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7. Abstract

This document provides the characterization information and interprets the data for Single-Shell Tank T-104

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Tank Characterization Report for Single-Shell Tank 241-T-104

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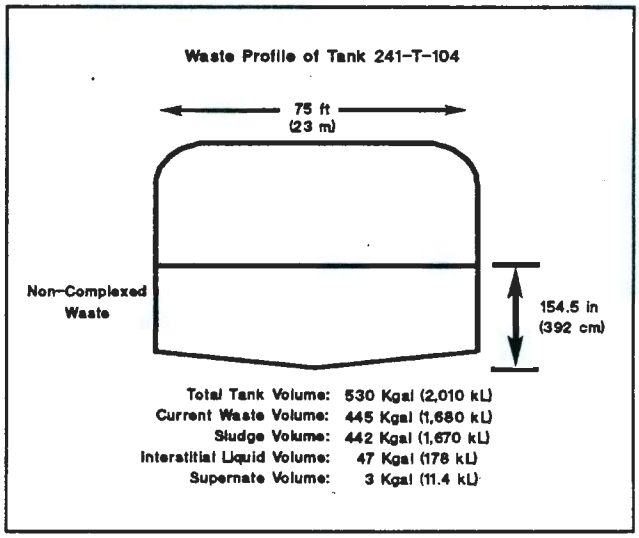
EXECUTIVE SUMMARY

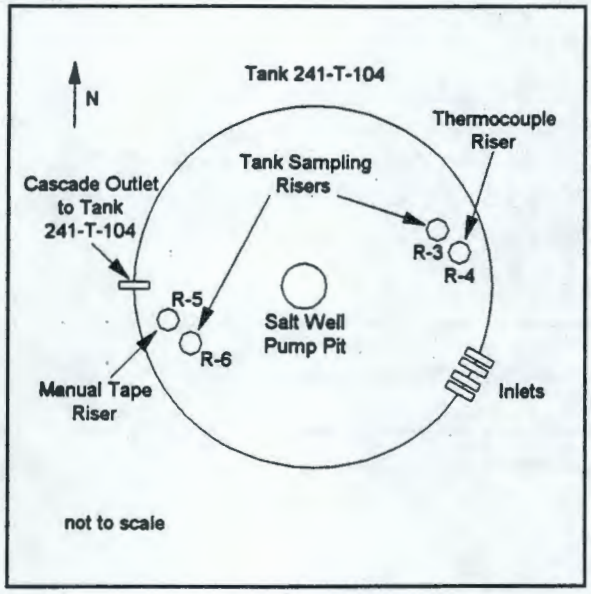
Single-Shell Tank 241-T-104 is an underground radioactive waste storage tank most recently sampled in August of 1992. Sampling and characterization of the waste in Tank 241-T-104 contributes toward the fulfillment of Milestone M-44-05 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology, EPA, and DOE, 1993). Characterization will also provide support for the Tank Farm Operations, safety programs, and design of retrieval, pretreatment, and disposal systems.



Tank 241-T-104, located in the 200 West Area T Tank Farm, was constructed in 1944 and went into service in March of 1946 by receiving first cycle decontamination waste from the bismuth phosphate in the T Plant. Only T Plant first cycle decontamination waste was received during the service life of the tank. It is the first tank in a cascade with Tanks 241-T-105 and 241-T-106. The tank has an operational capacity of 2,010,000 L (530,000 gallons), and currently contains 1,680,000 (445,000 gallons of non-complexed waste, existing primarily as sludge. The final disposal of the waste in Tank 241-T-104 will be as high- and low-level glass fractions. The tank is not classified as a Watch List tank, and there are no Unreviewed Safety Questions associated with Tank 241-T-104 at this time. The tank was primary stabilized in 1978 and partial interim isolated in 1982.

The waste in Tank 241-T-104 is largely comprised of precipitated salts, some of which contain radioactive isotopes. The most prevalent analytes in the both the solid and liquid portions of the waste include aluminum, bismuth, iron, silicon, sodium, fluoride, nitrate, nitrite, phosphate and sulfate. In addition, the chromium concentration in both the liquid and solid phases exceeded the Toxicity Characteristic regulatory threshold. The major radionuclide constituents present in the solids are ^{241}Am, ^{137}Cs, ^{237}Np, $^{239/240}$Pu, and ^{90}Sr. Only ^{137}Cs was found in substantial concentration in the liquid waste. The solid waste was found to be 70.5% water. Comparisons to established limits for concern for selected analytes can be made by referring to the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

The results of the analyses have been compared to the dangerous waste codes in the *Washington Dangerous Waste Regulations* (Ecology, 1991). This assessment was conducted by comparing tank analyses against dangerous waste characteristics ("D" waste codes) and against state waste codes. It did not include checking tank analyses against "U", "P", "F", or "K" waste codes since application of these codes is dependent on the source of the waste and not on particular constituent concentrations. The results indicate that the waste in this tank is adequately described in the Dangerous Waste Permit Application for the Single-Shell Tank System; this permit is discussed in the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).



