4									0.1	4.5	3.3			5.0	1476.4
AP-103			0.7					2.2									25.4	32.0	15.4			41.0	619.2
AP-104																						5.1	
AP-105			29.2					89.5									0.2	1512.5	797.0			643.1	4280.4
AP-106			10.6					32.3									2.5	548.7	283.0			281.4	2052.2
AP-107																						1115.0	18.0
AP-108			0.1					0.4									14.4	86.0	1.8			112.6	423.4
AW-101			78.7					294.9									1.0	2281.2	1137.8			4101.7	28.0
AW-102			25.7					56.3									0.1	1132.1	542.2			424.5	3032.1
AW-103			0.0					0.0									0.0	10.3	220.5			71.2	0.0
AW-104			0.0					0.1									0.0	934.5	0.3			57.4	0.0
AW-105			9.5					34.0									0.1	543.7	514.0			80.9	1363.2
AW-106			33.0					68.3									0.2	1227.5	597.3			528.5	3491.7
AY-101			13.4					36.1									0.0	21.8	0.8			512.4	0.0
AY-102			0.0					0.1									4.2	1.1	0.5			0.7	359.0
AZ-101			3.8					12.4									663.4	10.8	0.0			1560.5	0.1
AZ-102			0.1					0.8									378.4	12.1	0.0			1815.2	0.0
BY-101			219.1					17.4														2221.5	9.0
BY-102			0.0					0.1									0.0	0.3	0.0			347.8	0.0
BY-103			109.0					66.8														1480.4	
COND																							
CWB																						31829.2	
CSR			2589.9					41.9														13263.8	
GROUT			0.1					0.3									0.0	4.5	2.7			0.5	271.8
LEAK			19.0																			63.0	0.0
PCOND																							
R2028			271.5																			283.3	
RCOND																							
RR																						438.7	
TF&CN																						1178.3	
UNK																						2212.4	
UR																						33345.8	
VENT																							
A1COND																							
A2COND																							
BCOND																							
BYCOND																							
S1COND																							
S2COND																							
T1COND																							
T2COND																							
A1-In			1897.1					55889.2														81414.9	41.0
A2-In																						20.1	
B-In																						428.5	
BY-In			7.1					1883.0														5888.2	
S1-In			36474.7					718.7														308345.1	
S2-In			7247.5					414.8														82866.5	1.7

WST623.456 ft In	ABSCl	T2 In	T2 SHCl	BY In	BY SHCl	S1 In	S1 SHCl	S2 In	S2 SHCl	A1 In	A1 SHCl	A2 In	A2 SHCl	P3	PL2	CWZ2	BP /Cdn	BP /mCdn	PASe	WTR	GAS
T1 In																					
T2 In	23872.0																				3245.5
STATLOSS																					174025.2
B-foot																					198.9
BY-foot	45.8																				2482.9
S1-foot																					
S2-foot																					
T1-foot																					
T2-foot																					
A1-foot	88.7																				1017.7
B-foot	0.0																				2891.8
Emergency						7.6															0.0

[illegible]

WSTR3.45b	SWLQ	UNK	assume	mmVol	supVol	tmVol	tankVol	traffic	assum trf.	Max. TOC wt%	date of Max. TOC	TOC wt% now	Max. Haz. Index	Haz. Ind. Now
C-102		0.0	0.0	0.0	0.0	423	423	19819	1790	0.85	1976.20		1.65	
C-103		23.4	103.9	189.4	133.0	62	195	10292	1113	2.48	1975.28	1.72	6.32	4.36
C-104		1.8	3.8	18.8	5.0	290	295	25290	1484	6.88	1975.71	1.08	16.68	1.27
C-105		0.0	0.0	0.0	0.0	150	150	26291	1758	0.98	1985.28		2.40	
C-106		27.0	4.9	32.0	32.0	197	229	11045	2988	0.70	1976.08	0.09	2.23	0.88
C-107			1.1	1.1	0.0	275	275	4374	393	5.74	1984.03		19.05	
C-108		0.0		0.0	0.0	86	86	6799	2104	0.77	1966.28		2.07	
C-109		8.0		8.0	4.0	82	66	4970	1041	0.87	1970.03		2.34	
C-110		0.0	0.0	0.0	0.0	187	187	3730		0.71	1956.72		3.88	
C-111		0.0	0.0	0.0	0.0	57	57	6059	1207	1.15	1970.47		2.47	
C-112		0.0	0.0	0.0	0.0	104	104	6778	1051	0.35	1974.22		0.84	
C-201		2.0		2.0	0.0	2	2	277	57	2.54	1965.97		11.18	
C-202						1	1	285	285	2.31	1956.47		11.18	
C-203		4.3	0.8	5.2	0.0	5	5	204	202	9.56	1955.97		11.18	
C-204		22.7	38.5	61.3	0.0	3	3	255	202	3.69	1955.97		11.18	
S-101		46.8	210.7	1089.8	216.0	211	427	7039	3187	0.89	1979.07	0.73	0.85	0.85
S-102		99.8	295.0	2428.0	545.0	4	548	90240	78998	2.28	1976.81	0.87	6.37	0.85
S-103		76.3	234.4	1800.0	238.0	9	248	9191	8527	1.81	1976.82	0.87	1.45	0.88
S-104		1.1	0.6	1.7	1.0	293	294	3497	852	0.01	1974.87	0.01	0.01	0.01
S-105		79.2	389.0	1703.2	406.0	2	407	2966	2822	0.29	1974.87	0.29	0.25	0.25
S-106		96.9	437.3	2208.4	447.0	32	479	3778	3596	0.36	1976.72	0.37	0.30	0.29
S-107		46.5	81.9	478.5	122.1	254	378	18355	8772	1.19	1980.53	0.94	1.21	1.04
S-108		112.6	477.6	2480.5	497.0	5	502	3485	3490	0.36	1974.60	0.35	0.28	0.28
S-109		98.8	483.0	2541.7	494.0	13	507	2924	2937	0.37	1974.85	0.37	0.30	0.30
S-110		42.8	276.7	1303.6	277.0	113	390	12899	1868	0.81	1977.35	0.81	0.80	0.50
S-111		95.0	453.9	2660.1	480.0	78	538	4072	4144	0.56	1985.57	0.66	0.41	0.41
S-112		114.0	504.1	2822.3	517.0	6	523	2550	2548	0.36	1975.85	0.36	0.28	0.28
SX-101		78.5	128.8	451.5	148.0	310	458	7141	1417	0.67	1980.34	0.44	0.84	0.83
SX-102		133.6	430.4	3212.1	484.0	59	543	15087	5491	1.05	1976.87	1.03	0.72	0.72
SX-103		119.1	538.5	3281.6	540.0	112	852	9691	4835	1.07	1978.47	1.01	0.76	0.76
SX-104		118.8	435.3	2785.8	445.0	199	614	6276	3238	1.08	1976.85	0.92	0.72	0.69
SX-105		155.7	617.1	4028.2	628.0	55	663	11309	4470	1.07	1976.85	0.96	0.78	0.70
SX-106		156.4	525.2	3296.8	537.0	1	538	33517	10318	2.32	1978.47	0.81	7.25	0.68
SX-107		0.0	67.8	100.4	0.0	104	104	4387	737	0.02	1974.83		0.01	
SX-108		8.2	153.9	187.7	0.0	87	87	4699	742	0.02	1968.72		0.01	
SX-109		2.9	45.7	62.7	0.0	250	250	2894	868	0.02	1973.87		0.01	
SX-110			30.0	30.0	0.0	82	82	7146	506	0.37	1979.26		0.83	
SX-111		0.2	0.5	7.2	0.0	125	125	6219	991	0.69	1974.47		0.88	
SX-112		26.3	17.3	114.4	0.0	82	82	3782	806	0.01	1965.85		0.01	
SX-113		28.1	3.3	74.3	0.0	31	31	724						
SX-114		0.7	13.7	54.3	0.0	181	181	7926	881	0.59	1973.22		0.57	
SX-115		0.0		0.0	0.0	12	12	2044	279					
U-101		3.0		3.0	3.0	22	25	5280	906	0.38	1980.22		0.13	
U-102		73.5	329.3	1952.4	331.0	43	374	6899	5174	1.18	1978.04	0.86	1.82	0.73
U-103		132.0	389.6	2482.8	438.0	32	488	10152	5905	1.18	1975.80	0.82	1.94	0.72
U-104		25.5	85.1	410.0	43.0	79	122	3584	681	0.24	1978.72	0.20	0.13	0.13
U-105		100.7	374.0	2370.5	386.0	32	418	9044	4905	1.35	1975.60	1.00	1.47	0.74
U-106		82.8	188.0	1318.8	200.0	26	226	4848	2887	1.28	1978.10	1.13	1.83	0.80
U-107		114.5	309.0	2087.9	330.0	76	406	18448	4819	1.01	1978.48	0.84	0.78	0.66
U-108		132.8	361.2	2841.5	439.0	28	468	8257	4189	1.02	1977.49	0.89	0.71	0.71
U-109		136.1	395.6	2980.1	415.0	48	463	6616	3688	1.18	1978.10	1.13	0.76	0.76