Tank 241-T-104	
Tank Description	
Type:	Single-Shell
Constructed:	1944
In-Service:	1946
Out of Service:	1976
Diameter:	23 m (75 feet)
Usuable Depth:	4.9 m (16 feet)
Operating Capacity:	2,010,000 L (530,000 gal)
Bottom Shape:	Dish
Hanford Coordinates:	43,547° North 75,657° West
Total Risers:	9
Ventilation:	Passive
Tank Status (as of September 1994)	
Contents:	Non-Complexed waste
Total Waste Volume:	1,680,000 L) (445,000 gal)
Sludge Volume:	1,670,000 L (442,000 gal)
Interstitial Liquid Volume:	1.78E+05L (47,000 gal)
Supernatant Volume:	11,400 L (3,000 gallons)
Manual Tape Level:	392 cm (154.5 in)
Temperature:	67° F (19.4°C) (7/21/94)
Integrity Category:	Sound
Isolation Status	
Primary Stabilized:	1978
Partial Interim Isolated:	1982

Single-Shell Tank 241-T-104 Concentrations and Inventories for Critical List Analytes (as of August 1992)		
Physical Properties	**Solids**	
Density	liquid: 1.13 g/mL	solid: 1.29 g/mL
pH		9.99
Percent Water (solid)		70.5%
Heat Load		60.3 Watts
Chemical Constituents	**Analyte Weight Percent**	**Solid Bulk Inventory (kg)**
Metals		
Al (Aluminum)	1.92	34,800
Bi (Bismuth)	2.24	40,600
Ca (Calcium)	0.183	3,310
Fe (Iron)	1.07	19,400
Si (Silicon)	0.773	14,000
Na (Sodium)	7.68	1.39E+05
Anions		
F^- (Fluoride)	1.02	18,400
NO_3^- (Nitrate)	6.91	1.25E+05
NO_2^- (Nitrite)	0.485	8,770
PO_4^{3-} (Phosphate)	2.12	38,300
SO_4^{2-} (Sulfate)	0.464	8,390
Organics		
Total Organic Carbon	0.0840	1,520
Radionuclides	**Analyte Concentration (μCi/g)**	**Solid Bulk Inventory (Ci)**
^{241}Am	0.0173	37.2
^{137}Cs	0.199	428
^{237}Np	0.137	295
^{238}Pu	< 0.018	< 38.7
$^{239/240}Pu$	0.140	301
^{90}Sr	2.63	5,660

*These inventory values, as well as those presented in Section 5 and Appendix A, are based on the volume of the waste at the time of sampling (liquid: 1.89E+05 L; solid: 1.67E+06 L).

CONTENTS

1.0 INTRODUCTION 1-1
1.1 PURPOSE 1-1
1.2 SCOPE 1-1
1.3 ASSUMPTIONS 1-2

2.0 HISTORICAL TANK INFORMATION 2-1
2.1 TANK HISTORY 2-1
2.2 TANK STATUS 2-5
2.3 PROCESS KNOWLEDGE 2-5
2.4 HISTORICAL ESTIMATION OF THE CONTENTS OF TANK 241-T-104 . . . 2-6
2.4.1 Process History Estimation 2-6
2.4.2 Historical Sampling Estimation 2-8
2.5 SURVEILLANCE DATA 2-9
2.5.1 Surface Level Readings 2-9
2.5.2 Internal Tank Temperatures 2-10

3.0 TANK SAMPLING OVERVIEW 3-1
3.1 DESCRIPTION OF SAMPLING EVENT 3-1
3.2 REQUESTED ANALYSES 3-1

4.0 SAMPLE HANDLING AND ANALYTICAL SCHEME 4-1
4.1 WASTE DESCRIPTION 4-1
4.2 HOLD TIME CONSIDERATIONS 4-2
4.2.1 WHC 222-S Process and Analytical Chemistry Laboratory 4-3
4.2.2 Pacific Northwest Laboratory - 325 Laboratory 4-3
4.3 SAMPLE PREPARATION 4-3
4.4 ANALYTICAL METHODS 4-3
4.4.1 Physical and Rheological Tests 4-3
4.4.2 Chemical and Radionuclide Constituent Analysis 4-4
4.4.3 Volatile and Semi-Volatile Organic Constituent Analysis 4-5
4.5 MODULE SPECIFIC ANALYSES 4-6

5.0 ANALYTICAL RESULTS AND WASTE INVENTORY 5-1
5.1 CHEMICAL ANALYSES 5-1
5.1.1 Elemental Constituents 5-1
5.1.2 Anions 5-2
5.2 RADIOLOGICAL DETERMINATIONS 5-3
5.3 ORGANIC CONSTITUENTS 5-4
5.4 PHYSICAL MEASUREMENTS 5-5
5.4.1 Density and Percent Solids 5-5
5.4.2 Particle Size 5-6
5.4.3 Rheology 5-7
5.4.4 Energetics 5-8
5.5 DATA PRESENTATION 5-8

CONTENTS (continued)

6.0 ANALYTICAL RESULTS INTERPRETATION 6-1
6.1 TANK WASTE PROFILE 6-1
6.2 PROJECTED TANK HEAT LOAD 6-1
6.3 PROGRAM ELEMENT SPECIFIC ANALYSES 6-1

7.0 STATISTICAL INTERPRETATION 7-1
7.1 MASS AND CHARGE BALANCE 7-1
7.2 STATISTICAL ANALYSIS 7-2
7.3 ANALYTICAL ERROR ESTIMATION 7-5
7.3.1 Systematic Analytical Error 7-5
7.3.2 Random Analytical Error 7-6
7.4 DATA VALIDATION FINDINGS 7-8

8.0 RECOMMENDATIONS 8-1
8.1 SAFETY ISSUES 8-1
8.2 FURTHER CHARACTERIZATION NEEDS 8-1

9.0 REFERENCES 9-1

APPENDIX A ANALYTICAL RESULTS . . . . . A-i

LIST OF FIGURES

2-1. Basic Design of Tank 241-T-104 2-2

2-2. Riser Configuration for Tank 241-T-104 2-3

2-3. Location of the 241-T Tank Farm 2-4

2-4. Waste Volume History of Tank 241-T-104 2-7

2-5. Tank 241-T-104 Historical Temperature Data 2-11

6-1. Waste Profile of Tank 241-T-104. 6-2

LIST OF TABLES

2-1. Estimated Total Volume of Waste Types Received By Tank 241-T-104 2-6

2-2. Process History Model Estimate of Tank 241-T-104 Compared to TRAC and 1979 Sampling Estimates 2-9

3-1. Tank 241-T-104 Sample Numbers and Locations 3-2

3-2. Tank 241-T-104 Segment Tracking Numbers 3-3

3-3. Tank 241-T-104 Composite and Other Tracking Numbers 3-3

4-1. Physical and Rheological Tests 4-3

4-2. Analytical Methods 4-4

5-1. Analytical Data Presentation Tables 5-1

5-2. Comparison of Analytical and Historical Data for Elemental Constituents of the Solid Phase of Tank 241-T-104 5-2

5-3. Comparison of Analytical and Historical Results for Tank 241-T-104 Anions in the Solid Phase 5-2

5-4. Comparison of ICP and IC Phosphate Results 5-3

5-5. Half-lives of Selected Radionuclides 5-3

5-6. Comparison of Analytical and Historical Isotopic Results 5-4

5-7. Total Beta Comparison 5-4

5-8. Tank 241-T-104 Volatile Organic Compounds 5-4

5-9. Tank 241-T-104 Semi-Volatile Organic Compounds 5-5

5-10. Tank 241-T-104 Physical Measurements 5-5

5-11. Tank 241-T-104 Particle Size Data 5-6

5-12. Shear Strength Results 5-7

5-13. Tank Characterization Report Data for Single-Shell Tank 241-T-104 5-8

6-1. Tank 241-T-104 Projected Heat Load 6-3

6-2. Applicability of Characterization Information to the Data Needs of the TWRS Program Elements 6-4

LIST OF TABLES (continued)

7-1. Cation Mass and Charge Data 7-1

7-2. Anion Mass and Charge Data 7-2

7-3. Mass Balance Totals 7-2

7-4. Special Analyte List 7-3

7-5. Variance Component Estimates 7-4

7-6. Measurement Error Estimates for Tank 241-T-104 7-6

LIST OF TERMS

AEA	alpha energy analysis
ANOVA	analysis of variance
CVAA	cold vapor atomic absorption
DL	detection limit
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DQO	data quality objectives
DSC	differential scanning calorimetry
EPA	U.S. Environmental Protection Agency
GEA	gamma energy analysis
GHAA	gaseous hydride atomic absorption
IC	ion chromatography
ICP	inductively coupled plasma atomic emission spectrometry
NPH	normal paraffin hydrocarbon
PNL	Pacific Northwest Laboratory
RPD	relative percent difference
RSD	relative standard deviation
TGA	thermogravimetric analysis
TMACS	Tank Monitor and Control System
TOC	total organic carbon
TRAC	Track Radionuclide Components
TWRS	Tank Waste Remediation System
WHC	Westinghouse Hanford Company
1C	first-cycle decontamination

1.0 INTRODUCTION

In August 1992, Single-Shell Tank 241-T-104 was sampled to determine proper handling of the waste, to address corrosivity and compatibility issues, and to comply with requirements of the *Washington Administrative Code* (Ecology, 1991). This Tank Characterization Report presents an overview of that tank sampling and analysis effort, and contains observations regarding waste characteristics. It also addresses expected concentration and bulk inventory data for the waste contents based on this latest sampling data and background tank information.

1.1 PURPOSE

The purpose of this report is to describe and characterize the waste in Single-Shell Tank 241-T-104 (hereafter, Tank 241-T-104) based on information given from various sources. This report summarizes the available information regarding the waste in Tank 241-T-104, and using the historical information to place the analytical data in context, arranges this information in a useful format for making management and technical decisions concerning this waste tank. In addition, conclusions and recommendations are given based on safety issues and further characterization needs.

Specific objectives reached by the sampling and characterization of the waste in Tank 241-T-104 are:

- Contribute toward the fulfillment of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-44-05 concerning the characterization of Hanford Site high-level radioactive waste tanks (Ecology, EPA, and DOE; 1993).

- Complete safety screening of the contents of Tank 241-T-104 to meet characterization requirements of the *Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 93-5* (Conway, 1993).

- Provide tank waste characterization information to the Tank Waste Remediation System (TWRS) Program Elements in accordance with the *TWRS Tank Waste Analysis Plan* (Bell, 1994).

1.2 SCOPE

A broad description of the tank and its historical background are presented first. This allows a detailed estimation of the contents of Tank 241-T-104 based on historical process information and detailed transaction records. Next, the results of the sampling and analysis effort are summarized and interpreted both qualitatively and statistically. The information obtained from historical sources is then compared with the actual waste measurements to arrive at final waste inventory and concentration estimates. Finally, conclusions and recommendations are given based on the current waste inventory and tank status.

1.3 ASSUMPTIONS

The concentration and inventory estimates derived for this report are considered by the authors and by the Westinghouse Hanford Company Characterization Program to be the most accurate, defensible, technically valid, and contemporary data concerning Tank 241-T-104. This Tank Characterization Report incorporates all available previous sampling, characterization, and transfer data concerning Tank 241-T-104. In addition, estimates of the current tank contents based on process knowledge and waste transaction records provide important cross-checks and corroboration to the inventory estimates derived from recent analytical data.

The term "analytical results" is used in this report to denote sample results from the most recent sampling event. Characterization data from these samples are used as the basis for the analytical section of this report, Section 5.0. The historical characterization of this tank, Section 2.4, is based on the available "historical results" prior to the 1992 sampling.

Tank 241-T-104 no longer receives waste, and intrusion prevention work has been completed on this tank. The characterization of Tank 241-T-104 is considered accurate and representative of the tank contents as of the date of preparation of this report: September 1994.