WSTR3.45b	SWLQ	UNK	assume	ammVol	supVol	timVol	tankVol	traffic	assum trf.	Max. TOC wt%	date of Max. TOC	TOC wt% now	Max. Hag. Index	Max. Ind. New
U-110		0.0		0.0	0.0	186	186	4112	100					
U-111		69.1	283.0	1266.2	303.0	26	329	8525	4334	1.33	1978.10	0.64	1.23	0.66
U-112		4.0		4.0	4.0	45	49	959	964					
U-201		1.0	0.0	1.0	1.0	4	5	45						
U-202		1.0		1.0	1.0	4	5	47						
U-203		0.5	0.4	4.0	1.0	2	3	44						
U-204		1.0		1.0	1.0	2	3	13						
T-101		35.1	23.2	120.8	65.0	37	102	6240	201	0.56	1977.73	0.35	0.78	0.78
T-102		13.0		13.0	13.0	19	32	3113	2198	0.34	1972.73		0.66	
T-103		8.1	0.2	9.1	9.0	18	27	5174	1071	0.32	1973.23	0.04	0.63	0.62
T-104		1.7	1.0	8.8	3.0	442	445	3496	36	0.76	1978.60	0.57	0.85	0.85
T-105		0.0		0.0	0.0	88	88	6087	3137	1.76	1980.48		0.72	
T-106		7.0		7.0	2.0	19	21	3173	2205	0.36	1974.53		0.64	
T-107		9.0		9.0	8.0	171	180	5011	282	0.58	1976.48		0.82	
T-108		0.0		0.0	0.0	44	44	4285	3026	0.28	1974.48		0.61	
T-109						58	58	2465	1696	0.24	1973.73		0.51	
T-110		0.7		3.4	3.1	376	379	22535		0.00	1953.01	0.00	0.02	0.00
T-111		2.2	0.7	2.9	2.1	456	458	21507	21983	0.00	1953.03	0.00	0.01	0.00
T-112		8.0		8.0	7.0	60	67	28432	23894	0.75	1977.99		0.53	
T-201		1.0		1.0	1.0	28	29	65		0.01	1976.73		0.02	
T-202		0.6		0.0	0.0	21	21	87	118	0.00	1968.23		0.02	
T-203						35	35	173		0.03	1977.73		0.02	
T-204		0.0		0.0	0.0	38	38	55		0.00	1973.48		0.02	
TX-101		2.3	10.1	39.8	11.0	76	87	26338	8623	2.55	1975.53	0.52	4.42	0.60
TX-102		23.8	211.5	812.4	215.0	2	217	11755	9003	0.88	1975.60	0.88	0.90	0.89
TX-103		85.6	139.6	400.0	154.0	3	167	13068	10102	0.43	1975.35	0.37	0.56	0.56
TX-104		27.8	47.4	198.4	47.0	18	65	5457	3854	1.27	1979.23	0.84	0.98	0.96
TX-105		78.9	585.0	2421.1	601.0	8	609	9957	5135	0.37	1973.10	0.35	0.41	0.34
TX-106		38.7	334.4	1873.8	336.5	5	341	14806	10883	0.85	1976.48	0.82	0.85	0.82
TX-107		22.2	5.4	46.3	28.0	8	36	6221	2584	0.96	1975.85	0.23	1.01	0.84
TX-108		48.5	102.3	407.6	128.0	6	134	10289	8472	0.43	1976.88	0.32	0.42	0.39
TX-109		0.0	0.0	0.2	0.0	384	384	7831	1947	1.42	1982.26		1.38	
TX-110		71.4	410.8	1653.5	425.0	37	462	11824	11514	0.82	1978.73	0.81	0.80	0.80
TX-111		41.3	320.3	1256.6	327.0	43	370	10000	9416	0.69	1976.10	0.68	0.68	0.68
TX-112		94.1	595.0	2490.0	625.0	24	649	4287	3501	0.33	1975.96	0.32	0.31	0.31
TX-113		68.7	407.0	1712.0	424.0	183	907	7808	4415	0.27	1974.35	0.26	0.25	0.25
TX-114		59.7	487.7	1960.5	473.0	62	535	10814	9539	0.29	1974.79	0.28	0.27	0.27
TX-115		75.7	548.5	2321.9	580.0	8	569	10352	8111	0.34	1982.26	0.34	0.32	0.32
TX-116		23.9	170.0	675.5	172.0	391	563	8172	3454	0.09	1970.10	0.09	0.10	0.10
TX-117		41.0	306.2	1335.2	306.0	228	832	11137	5435	0.14	1971.10	0.14	0.14	0.14
TX-118		67.4	215.3	680.4	240.0	45	285	14962	123590	1.54	1975.59	0.42	1.89	0.62
TY-101		0.0	0.0	0.0	0.0	118	118	4130	552	0.00	1974.07		0.00	
TY-102		8.0	30.4	126.2	35.0	29	64	5106	4152	0.42	1975.35	0.38	0.41	0.41
TY-103		21.7	37.8	172.4	54.0	108	162	19451	4281	0.75	1968.32	0.24	1.05	0.30
TY-104		8.0		8.0	3.0	43	46	3915	1436	0.15	1974.53		0.17	
TY-105		7.6		104.8	73.0	158	231	6237		0.00	1976.89	0.00	0.00	0.00
TY-106						21	21	5052	5033	0.00	1971.49		0.00	
AN-101	0.4	271.0	437.5	1899.8	740.0		740	7078	1179	3.85	1984.04	0.28	11.80	0.45
AN-102		365.2	1554.2	7409.0	1090.0		1090	3684		1.53	1994.24	1.53	1.02	1.02
AN-103	20.6	402.4	1804.5	8111.4	951.0	2	953	4736	377	1.08	1986.09	1.06	0.82	0.80
AN-104		336.8	1496.7	6147.9	1056.0		1056	2381		1.44	1983.99	1.08	0.87	0.86

WSTR33.45b	SWLIQ	UNK	assume	ammVal	supVal	linVal	tankVal	traffic	assum trf.	Max. TOC wt%	date of Max. TOC	TOC wt% now	Max. Haz. Index	Haz. Ind. Now
AN-105		711.0	3484.0	11702.1	1130.0		1130	2189		1.39	1995.50	1.38	0.84	0.84
AN-106		6.2	17.5	110.9	21.0		21	1067		1.00	1983.02	0.86	0.89	0.89
AN-107		295.0	1551.2	4904.5	1063.0		1063	1157		1.48	1994.24	1.48	1.15	1.15
AP-101	0.7	38.8	93.6	1929.1	1060.0		1060	2710	104	0.24	1989.25	0.09	0.82	0.78
AP-102		212.8	847.4	4238.4	1103.0		1103	3088		0.86	1994.24	0.86	0.85	0.85
AP-103	0.1	10.2	471.7	1425.8	1131.0		1131	2951	99	0.19	1993.99	0.19	0.80	0.80
AP-104		6.9		27.8	18.0		18	1060						
AP-105	7.0	266.5	1475.5	8602.4	820.0		820	1683		1.03	1989.15	0.86	0.83	0.83
AP-106	2.5	88.2	638.7	4358.8	1127.0		1127	2083		0.89	1988.64	0.39	0.86	0.85
AP-107		22.0		1155.0	1110.0		1110	1153						
AP-108	0.0	32.0	285.4	1240.6	1131.0		1131	1152	233	0.24	1991.88	0.23	0.83	0.83
AW-101	33.4	431.0	2401.8	12396.1	1078.0	61	1139	10301	417	1.81	1991.75	1.14	1.08	0.81
AW-102	218.8	241.3	988.4	7075.9	878.0		878	101881	5075	1.81	1991.75	0.57	1.82	0.81
AW-103	0.0	28.2	7.8	329.2	283.0	363	848	5232	74	1.32	1991.99	0.00	1.12	0.07
AW-104	0.0	68.3	43.6	1063.0	1020.0	103	1123	15343	247	1.43	1995.24	0.04	1.04	0.77
AW-105	2.9	90.8	422.2	3282.9	800.0	240	1040	7099	1270	1.38	1992.49	0.35	1.09	0.80
AW-106	143.5	272.4	1118.1	7991.5	1107.0	1	1108	28782	571	1.18	1993.99	0.88	1.11	0.80
AY-101	15.0	88.7	149.9	1410.8	848.0	33	881	8702	1382	1.36	1988.50	1.22	2.96	2.66
AY-102	0.0	5.5	18.9	715.1	679.1	32	711	20986	2878	1.58	1978.50	0.21	1.41	0.85
AZ-101		72.3	928.9	2435.1	931.0	29	990	8323	3654	1.64	1979.24	0.08	1.69	0.22
AZ-102		8.8	176.6	2048.8	920.0	43	983	8812	3387	1.83	1978.60	0.02	5.83	0.10
BY-101		405.0	1901.3	8708.4	1100.0		1100	1808	1830	1.17	1978.38	1.14	0.83	0.78
BY-102		60.1	825.0	826.2	678.1	71	747	35493	34787	1.18	1977.31	0.00	0.90	0.01
BY-103		247.5	959.6	4805.7	744.0		744	2433	2021	1.61	1978.24	0.88	1.42	0.79
COND				616.0	616.0		616							
CRIB		872.4	40743.4	121209.5	111701.0		111701							
CSR		2138.5	13240.3	75393.5	25638.0		25638							
GROUT	0.0	48.9	4.1	1060.0	1001.0		1001							
LEAK		11.1	91.7	548.1	428.0		428							
PCOND				57995.0	57995.0		57995							
R202S		6.6	410.3	1182.0	733.0		733							
RCOND				23261.0	23261.0		23261							
SRH		77.1	592.1	2020.8	895.0		895							
TFCN		296.7	6310.4	11889.5	11183.0		11183							
UNK		156.2	6587.1	14067.7	7269.0		7269							
UR		642.7	56049.2	71700.3	70690.0		70690							
VENT				1113.0	1113.0		1113							
A1COND				8272.0	8272.0		8272							
A2COND				47867.0	47867.0		47867							
BCOND				7820.0	7820.0		7820							
BYCOND				38738.0	38738.0		38738							
S1COND				41997.0	41997.0		41997							
S2COND				4631.0	4631.0		4631							
T1COND				10560.0	10560.0		10560							
T2COND				29650.0	29650.0		29650							
A1-in		10183.3	165565.0	287201.5	35750.0		35750							
A2-in			0.0	20.1	80.0		80							
B-in		903.3	26247.7	46844.7	15574.0		15574							
BY-in		3228.3	866.1	71538.8	57987.0		57987							
S1-in		32323.2	424759.8	875064.4	87393.0		87393							
S2-in		10650.0	69778.9	275897.7	26327.0		26327							

WESTRES 460-SWALO	UNK	assume	termV/d	impV/d	denV/d	termV/d	termV/d	assum trf.	Max. TOC wt%	date of Max. TOC	TOC wt% now	Max. Hrs. Index	Max. Ind. News
T1-4n	593.6	3934.5	47692.7	20393.0		20393							
T2-4n	38434.6	559510.9	1367886.3	127010.0		127010							
87ATL053													
P-3n	186.2	3393.0	8537.3	4359.0		4359							
87-3n	1864.1	3785.1	42318.7	8124.0		8124							
81-3n													
82-3n													
T1-3n	186.9	8508.7	13200.9	6610.0		6610							
T2-3n													
A1-3n	481.4	1494.0	20681.0	7669.0		7669							
R-3n	2.4	7.8	10.0	10.0		10							
programming													

[illegible]

WSTRS3.45b	MW1	MW2	1C1	1C2	2C1	2C2	224	UN/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R1	R2	CWR1	CWR2	P1	P2	P2'	PL1	CWP1	CWP2	CW2:1	OWW1	OWW2	OWW3	Z
C-104	3.0																15.0	2.0		10.0	88.0	69.0	27.0			31.0	
C-105								15.0													135.0						
C-106								15.0													34.0						
C-107			218.0																			37.0					
C-108			28.0					25.0			12.0																
C-109			10.0								45.0																
C-110			187.0																								
C-111			36.0								5.0										18.0						
C-112			15.0								72.0										13.0	3.0					
C-201	1.0																										
C-202																											
C-203	4.0																										
C-204	2.0																										
S-101													92.0		29.0												
S-102													4.0														
S-103													9.0														
S-104													108.0		24.0												
S-105													2.0														
S-106															32.0												
S-107													92.0		89.0	42.0								18.0			
S-108													5.0														
S-109															13.0												
S-110													89.0		24.0												
S-111													86.0		12.0												
S-112													3.0		3.0												
SX-101													154.0														
SX-102													59.0														
SX-103													10.0														
SX-104													99.0														
SX-105													15.0	9.0													
SX-106																											
SX-107													83.0	24.0													
SX-108													69.0	18.0													
SX-109													44.0	16.0													
SX-110															32.0												
SX-111													42.0	41.0													
SX-112													44.0	26.0													
SX-113													2.0														
SX-114													11.0	37.0													
SX-115													6.0														
U-101	22.0																										
U-102	43.0																										
U-103	32.0																										
U-104	40.0																										
U-105	32.0																										
U-106	26.0																										
U-107															76.0												
U-108	3.0															26.0											
U-109	24.0														24.0												
U-110	24.0		182.0																								
U-111			13.0										13.0														
U-112			32.0										7.0		6.0												
U-201															4.0												

[illegible]

WT183.45b	MW1	MW2	IC1	IC2	IC1	IC2	224	UNITP	PF-CH1	PF-CH2	TP-CH	IC-CH	R1	R2	CWR1	CWR2	P1	P2	R1	CWF1	CWF2	CWZ1	QWW1	QWW2	QWW3	Z
AP-104																										
AP-105																										
AP-106																										
AP-107																										
AP-108																										
AW-101																										
AW-102																										
AW-103																										
AW-104																										
AW-105																										
AW-106																										
AT-101																										
AT-102																										
AL-101																										1.0
AL-102																										28.0
ST-101																										
ST-102																										
ST-103																										

WSTR53.45b	HS	TH1	TH2	AR	B	BL	SAR	CSR In	CSR	DE	CEM	NT	Salt Shury	DW	N	B In	B-ShCk	T1 In	T1-ShCk	R In	RShCk	T2 In	T2-ShCk	BY In	BY-ShCk	S1 In	S1-ShCk	S2 In
A-101								3.0																				
A-102					3.0																							
A-103					27.0																							
A-104																												
A-105																												
A-106					21.0			29.0																				
AX-101								3.0																				
AX-102					5.0																							
AX-103																												
AX-104																												
B-101					5.0	20.0											85.0											
B-102																	24.0											
B-103																	58.0											
B-104																	61.0											
B-105																	130.0											
B-106																	118.0											
B-107																												
B-108																	80.0											
B-109																	84.0											
B-110																												
B-111														1.0														
B-112																									16.0			
B-201																												
B-202																												
B-203																												
B-204																												
BX-101						13.0																						
BX-102										68.0																		
BX-103																												
BX-104																												
BX-105																												
BX-106																									28.0			
BX-107																												
BX-108																												
BX-109																												
BX-110																									42.0			
BX-111																									179.0			
BX-112																	32.0											
BY-101																									350.0			
BY-102																									312.0			
BY-103																									391.0			
BY-104																									176.0			
BY-105											8.0														337.0			
BY-106																									544.0			
BY-107																									149.0			
BY-108																									83.0			
BY-109																									287.0			
BY-110																									208.0			
BY-111																									433.0			
BY-112																									283.0			
C-101																												
C-102			26.0																									
C-103					25.0																							