2.0 HISTORICAL TANK INFORMATION

The purpose of this section is to describe Tank 241-T-104 based on historical information. It is divided into five parts. A brief description and historical background of the tank comprise the first part, followed by the current tank status, a summary of the process sources that contributed to the tank waste, and an estimation of the contents of Tank 241-T-104 based on historical information. The final part details the surveillance data taken on the tank.

2.1 TANK HISTORY

Single-Shell Tank 241-T-104 consists of a carbon steel tank within a reinforced concrete shell and dome. The tank has a diameter of 23m (75 ft), an operating depth of 4.9 m (16 ft), and a capacity of 2,010,000 L (530,000 gallons) (Husa et al., 1993). The bottom of the tank is dish-shaped. The basic design of Tank 241-T-104 is shown in Figure 2-1. Instruments access Tank 241-T-104 through risers and monitor the temperature, sludge level, and other bulk tank characteristics (Fulton, 1992). The position of these risers is found in Figure 2-2.

The 241-T Tank Farm, built in 1943 and 1944, is one of the initial four tank farms to be used at the Hanford Site. It is the northernmost tank farm in the 200 West Area. Figure 2-3 details the Hanford Site's 200 West Area and the location of the 241-T Tank Farm. Figure 2-2 shows the position of Tank 241-T-104 within the 241-T Tank Farm.

Tank 241-T-104 is the first, or primary, tank in a "cascade" connecting it to Tanks 241-T-105 and 241-T-106. A cascade was a system where a number of tanks were connected in series by pipes. These pipes were located near the top of the tanks' working depths. Waste added to the primary tank in a cascade would flow to the next tank when the waste reached the level of the cascade piping. By using a cascade, fewer connections needed to be made during waste handling operations. This method reduced waste handling requirements, personnel exposure, and the chance of a loss of tank integrity from waste overflow. Another advantage of using the cascade system was waste volume reduction from the disposal of clarified liquid waste. Entrained and precipitated solids would settle in the primary tank (in this case Tank 241-T-104), and the clarified liquids would flow through the cascade on to the secondary tanks (241-T-105 and 241-T-106). This practice led to rapid accumulation of solids in the primary tank and disposal of clarified liquid from secondary tanks into cribs.

Tank 241-T-104 went into service in 1946, receiving first cycle decontamination (1C) waste (Anderson, 1990). Produced in the bismuth phosphate process at T-Plant, 1C waste contained by-products co-precipitated from a solution containing plutonium. The 1C waste was discharged to Tank 241-T-104, cascaded to Tank 241-T-105, and then on to Tank 241-T-106. Waste from Tank 241-T-104 has been transferred to various tanks and cribs.

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Figure 2-1. Basic Design of Tank 241-T-104.