WTRSS3.4db	HS	TH1	TH2	AR	B	BL	SRR	CSR In	CSR	DE	CEM	NIT	Salt Sherry	DW	N	B In	S-SRCh	T1 In	T1-SRCh	R In	ASRCh	T2 In	T2-SRCh	BY In	BY-SRCh	S1 In	S1-SRCh	S2 In
C-104			24.0					11.0																				
C-105																												
C-106				96.0		52.0																						
C-107								20.0																				
C-108																												
C-109		7.0																										
C-110																												
C-111																												
C-112		1.0																										
C-201		1.0																										
C-202		1.0																										
C-203		1.0																										
C-204		1.0																										
S-101																						90.0						
S-102																												
S-103																												
S-104																						161.0						
S-105																												
S-106																						13.0						
S-107																												
S-108																												
S-109																												
S-110																												
S-111																												
S-112																												
SX-101																						156.0						
SX-102																												
SX-103																						102.0						
SX-104																						70.0						
SX-105																						31.0						
SX-106																						1.0						
SX-107																						17.0						
SX-108																												
SX-109																						190.0						
SX-110																						30.0						
SX-111																						42.0						
SX-112																						23.0						
SX-113																												
SX-114																						133.0						
SX-115																						6.0						
U-101																												
U-102																												
U-103																												
U-104																												
U-105																												
U-106																												
U-107																												
U-108																												
U-109																												
U-110																												
U-111																												
U-112																												
U-201																												

WST#33.45b	HS	TH1	TH2	AR	B	BL	SRR	CSR In	CSR	DE	CEM	NIT	Salt Skurry	DW	N	B In	B-SRCh	T1 In	T1 SRCh	R In	RSRCh	T2 In	T2-SRCh	BY In	BY-SRCh	S1 In	S1-SRCh	S2 In
U-202																												
U-203																												
U-204																												
T-101																												
T-102																												
T-103																												
T-104																												
T-105																												
T-106																												
T-107																												
T-108																				23.0								
T-109																				21.0								
T-110																												
T-111																												
T-112																												
T-201																												
T-202																												
T-203																												
T-204																												
TX-101																												
TX-102																												
TX-103																					3.0							
TX-104																												
TX-105																												
TX-106																												
TX-107																												
TX-108																												
TX-109																												
TX-110																												
TX-111																												
TX-112																					24.0							
TX-113																					58.0							
TX-114																												
TX-115																												
TX-116										88.0											323.0							
TX-117										29.0											197.0							
TX-118																					8.0							
TY-101																					48.0							
TY-102																					29.0							
TY-103																												
TY-104																												
TY-105																												
TY-106										20.0																		
AN-101																												
AN-102																												
AN-103						2.0																						
AN-104																												
AN-105																												
AN-106																												
AN-107																												
AP-101																												
AP-102																												
AP-103																												

[illegible]

WSTRS3.45b	S2-ShSh	A1 In	A1-ShCt	A2 In	A2-ShSh	P3	PL2	CWZr2	BP /Cpts	BP /NCpts	PASf	WTR	GAS	SWLIQ	UNK	assume	dmVal	termVal
C-104																	290.0	295
C-105																	150.0	150
C-106																	187.0	228
C-107																	275.0	275
C-108																	86.0	86
C-109																	82.0	86
C-110																	187.0	187
C-111																	87.0	87
C-112																	104.0	104
C-201																	2.0	2
C-202																	1.0	1
C-203																	6.0	8
C-204																	2.0	3
S-101																	211.0	427
S-102																	4.0	548
S-103																	8.0	248
S-104																	293.0	284
S-105																	2.0	407
S-106																	32.0	478
S-107																	253.8	276
S-108																	8.0	502
S-109																	13.0	507
S-110																	113.0	380
S-111																	78.0	538
S-112																	6.0	823
SX-101																	310.0	458
SX-102																	68.0	543
SX-103																	112.0	852
SX-104																	188.0	614
SX-105																	55.0	683
SX-106																	1.0	538
SX-107																	104.0	104
SX-108																	87.0	87
SX-110																	250.0	250
SX-111																	62.0	62
SX-112																	125.0	125
SX-113																	92.0	82
SX-114																	31.0	31
SX-115																	181.0	181
U-101																	12.0	12
U-102																	22.0	25
U-103																	43.0	374
U-104																	32.0	488
U-105																	78.0	122
U-106																	32.0	418
U-107																	28.0	228
U-108																	76.0	406
U-109																	29.0	488
U-110																	48.0	483
U-111																	186.0	186
U-112																	28.0	328
U-201																	45.0	48
																	4.0	5

WSTRS3.45b	S2-ShStk	A1 In	A1-ShCh	A2 In	A2-ShStk	P3	PL2	CWZ:2	BP /Cpls	BP /NCpls	PASF	WTR	GAS	SWLIQ	UNK	assume	linVal	tanVal
U-202																	4.0	5
U-203																	2.0	3
U-204																	2.0	3
T-101																	37.0	102
T-102																	18.0	32
T-103																	18.0	27
T-104																	442.0	445
T-105																	86.0	98
T-106																	19.0	21
T-107																	171.0	180
T-108																	44.0	44
T-109																	58.0	58
T-110																	375.9	379
T-111																	455.9	458
T-112																	60.0	67
T-201																	28.0	29
T-202																	21.0	21
T-203																	35.0	35
T-204																	38.0	38
TX-101																	78.0	87
TX-102																	2.0	217
TX-103																	3.0	187
TX-104																	18.0	85
TX-106																	8.0	609
TX-106																	5.0	341
TX-107																	8.0	35
TX-108																	8.0	134
TX-109																	384.0	384
TX-110																	37.0	482
TX-111																	43.0	370
TX-112																	24.0	649
TX-113																	183.0	607
TX-114																	62.0	835
TX-115																	8.0	588
TX-116																	391.0	583
TX-117																	228.0	632
TX-118																	45.0	285
TY-101																	118.0	118
TY-102																	28.0	84
TY-103																	106.0	162
TY-104																	43.0	48
TY-106																	156.0	231
TY-106																	21.0	21
AN-101																		740
AN-102																		1090
AN-103																	2.0	853
AN-104																		1058
AN-105																		1130
AN-106																		21
AN-107																		1083
AP-101																		1060
AP-102																		1103
AP-103																		1131

WSTRES 456	A2-SHEB	A1 In	A1-SHC3	A2 In	A2-SHEB	P3	PL2	CHV2.2	BP /Cph	BP /MCph	PASF	WTR	GAS	SWLQ	LNK	assums	tenVd	tenVd
AP-104																		18
AP-105																		830
AP-106																		1127
AP-107																		1110
AP-108																		1131
AW-101						81.0											81.0	1139
AW-102																	979	
AW-103								263.0									263.0	646
AW-104						88.0	8.0										103.0	1123
AW-105						26.0	215.0										245.0	1040
AW-106																	1.0	1105
AY-101																	32.0	811
AY-102							4.0										21.0	711
AZ-101						27.0	1.0										21.0	640
AZ-102						13.0	3.0										21.0	640
ET-101																	43.0	892
ET-102																	1100	
ET-103	41.0																70.8	747
																	744	

Appendix E.**Inventory Estimates***May 1996*

Each tank's inventory estimate is given in three tables: TLM Solids Composite, SMM Composite, and Total Inventory Estimates. Furthermore, each table expresses analyte average concentration as mol/L or ppm as well as kg or MCi inventories. Total site inventories in Mmoles and kg are also shown for Rev. 3 as well as for previous revisions, Rev. 1 and Rev. 2. These site inventories are further broken down into DST, SST, Crib, and Leak destinations.

NE Quadrant

Single-Shell Tank 241-AX-101			
TLM Solids Composite Inventory Estimate*			
Physical Properties			
Total Solid Waste	7.34E+04 kg	(13.0 kgal)	
Heat Load	4.22 kW	(1.44E+04 BTU/hr)	
Bulk Density	1.49 (g/cc)		
Void Fraction	0.818		
Water wt%	56.5		
TOC wt% C (wet)	0.808		
Elemental Compositions			
	mg/kg	µg/g	kg
Na ⁺	4.59	7.07E+04	5.19E+03
Al ³⁺	0	0	0
Fe ³⁺ (total Fe)	2.62	9.82E+04	7.21E+03
Cu ²⁺	5.01E-03	175	12.8
Bi ³⁺	0	0	0
La ³⁺	0	0	0
Hg ²⁺	0	0	0
Zr (as ZrO(OH) ₂)	0	0	0
Pb ²⁺	0	0	0
Ni ²⁺	4.48E-02	1.76E+03	129
Sr ²⁺	0	0	0
Mn ²⁺	0	0	0
Ca ²⁺	0.219	5.87E+03	431
K ⁺	6.20E-03	163	11.9
OH ⁻	10.3	1.17E+05	8.61E+03
NO ₃ ⁻	9.05E-07	3.76E-02	2.76E-03
NO ₂ ⁻	0.580	1.79E+04	1.31E+03
CO ₃ ²⁻	0.265	1.07E+04	784
PO ₄ ³⁻	0	0	0
SO ₄ ²⁻	0.119	7.69E+03	565
Si (as SiO ₂) ²	1.59	2.99E+04	2.20E+03
F ⁻	0	0	0
Cl ⁻	2.85E-02	677	49.7
C ₆ H ₅ O ₇ ³⁻	0	0	0
EDTA ⁴⁻	2.95E-02	5.71E+03	419
HEDTA ³⁻	5.91E-02	1.09E+04	797
glycolate ⁻	5.91E-02	2.97E+03	218
acetate ⁻	0	0	0
oxalate ²⁻	0	0	0
DBP	5.98E-06	1.07	7.83E-02
butanol	5.98E-06	0.297	2.18E-02
NH ₃	0.213	2.42E+03	178
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Compositions			
Pu		1.35 (µCi/g)	1.65 (kg)
U	0.366 (M)	5.84E+04 (µg/g)	4.29E+03 (kg)
Cs	0.441 (Ci/L)	296 (µCi/g)	2.17E+04 (Ci)
Sr	12.4 (Ci/L)	8.33E+03 (µCi/g)	6.12E+03 (Ci)

*Unknowns in tank solids inventory are assigned by Tank Layering Model (TLM).

Single-Shell Tank 241-AX-101			
SMM Composite Inventory Estimate			
Physical Properties			
Total Supernatant Wa	4.15E+06 kg	(735 kgal)	
Heat Load	5.01 kW	(1.71E+04 BTU/hr)	
Bulk Density*	1.49 (g/cc)		
Water wt%†	42.3		
TOC wt% C (wet)	1.35		
Chemical Constituents	mmol/L	ppm	kg
Na ⁺	10.4	1.60E+05	6.65E+05
Al ³⁺	1.49	2.69E+04	1.11E+05
Fe ³⁺ (total Fe)	5.41E-03	203	841
Cy ³⁺	4.33E-02	1.51E+03	6.26E+03
Bi ³⁺	1.08E-03	152	630
La ³⁺	1.96E-05	1.83	7.59
Hg ²⁺	8.78E-06	1.18	4.90
Zr (as ZrO(OH) ₂)	5.71E-04	35.0	145
Pb ²⁺	1.20E-03	167	694
Ni ²⁺	4.45E-03	175	726
Sr ²⁺	6.55E-06	0.385	1.60
Mn ²⁺	4.13E-03	152	631
Ca ²⁺	2.45E-02	660	2.74E+03
K ⁺	5.15E-02	1.35E+03	5.60E+03
OH ⁻	6.47	7.38E+04	3.06E+05
NO ₃ ⁻	3.95	1.64E+05	6.81E+05
NO ₂ ⁻	2.16	6.65E+04	2.76E+05
CO ₃ ²⁻	0.461	1.86E+04	7.70E+04
PO ₄ ³⁻	8.31E-02	5.29E+03	2.19E+04
SO ₄ ²⁻	0.254	1.63E+04	6.77E+04
Si (as SiO ₂) ²⁻	6.70E-02	1.26E+03	5.23E+03
F ⁻	6.58E-02	839	3.48E+03
Cl ⁻	0.185	4.40E+03	1.83E+04
C ₆ H ₅ O ₇ ³⁻	3.01E-02	3.82E+03	1.58E+04
EDTA ⁴⁻	3.30E-02	6.38E+03	2.65E+04
HEDTA ³⁻	5.91E-02	1.09E+04	4.51E+04
glycolate ⁻	0.119	5.99E+03	2.48E+04
acetate ⁻	2.19E-02	867	3.60E+03
oxalate ²⁻	1.68E-05	0.992	4.12
DBP	2.43E-02	4.33E+03	1.80E+04
butanol	2.43E-02	1.21E+03	5.00E+03
NH ₃	3.53E-02	402	1.67E+03
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu	65.9 (μCi/L)		3.06 (kg)
U	9.34E-03 (M)	1.49E+03 (μg/g)	6.19E+03 (kg)
Cs	0.245 (Ci/L)	164 (μCi/g)	6.81E+05 (Ci)
Sr	9.74E-02 (Ci/L)	65.3 (μCi/g)	2.71E+05 (Ci)

*Density is calculated based on Na, OH⁻, and AlO₂.

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-AX-101			
Total Inventory Estimate*			
Physical Properties			
Total Waste	4.22E+06 kg	(748 kgal)	
Heat Load	9.24 kW	(3.15E+04 BTU/hr)	
Bulk Density†	1.49 (g/cc)		
Water wt%†	42.6		
TOC wt% C (wt)†	1.34		
Chemical Constituents			
	mg/L	ppm	kg
Na ⁺	10.3	1.59E+05	6.70E+05
Al ³⁺	1.46	2.64E+04	1.11E+05
Fe ³⁺ (total Fe)	5.09E-02	1.91E+03	8.05E+03
Cu ²⁺	4.26E-02	1.49E+03	6.27E+03
Ba ²⁺	1.06E-03	149	630
La ³⁺	1.93E-05	1.80	7.59
Hg ²⁺	8.63E-06	1.16	4.90
Zr (as ZrO(OH) ₂)	5.61E-04	34.3	145
Pb ²⁺	1.18E-03	164	694
Ni ²⁺	5.15E-03	203	856
Sr ²⁺	6.44E-06	0.378	1.60
Mn ²⁺	4.06E-03	150	631
Ca ²⁺	2.79E-02	750	3.17E+03
K ⁺	5.07E-02	1.33E+03	5.61E+03
OH ⁻	6.54	7.45E+04	3.15E+05
NO ₃ ⁻	3.88	1.61E+05	6.81E+05
NO ₂ ⁻	2.13	6.57E+04	2.77E+05
CO ₃ ²⁻	0.458	1.84E+04	7.78E+04
PO ₄ ³⁻	8.16E-02	5.20E+03	2.19E+04
SO ₄ ²⁻	0.251	1.62E+04	6.83E+04
Si (as SiO ₂) ²⁻	9.34E-02	1.76E+03	7.43E+03
F ⁻	6.47E-02	824	3.48E+03
Cl ⁻	0.183	4.34E+03	1.83E+04
C ₆ H ₅ O ₇ ³⁻	2.96E-02	3.75E+03	1.58E+04
EDTA ⁴⁻	3.29E-02	6.37E+03	2.69E+04
HEDTA ⁴⁻	5.91E-02	1.09E+04	4.59E+04
glycolate ⁻	0.118	5.93E+03	2.51E+04
acetate ⁻	2.15E-02	852	3.60E+03
oxalate ²⁻	1.65E-05	0.975	4.12
DBP	2.38E-02	4.25E+03	1.80E+04
butanol	2.38E-02	1.18E+03	5.00E+03
NH ₃	3.83E-02	437	1.85E+03
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu		6.69E-02 (μCi/g)	4.70 (kg)
U	1.55E-02 (M)	2.48E+03 (μg/g)	1.05E+04 (kg)
Cs	0.248 (Ci/L)	166 (μCi/g)	7.03E+05 (Ci)
Sr	0.312 (Ci/L)	209 (μCi/g)	8.83E+05 (Ci)

*Unknowns in tank solids inventory are assigned by Tank Layering Model (TLM).