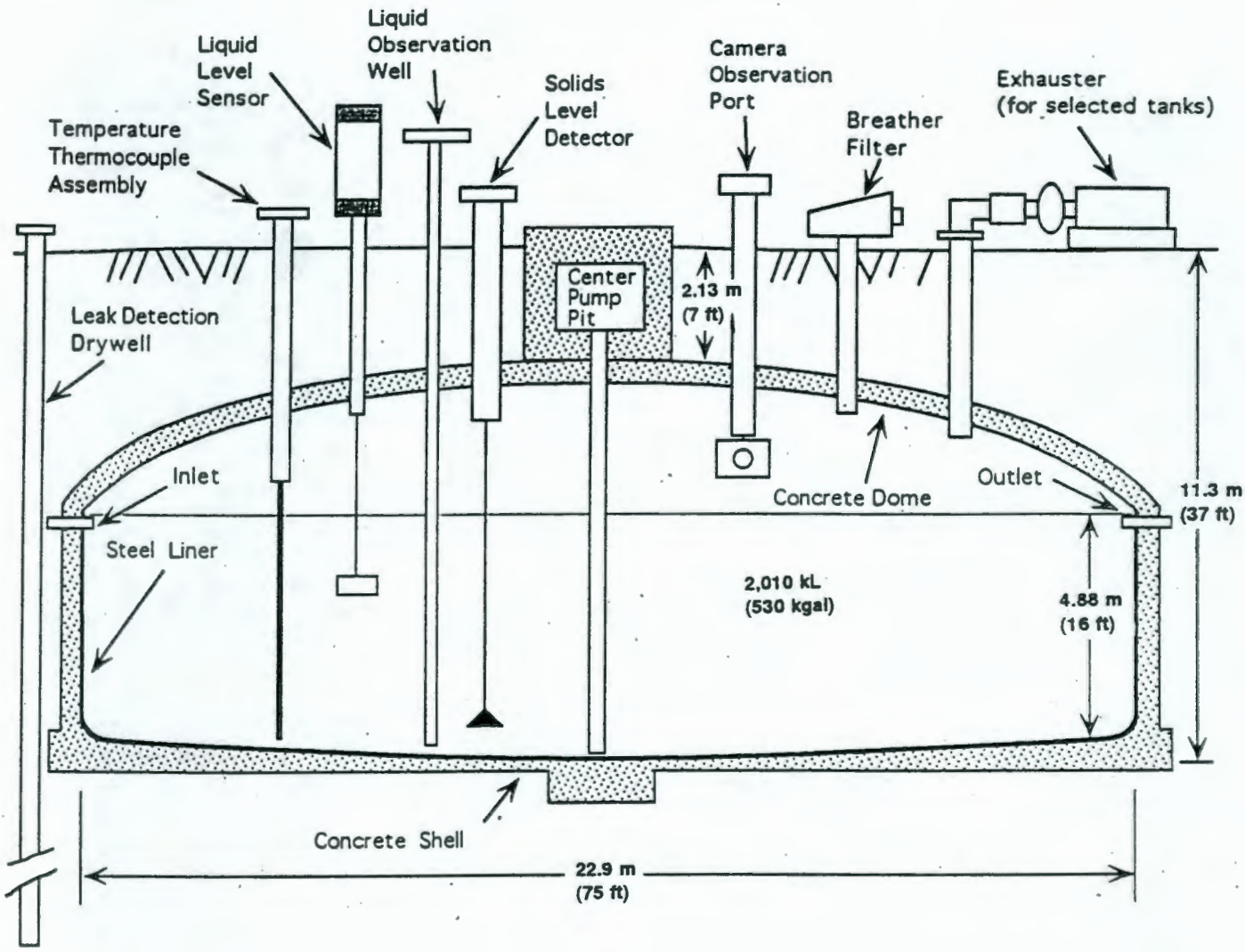
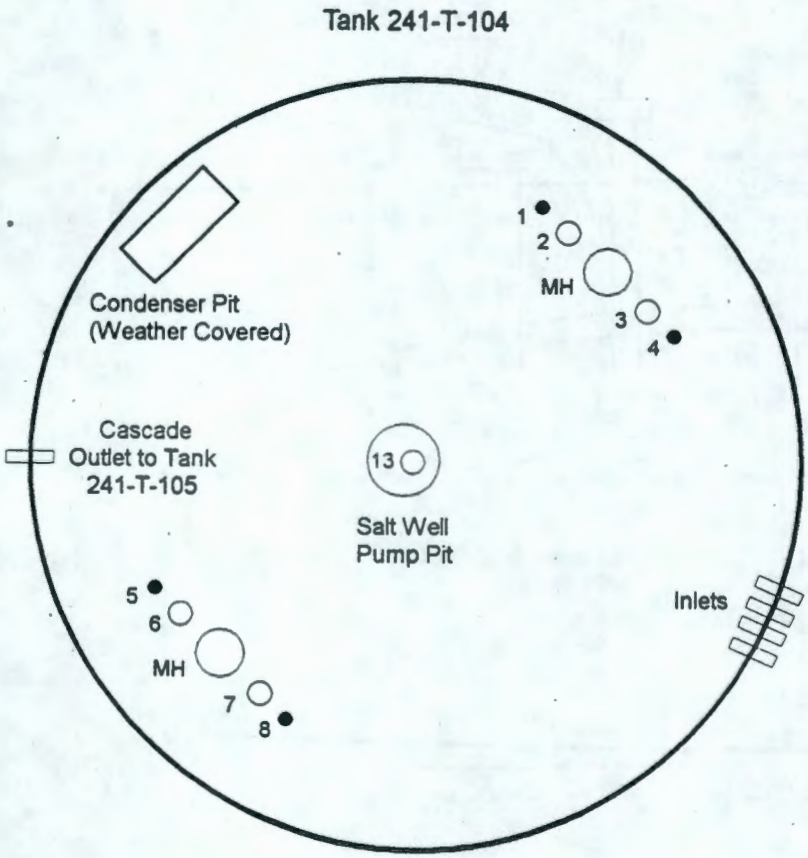
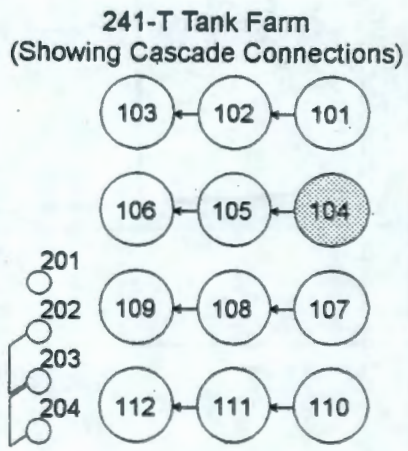


Figure 2-2. Riser Configuration for Tank 241-T-104.



MH 42" Manhole in dome, no riser to surface

No.	Dia.	Description and Comments
1	4"	Liquid Observation Well
2	12"	Blind Flange
3	12"	Spare
4	4"	Thermocouple Probe
5	4"	Liquid Level Reel
6	12"	Spare
7	12"	Concrete Plug
8	4"	Breather Filter
13	12"	Saltwell Screen