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-AX-102			
TLM Solids Composite Inventory Estimate*			
Physical Properties			
Total Solid Waste	3.20E+04 kg	(5.98 kgal)	
Heat Load	3.90 kW	(1.33E+04 BTU/hr)	
Bulk Density	1.41 (g/cc)		
Void Fraction	0.849		
Water wt%	63.7		
TOC wt% C (wet)	3.59E-02		
Chemical Constituents			
	mol/L	ppm	kg
Na ⁺	2.94	4.78E+04	1.53E+03
Al ³⁺	1.02	1.95E+04	625
Fe ³⁺ (total Fe)	1.32	5.22E+04	1.67E+03
Cr ³⁺	2.56E-03	94.3	3.02
Bi ³⁺	0	0	0
La ³⁺	0	0	0
Hg ²⁺	0	0	0
Zr (as ZrO(OH) ₂)	0	0	0
Pb ²⁺	9.37E-06	1.37	4.39E-02
Ni ²⁺	5.19E-02	2.16E+03	69.1
Se ²⁺	0	0	0
Mn ²⁺	0	0	0
Ca ²⁺	0.237	7.30E+03	234
K ⁺	4.07E-03	113	3.61
OH ⁻	9.62	1.16E+05	3.70E+03
NO ₃ ⁻	0.329	1.44E+04	461
NO ₂ ⁻	0.274	8.93E+03	286
CO ₃ ²⁻	0.237	1.09E+04	350
PO ₄ ³⁻	1.39E-02	931	29.8
SO ₄ ²⁻	1.94E-02	1.32E+03	42.1
Si (as SiO ₃ ²⁻)	1.02	2.03E+04	651
F ⁻	0	0	0
Cl ⁻	1.87E-02	469	15.0
C ₆ H ₅ O ₇ ³⁻	7.05E-03	943	30.2
EDTA ⁴⁻	0	0	0
HEDTA ³⁻	0	0	0
glycolate ⁻	0	0	0
acetate ⁻	0	0	0
oxalate ²⁻	0	0	0
DBP	0	0	0
butanol	0	0	0
NH ₃	0.119	1.43E+03	45.8
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu		12.7 (μCi/g)	6.78 (kg)
U	0.384 (M)	6.46E+04 (ng/g)	2.07E+03 (kg)
Cs	0.236 (Ci/L)	167 (μCi/g)	5.35E+03 (Ci)
Sr	25.4 (Ci/L)	1.79E+04 (μCi/g)	5.75E+03 (Ci)

*Unknowns in tank solids inventory are assigned by Tank Layering Model (TLM).

Single-Shell Tank 241-AX-102			
SMM Composite Inventory Estimate			
Physical Properties			
Total Supernatant Wa	1.91E+05 kg	(33.0 kgal)	
Heat Load	0.258 kW	(880 BTU/hr)	
Bulk Density*	1.53 (g/cc)		
Water wt%†	39.3		
TOC wt% C (wet)	1.18		
Chemical Constituents	mole/L	ppm	kg
Na ⁺	11.2	1.69E+05	3.22E+04
Al ³⁺	1.58	2.79E+04	5.32E+03
Fe ³⁺ (total Fe)	6.45E-03	236	45.0
Cr ³⁺	5.04E-02	1.72E+03	328
Bi ³⁺	1.19E-03	162	30.9
La ³⁺	2.66E-05	2.42	0.461
Hg ²⁺	9.05E-06	1.19	0.227
Zr (as ZrO(OH) ₂)	6.96E-04	41.5	7.93
Pb ²⁺	1.16E-03	157	30.0
Ni ²⁺	5.41E-03	208	39.7
Sr ²⁺	8.86E-06	0.508	9.70E-02
Mn ⁴⁺	4.22E-03	152	29.0
Ca ²⁺	2.92E-02	767	146
K ⁺	5.47E-02	1.40E+03	267
OH ⁻	6.88	7.66E+04	1.46E+04
NO ₃ ⁻	4.50	1.83E+05	3.49E+04
NO ₂ ⁻	2.32	6.99E+04	1.34E+04
CO ₃ ²⁻	0.469	1.84E+04	3.52E+03
PO ₄ ³⁻	8.72E-02	5.42E+03	1.04E+03
SO ₄ ²⁻	0.259	1.63E+04	3.11E+03
Si (as SiO ₂) [‡]	7.54E-02	1.39E+03	265
F ⁻	7.02E-02	873	167
Cl ⁻	0.199	4.62E+03	882
C ₆ H ₅ O ₇ ³⁻	3.11E-02	3.85E+03	734
EDTA ⁴⁻	2.74E-02	5.17E+03	987
HEDTA ³⁻	4.93E-02	8.85E+03	1.69E+03
glycolate ⁻	0.112	5.51E+03	1.05E+03
acetate ⁻	1.76E-02	679	130
oxalate ²⁻	2.27E-05	1.31	0.250
DBP	2.37E-02	4.14E+03	790
butanol	2.37E-02	1.15E+03	220
NH ₃	4.43E-02	493	94.2
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu	75.2 (μCi/L)		0.157 (kg)
U	1.09E-02 (M)	1.70E+03 (μg/g)	325 (kg)
Cs	0.281 (Ci/L)	184 (μCi/g)	3.52E+04 (Ci)
Sr	0.110 (Ci/L)	72.2 (μCi/g)	1.38E+04 (Ci)

*Density is calculated based on Na, OH⁻, and AlO₂⁻.

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-AX-102			
Total Inventory Estimate*			
Physical Properties			
Total Waste	2.23E+05 kg	(39.0 kgal)	
Heat Load	4.15 kW	(1.42E+04 BTU/hr)	
Bulk Density†	1.51 (g/cc)		
Water wt%†	42.8		
TOC wt% C (wet)†	1.01		
Chemical Constituents			
	mol/L	ppm	kg
Na ⁺	9.94	1.51E+05	3.37E+04
Al ³⁺	1.49	2.67E+04	5.95E+03
Fe ³⁺ (total Fe)	0.208	7.69E+03	1.72E+03
Cu ²⁺	4.31E-02	1.48E+03	331
Bi ³⁺	1.00E-03	139	30.9
La ³⁺	2.25E-05	2.07	0.461
Hg ²⁺	7.66E-06	1.02	0.227
Zr (as ZrO(OH) ₂)	5.89E-04	35.6	7.93
Pb ²⁺	9.84E-04	135	30.1
Ni ²⁺	1.26E-02	488	109
Sr ²⁺	7.50E-06	0.435	9.70E-02
Mn ²⁺	3.57E-03	130	29.0
Ca ²⁺	6.42E-02	1.71E+03	380
K ⁺	4.70E-02	1.22E+03	271
OH ⁻	7.30	8.22E+04	1.83E+04
NO ₃ ⁻	3.86	1.59E+05	3.53E+04
NO ₂ ⁻	2.01	6.12E+04	1.36E+04
CO ₃ ²⁻	0.437	1.74E+04	3.87E+03
PO ₄ ³⁻	7.60E-02	4.78E+03	1.07E+03
SO ₄ ²⁻	0.222	1.41E+04	3.15E+03
Si (as SiO ₃ ²⁻)	0.221	4.11E+03	916
F ⁻	5.94E-02	747	167
Cl ⁻	0.171	4.02E+03	897
C ₆ H ₅ O ₇ ³⁻	2.74E-02	3.43E+03	765
EDTA ⁴⁻	2.32E-02	4.43E+03	987
HEDTA ³⁻	4.18E-02	7.58E+03	1.69E+03
glycolate ⁻	9.50E-02	4.72E+03	1.05E+03
acetate ⁻	1.49E-02	581	130
oxalate ²⁻	1.92E-05	1.12	0.250
DBP	2.01E-02	3.54E+03	790
butanol	2.01E-02	987	220
NH ₃	5.58E-02	628	140
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu		1.87 (μCi/g)	6.94 (kg)
U	6.81E-02 (M)	1.07E+04 (μg/g)	2.39E+03 (kg)
Cs	0.274 (Ci/L)	182 (μCi/g)	4.05E+04 (Ci)
Sr	3.99 (Ci/L)	2.64E+03 (μCi/g)	5.88E+05 (Ci)

*Unknowns in tank solids inventory are assigned by Tank Layering Model (TLM).

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-AX-103			
TLM Solids Composite Inventory Estimate*			
Physical Properties			
Total Solid Waste	7.50E+04 kg	(14.0 kgal)	
Heat Load	5.02 kW	(1.71E+04 BTU/hr)	
Bulk Density	1.42 (g/cc)		
Void Fraction	0.808		
Water wt%	59.2		
TOC wt% C (wet)	0		
Chemical Constituents	mol/L	g/L	kg
Na ⁺	4.03	6.55E+04	4.91E+03
Al ³⁺	0	0	0
Fe ³⁺ (total Fe)	2.96	1.17E+05	8.76E+03
Cr ³⁺	6.51E-03	239	17.9
Bi ³⁺	0	0	0
La ³⁺	0	0	0
Hg ²⁺	0	0	0
Zr (as ZrO(OH) ₂)	0	0	0
Pb ²⁺	0	0	0
Ni ²⁺	5.82E-02	2.41E+03	181
Sr ²⁺	0	0	0
Mn ²⁺	0	0	0
Ca ²⁺	0.243	6.88E+03	516
K ⁺	4.59E-03	127	9.50
OH ⁻	10.2	1.22E+05	9.18E+03
NO ₃ ⁻	1.52E-14	6.67E-10	5.00E-11
NO ₂ ⁻	0.587	1.91E+04	1.43E+03
CO ₃ ²⁻	0.243	1.03E+04	773
PO ₄ ³⁻	0	0	0
SO ₄ ²⁻	0.129	8.77E+03	657
Si (as SiO ₂) ²⁻	1.52	3.02E+04	2.27E+03
F ⁻	0	0	0
Cl ⁻	2.11E-02	528	39.6
C ₆ H ₅ O ₇ ³⁻	0	0	0
EDTA ⁴⁻	0	0	0
HEDTA ⁴⁻	0	0	0
glycolate ⁻	0	0	0
acetate ⁻	0	0	0
oxalate ²⁻	0	0	0
DBP	0	0	0
butanol	0	0	0
NH ₃	0.242	2.91E+03	218
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu		1.04 (μCi/g)	1.29 (kg)
U	0.175 (M)	2.95E+04 (μg/g)	2.21E+03 (kg)
Cs	0.561 (Ci/L)	396 (μCi/g)	2.97E+04 (Ci)
Sr	13.7 (Ci/L)	9.67E+03 (μCi/g)	7.25E+05 (Ci)

*Unknowns in tank solids inventory are assigned by Tank Layering Model (TLM).

Single-Shell Tank 241-AX-103			
SMM Composite Inventory Estimate			
Physical Properties			
Total Supernatant Wa	5.38E+05 kg	(98.0 kgal)	
Heat Load	0.600 kW	(2.05E+03 BTU/hr)	
Bulk Density*		1.45 (g/cc)	
Water wt%†		45.6	
TOC wt% C (wet)		1.20	
Chemical Constituents	mmole/L	µg/L	kg
Na ⁺	9.55	1.51E+05	8.15E+04
Al ³⁺	1.37	2.34E+04	1.37E+04
Fe ³⁺ (total Fe)	5.07E-03	195	105
Cr ³⁺	3.95E-02	1.41E+03	761
Bi ³⁺	9.84E-04	142	76.3
La ³⁺	1.90E-05	1.81	0.977
Hg ²⁺	7.85E-06	1.09	0.584
Zr (as Zr(OH) ₂)	5.33E-04	33.5	18.1
Pb ²⁺	1.06E-03	151	81.5
Ni ²⁺	4.20E-03	170	91.5
Sr ²⁺	6.32E-06	0.382	0.205
Mn ²⁺	3.67E-03	139	74.9
Ca ²⁺	2.30E-02	634	342
K ⁺	4.71E-02	1.27E+03	683
OH ⁻	5.95	6.97E+04	3.76E+04
NO ₃ ⁻	3.71	1.58E+05	8.53E+04
NO ₂ ⁻	1.94	6.15E+04	3.31E+04
CO ₃ ²⁻	0.427	1.76E+04	9.50E+03
PO ₄ ³⁻	7.47E-02	4.89E+03	2.63E+03
SO ₄ ²⁻	0.228	1.51E+04	8.11E+03
Si (as SiO ₂)	6.23E-02	1.21E+03	649
F ⁻	5.94E-02	778	419
Cl ⁻	0.170	4.16E+03	2.24E+03
C ₆ H ₅ O ₇ ³⁻	2.79E-02	3.63E+03	1.95E+03
EDTA ⁴⁻	2.71E-02	5.37E+03	2.89E+03
HEDTA ³⁻	4.83E-02	9.12E+03	4.91E+03
glycolate ⁻	0.115	5.97E+03	3.21E+03
acetate ⁻	1.87E-02	762	410
oxalate ²⁻	1.62E-05	0.984	0.530
DBP	2.15E-02	3.95E+03	2.13E+03
butanol	2.15E-02	1.10E+03	592
NH ₃	3.29E-02	385	207
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu	61.4 (µCi/L)		0.379 (kg)
U	8.75E-03 (M)	1.44E+03 (µg/g)	773 (kg)
Ca	0.216 (Ci/L)	149 (µCi/g)	8.03E+04 (Ci)
Sr	8.97E-02 (Ci/L)	61.8 (µCi/g)	3.33E+04 (Ci)

*Density is calculated based on Na, OH⁻, and AlO₂⁻.

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-AX-103			
Total Inventory Estimate*			
Physical Properties			
Total Waste	6.13E+05 kg	(112 kgal)	
Heat Load	5.62 kW	(1.92E+04 BTU/hr)	
Bulk Density†	1.45 (g/cc)		
Water wt%†	47.2		
TOC wt% C (wet)†	1.05		
Chemical Constituents			
	mg/L	ppm	kg
Na ⁺	8.86	1.41E+05	8.64E+04
Al ³⁺	1.20	2.23E+04	1.37E+04
Fe ²⁺ (total Fe)	0.374	1.44E+04	8.86E+03
Cu ²⁺	3.53E-02	1.27E+03	779
Bi ³⁺	8.61E-04	124	76.3
La ³⁺	1.66E-05	1.59	0.977
Hg ²⁺	6.87E-06	0.952	0.584
Zr (as Zr(OH) ₄)	4.67E-04	29.4	18.1
Pb ²⁺	9.28E-04	133	81.5
Ni ²⁺	1.09E-02	444	272
Se ²⁺	5.53E-06	0.335	0.205
Mn ²⁺	3.22E-03	122	74.9
Ca ²⁺	5.05E-02	1.40E+03	858
K ⁺	4.18E-02	1.13E+03	692
OH ⁻	6.48	7.62E+04	4.67E+04
NO ₃ ⁻	3.24	1.39E+05	8.53E+04
NO ₂ ⁻	1.77	5.63E+04	3.46E+04
CO ₃ ²⁻	0.404	1.67E+04	1.03E+04
PO ₄ ³⁻	6.53E-02	4.29E+03	2.63E+03
SO ₄ ²⁻	0.215	1.43E+04	8.76E+03
Si (as SiO ₂) ⁺	0.245	4.76E+03	2.92E+03
F ⁻	5.20E-02	683	419
Cl ⁻	0.152	3.71E+03	2.28E+03
C ₆ H ₅ O ₇ ³⁻	2.44E-02	3.19E+03	1.95E+03
EDTA ⁴⁻	2.37E-02	4.72E+03	2.89E+03
HEDTA ⁴⁻	4.22E-02	8.00E+03	4.91E+03
glycolate ⁻	0.101	5.24E+03	3.21E+03
acetate ⁻	1.64E-02	669	410
oxalate ²⁻	1.42E-05	0.864	0.530
DBP	1.88E-02	3.47E+03	2.13E+03
butanol	1.88E-02	966	592
NH ₃	5.90E-02	693	425
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu		0.164 (μCi/g)	1.67 (kg)
U	2.96E-02 (M)	4.86E+03 (μg/g)	2.98E+03 (kg)
Cs	0.259 (Ci/L)	179 (μCi/g)	1.10E+05 (Ci)
Sr	1.79 (Ci/L)	1.24E+03 (μCi/g)	7.58E+05 (Ci)

*Unknowns in tank solids inventory are assigned by Tank Layering Model (TLM).