Sources: Fulton, 1992
Vitro Eng. Corp., 1979
Hanford Eng. Works, 1944

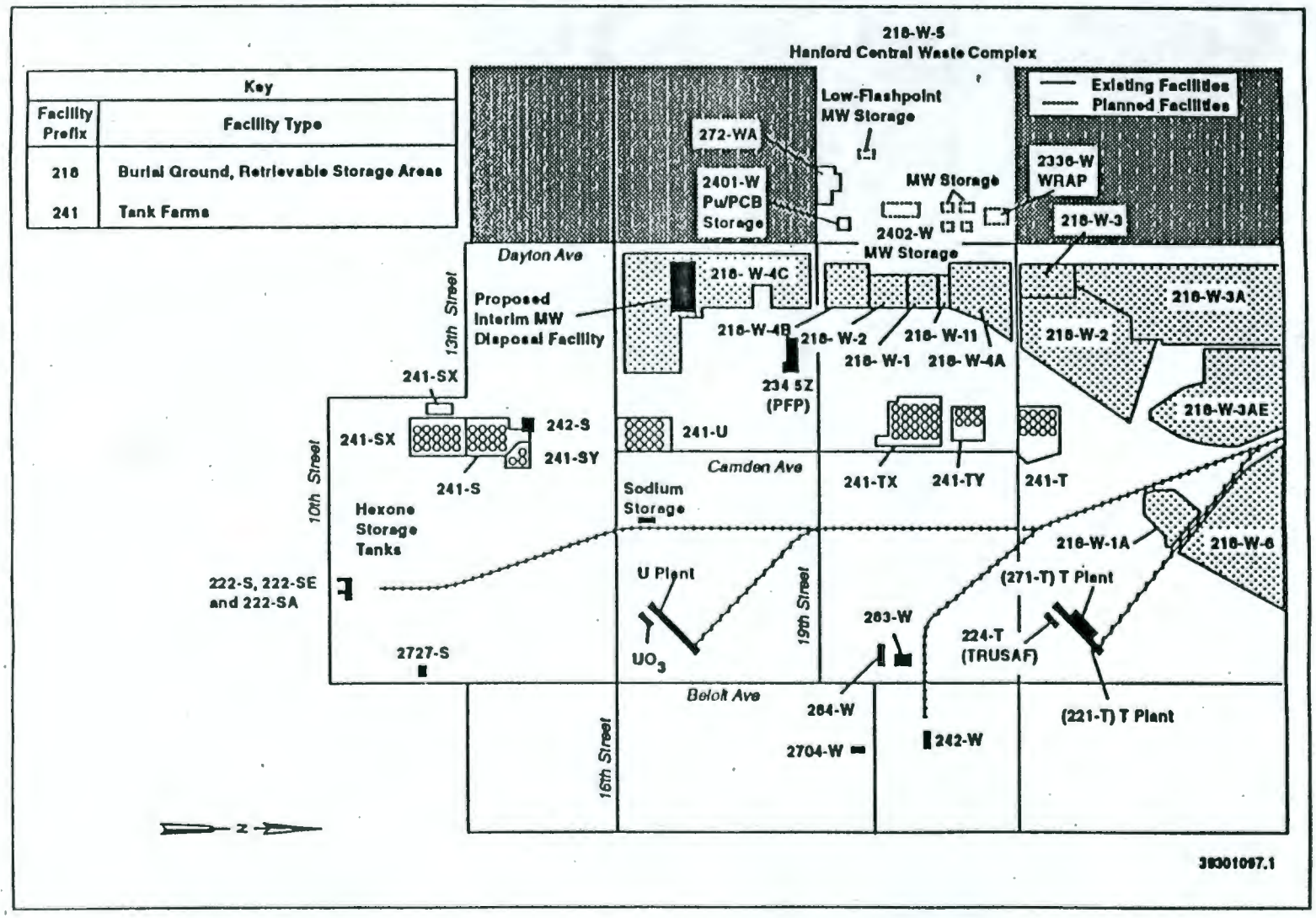


Figure 2-3. Location of the 241-T Tank Farm.

Two dry wells were drilled in 1974; another three dry wells were drilled in 1975 (Anderson, 1990). Tank 241-T-104 received its last waste additions in 1954 (Jungfleisch, 1984a). The tank was officially removed from service in 1976. A new salt well was installed in 1976. Pumping of the salt well was completed in 1978. Later that year the tank was primary stabilized (Anderson, 1990). This involved the removal of liquid above the solids (except for isolated surface pockets). Removing liquids minimizes the risk of waste leaking out of the tank. The tank was partially interim isolated in 1982. Partial interim isolation involves the completion of the physical effort required to minimize the potential for liquids to be inadvertently added to an inactive storage tank; however, risers and piping necessary for further stabilization efforts are kept available.

2.2 TANK STATUS

The *Tank Farm Surveillance and Waste Status Summary Report for March 1994* (Hanlon, 1994) reports that Tank 241-T-104 has a total waste volume of 1,680,000 liters (445,000 gallons). Of this waste, 1,670,000 liters (420,000 gallons) are sludge and 11,400 liters (3,000 gallons) are supernate. There are 178,000 liters (47,000 gallons) of drainable interstitial liquid. The tank is filled to 84% of its working capacity. Current temperature data indicates that the highest temperature in the tank is 19.4°C (67°F). Waste levels and tank temperatures are further discussed in Section 2.5. Tank 241-T-104 is listed as a low heat load tank (Hanlon, 1994). Heat generation is discussed further in Section 6.2.1. Tank 241-T-104 is passively vented to the atmosphere through a breather filter (Bergmann, 1991). All monitoring systems are currently in compliance with documented standards (Hanlon, 1994).

The contents of Tank 241-T-104 are currently designated as non-complexed waste. This is a general term to describe waste that does not have a high content of carbon complexants and/or organic carbon. Tank 241-T-104 is not a Watch List tank, nor does it have Unreviewed Safety Questions associated with it. The integrity of Tank 241-T-104 is sound. The tank has been primary stabilized and partially interim isolated. It is scheduled for interim stabilization in 1998 (Hanlon, 1994).

2.3 PROCESS KNOWLEDGE

Tank 241-T-104 began to be filled with 1C waste in March 1946. The tank was filled in August of that year. There was no cascading at this time. Nearly 3,400,000 liters (900,000 gallons) of 1C waste was received by Tank 241-T-104 in a series of additions in 1948 and 1949 (Jungfleisch, 1984a). The tank was already full, so this waste all cascaded to Tanks 241-T-105 and 241-T-106. Since it was the primary tank in the cascade, most of the solids in the 1C waste settled in Tank 241-T-104. When the supernate was removed from the tanks in the cascade and sent to cribs in 1954, Tank 241-T-104 held 1,410,000 liters (372,000 gallons) of solids (Anderson, 1990). A discrepancy in the historical records is found here. Up to this time, 5,360,000 liters (1,440,000 gallons) of waste additions (all pre-1951 1C) to Tank 241-T-104 are documented (Jungfleisch, 1984a). For 5,360,000 liters of waste to deposit 1,410,000 liters of solids in a tank, the waste stream must be at least 26% solids. Pre-1951 1C waste, however, is expected to be only about 13.7% solids (Agnew, 1994).