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-AX-104			
TLM Solids Composite Inventory Estimate*			
Physical Properties			
Total Solid Waste	3.75E+04 kg	(6.99 kgal)	
Heat Load	2.51 kW	(8.57E+03 BTU/hr)	
Bulk Density	1.42 (g/cc)		
Void Fraction	0.808		
Water wt%	59.2		
TOC wt% C (wet)	0		
Chemical Constituents			
	mg/L	ppm	kg
Na ⁺	4.03	6.55E+04	2.45E--
Al ³⁺	0	0	0
Fe ³⁺ (total Fe)	2.96	1.17E+05	4.38E+03
Cr ³⁺	6.51E-03	239	8.96
Bi ³⁺	0	0	0
La ³⁺	0	0	0
Hg ²⁺	0	0	0
Zr (as ZrO(OH) ₂)	0	0	0
Pb ²⁺	0	0	0
Ni ²⁺	5.82E-02	2.41E+03	90.4
Sr ²⁺	0	0	0
Mn ²⁺	0	0	0
Ca ²⁺	0.243	6.88E+03	258
K ⁺	4.59E-03	127	4.75
OH ⁻	10.2	1.22E+05	4.58E+03
NO ₃ ⁻	1.52E-14	6.67E-10	2.50E-11
NO ₂ ⁻	0.587	1.91E+04	715
CO ₃ ²⁻	0.243	1.03E+04	386
PO ₄ ³⁻	0	0	0
SO ₄ ²⁻	0.129	8.77E+03	328
Si (as SiO ₂)	1.52	3.02E+04	1.13E+03
F ⁻	0	0	0
Cl ⁻	2.11E-02	528	19.8
C ₆ H ₅ O ₇ ³⁻	0	0	0
EDTA ⁴⁻	0	0	0
HEDTA ³⁻	0	0	0
glycolate ⁻	0	0	0
acetate ⁻	0	0	0
oxalate ²⁻	0	0	0
DBP	0	0	0
butanol	0	0	0
NH ₃	0.242	2.91E+03	109
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu		1.04 (μCi/g)	0.647 (kg)
U	0.175 (M)	2.95E+04 (μg/g)	1.10E+03 (kg)
Cs	0.561 (Ci/L)	396 (μCi/g)	1.48E+04 (Ci)
Sr	13.7 (Ci/L)	9.67E+03 (μCi/g)	3.62E+05 (Ci)

*Unknowns in tank solids inventory are assigned by Tank Layering Model (TLM).

Single-Shell Tank 241-AJ-104			
SMM Composite Inventory Estimate			
Physical Properties			
Total Supernatant Wa	0 kg	(0 kgal)	
Heat Load	0 kW	(0 BTU/hr)	
Bulk Density*		0 (g/cc)	
Water wt%†		0	
TOC wt% C (wet)		0	
Chemical Constituents			
	moles/l	ppm	kg
Na ⁺	0	0	0
Al ³⁺	0	0	0
Fe ³⁺ (total Fe)	0	0	0
Cu ²⁺	0	0	0
Bi ³⁺	0	0	0
La ³⁺	0	0	0
Hg ²⁺	0	0	0
Zr (as ZrO(OH) ₂)	0	0	0
Pb ²⁺	0	0	0
Ni ²⁺	0	0	0
Sr ²⁺	0	0	0
Mn ²⁺	0	0	0
Ca ²⁺	0	0	0
K ⁺	0	0	0
OH ⁻	0	0	0
NO ₃ ⁻	0	0	0
NO ₂ ⁻	0	0	0
CO ₃ ²⁻	0	0	0
PO ₄ ³⁻	0	0	0
SO ₄ ²⁻	0	0	0
Si (as SiO ₂) ²⁻	0	0	0
F ⁻	0	0	0
Cl ⁻	0	0	0
C ₂ H ₃ O ₂ ⁻	0	0	0
EDTA ⁴⁻	0	0	0
HEDTA ³⁻	0	0	0
glycolate ⁻	0	0	0
acetate ⁻	0	0	0
oxalate ²⁻	0	0	0
DBP	0	0	0
butanol	0	0	0
NH ₃	0	0	0
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu	0 (μCi/L)		0 (kg)
U	0 (M)	0 (μg/g)	0 (kg)
Cs	0 (Ci/L)	0 (μCi/g)	0 (Ci)
Sr	0 (Ci/L)	0 (μCi/g)	0 (Ci)

*Density is calculated based on Na, OH⁻, and AlO₂⁻.

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-AX-104			
Total Inventory Estimate*			
Physical Properties			
Total Waste	3.75E+04 kg	(6.99 kgal)	
Heat Load	2.51 kW	(8.57E+03 BTU/hr)	
Bulk Density†		1.42 (g/cc)	
Water wt%†		59.2	
TOC wt% C (wet)†		0	
Chemical Constituents	mmole/L	ppm	kg
Na ⁺	4.03	6.55E+04	2.45E+03
Al ³⁺	0	0	0
Fe ³⁺ (total Fe)	2.96	1.17E+05	4.38E+03
Cr ³⁺	6.51E-03	239	8.96
Bi ³⁺	0	0	0
La ³⁺	0	0	0
Hg ²⁺	0	0	0
Zr (as ZrO(OH) ₂)	0	0	0
Pb ²⁺	0	0	0
Ni ²⁺	5.82E-02	2.41E+03	90.4
Sr ²⁺	0	0	0
Mn ⁴⁺	0	0	0
Ca ²⁺	0.243	6.88E+03	258
K ⁺	4.59E-03	127	4.75
OH ⁻	10.2	1.22E+05	4.58E+03
NO ₃ ⁻	1.52E-14	6.67E-10	2.50E-11
NO ₂ ⁻	0.587	1.91E+04	715
CO ₃ ²⁻	0.243	1.03E+04	386
PO ₄ ³⁻	0	0	0
SO ₄ ²⁻	0.129	8.77E+03	328
Si (as SiO ₃ ²⁻)	1.52	3.02E+04	1.13E+03
F ⁻	0	0	0
Cl ⁻	2.11E-02	528	19.8
C ₆ H ₅ O ₃ ³⁻	0	0	0
EDTA ⁴⁻	0	0	0
HEDTA ³⁻	0	0	0
glycolate ⁻	0	0	0
acetate ⁻	0	0	0
oxalate ²⁻	0	0	0
DBP	0	0	0
butanol	0	0	0
NH ₃	0.242	2.91E+03	109
Fe(CN) ₆ ⁴⁻	0	0	0
Radiological Constituents			
Pu		1.04 (μCi/g)	0.647 (kg)
U	0.175 (M)	2.95E+04 (μg/g)	1.10E+03 (kg)
Cs	0.561 (Ci/L)	396 (μCi/g)	1.48E+04 (Ci)
Sr	13.7 (Ci/L)	9.67E+03 (μCi/g)	3.62E+05 (Ci)

*Unknowns in tank solids inventory are assigned by Tank Layering Model (TLM).

†Volume average for density, mass average Water wt% and TOC wt% C.

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