In 1954, a series of additions of 1C waste to Tank 241-T-104 brought 3,900,000 liters (1,030,000 gallons) of waste into the tank (Jungfleisch, 1984a). This 1C waste included coating waste and stack drainage that were combined with 1C waste after May 1951 (Agnew, 1994). Coating waste was produced from the dissolution of aluminum fuel cladding in a sodium nitrate-sodium hydroxide solution. Much of this waste was cascaded to Tank 241-T-105; some of the waste was pumped to other tanks. This was the last time Tank 241-T-104 received waste. A supernate transfer out of the tank brought the volume to 1,830,000 liters (483,000 gallons). Salt well pumping and settling of the waste brought the tank to its current waste volume of 1,680,000 liters (445,000 gallons). Table 2-1 uses transaction records to present an estimate of the total volume of waste that has been received by Tank 241-T-104. A graphical waste volume history of Tank 241-T-104 is included as Figure 2-4.

Table 2-1. Estimated Total Volume of Waste Types Received By Tank 241-T-104. (Jungfleisch, 1984a; Anderson, 1990)

Waste Type	Estimated Volume*
1C 1944-1951	5,360,000 L (1,415,000 gallons)
1C 1951-1956**	3,900,000 L (1,030,000 gallons)

1C First cycle decontamination waste.

* Total volume is greater than 2,010,000 L (530,000 gallons) because waste was routinely pumped from Tank 241-T-104 and also cascaded to Tank 241-T-105.

** Coating waste and stack drainage were added to 1C waste after May 1951.

2.4 HISTORICAL ESTIMATION OF THE CONTENTS OF TANK 241-T-104

A preliminary estimate of the waste constituents in Tank 241-T-104 can be developed by reviewing historical data for the tank. This section uses the process history of the tank and past sampling efforts to develop an estimation of the contents of Tank 241-T-104.

2.4.1 Process History Estimation

Section 2.3 describes the history of Tank 241-T-104 as repeated filling of the tank with first cycle (1C) decontamination waste and cascading to Tank 241-T-105 or pumping of the supernate. There is no record of any waste type other than 1C waste being received by the tank. The composition of 1C waste varied, however. As discussed in Section 2.3, coating waste and stack drainage were included in 1C waste after May 1951.

A model has been developed for this report to estimate the chemical content of Tank 241-T-104. This model has been labeled the Process History Model, and uses historical transfer records and level measurements to develop an estimate of the constituents in the tank. This model estimates the tank's solids content of both types of 1C waste and then uses the compositions of these wastes (Agnew, 1994) to develop an overall estimate. Another estimate based on the tank's process history is the TRAC (Track Radionuclide Components) database program (Jungfleisch, 1984b). Both estimates are presented in Table 2-2.

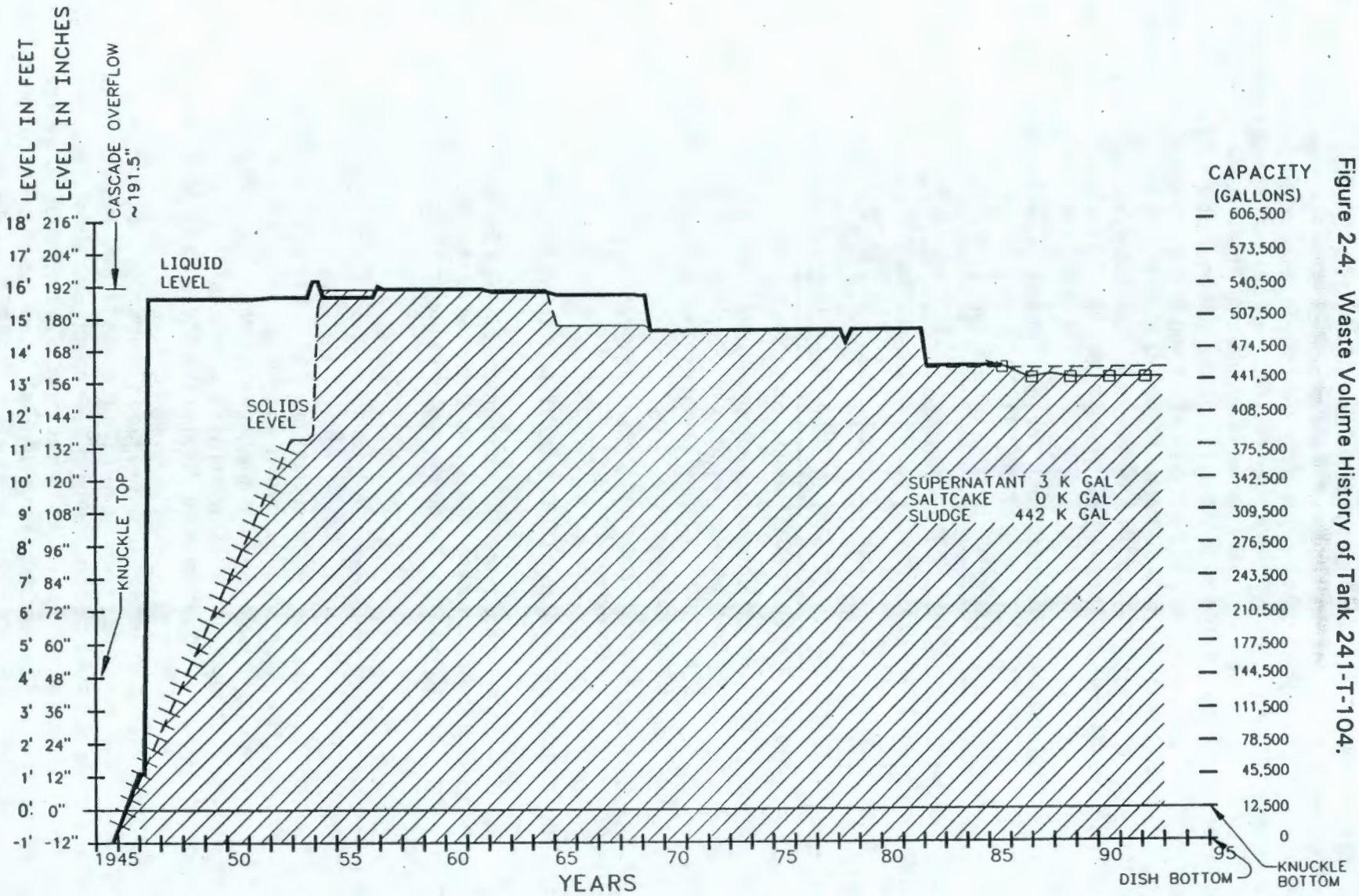


Figure 2-4. Waste Volume History of Tank 241-T-104.

2.4.1.1 Basis of the Process History Model. The following points from the process history of Tank 241-T-104 are key in developing a model to estimate the tank's current contents:

- Before any post-1951 1C waste was received, there were 1,410,000 liters of settled 1C solids in Tank 241-T-104 (Anderson, 1990).
- Post-1951 1C waste was then added and allowed to settle.
- After supernate was pumped from the tank, 1,830,000 liters of solids remained (Anderson, 1990).
- Salt well pumping and further settling of the solids have brought the waste to its current sludge volume of 1,670,000 liters.

The Process History Model for Tank 241-T-104 was used to estimate the tank's contents. This model assumes that when the tank's solids volume was 1,830,000 liters, the pre- and post-1951 1C waste volumes were 1,410,000 and 420,000 liters respectively. It then assumes that both types of solids settled and that the volume of each was reduced proportionally to arrive at a total solids volume of 1,670,000 liters. This resulted in 1,290,000 liters of pre-1951 1C waste and 386,500 liters of post-1951 1C waste. These were the volumes used for the estimate. The model neglects characterization of liquids.

A linear combination using 1,290,000 liters of pre-1951 1C waste and 386,500 liters of post-1951 1C waste was combined with waste stream constituent data to arrive at an inventory estimate. The constituent data was taken from *Hanford Defined Wastes: Chemical and Radionuclide Compositions* (Agnew, 1994). The resulting Process History Model estimates are presented in Table 2-2 and are used as the Historic Tank Content Estimates in Table 5-12.

2.4.2 Historical Sampling Estimation

Tank 241-T-104 was core sampled in 1979. Analyses were performed for both water soluble and water insoluble KOH fusion aliquots (Horton, 1979). The results of these analyses were given in weight percent. To develop an estimate of the tank's current contents, it was assumed that the 1.67E+06 L of solid waste currently in the tank reflects the character and analyte concentrations of this sampling. This assumption is justified because the only apparent change in the volume of Tank 241-T-104 since 1979 has been the result of a level adjustment. This estimate is compared to the Process History Model and TRAC estimates in Table 2-2. In cases where the analysis for a particular analyte was performed on both water soluble and KOH fusion samples, the greater result is reported.

The analyses from this 1979 sampling event indicate a very high level of organic constituents in the tank (Horton, 1979). The concentration of total organic carbon is high enough to qualify the tank for the organic Watch List. However, waste stream data indicate that the 1C waste that the tank holds should not contain any organic carbon. The high organics result has recently been re-evaluated and is believed to be incorrect. It is theorized that the sample was contaminated with organic carbon during the preparation or analysis, possibly by plastic bottles (Hopkins, 1992). The wisdom of using a KOH fusion for total organic carbon analysis was also questioned.

Table 2-2. Process History Model Estimate of Tank 241-T-104 Compared to TRAC (Jungfleisch, 1984b) and 1979 Sampling (Horton, 1979) Estimates.

Process History Model			TRAC	1979 Sample
Physical Properties				
Total Waste	1.67E+06 L (2.3E+06 kg)			2.2E+06 kg
Bulk Density	1.36 g/mL			1.31 g/mL
Void Fraction	0.629			
wt% Water	66.5			62.0
Chemical Constituents				
Analyte	**μg/g**	**kg**	**kg**	**kg**
Na	78,100	1.79E+05	1.15E+05	2.85E+05
Al	24,900	57,200	10,800	26,300
Fe	7,980	18,300	16,800	4,380
Cr	495	1,140	1,040	2,190
Bi	13,900	32,000	41,800	28,500
$ZrO(OH)_2$	1,740	4,700	5,360	-
U	8,900	23,800	2,380	162
OH^-	55,400	1.27E+05	17,000	-
NO_3^-	15,300	34,600	2.48E+05	1.51E+05
NO_2^-	3,950	8,940	13,800	-
PO_4^{3-}	89,900	2.06E+05	66,500	1.71E+05
SO_4^{2-}	2,840	6,440	9,600	< detection
SiO_3^{2-}	5,080	31,600	4,600	17,500
F^-	5,330	12,200	7,600	35,100
TOC	0	0	0	2.24E+05
Radiological Constituents				
Pu	0.030 μCi/g	95 Ci	320 Ci	552 Ci
Cs	9.05 μCi/g	20,000 Ci	10,000 Ci	2,850 Ci
Sr	0.43 μCi/g	952 Ci	45,000 Ci	11,000 Ci

2.5 SURVEILLANCE DATA

2.5.1 Surface Level Readings

To determine the surface level of the waste, Tank 241-T-104 is equipped with a manual tape. The manual tape uses a conductivity probe which is lowered by a hand crank until contact is made with the waste surface and an electric circuit is completed. The measurement is later manually recorded on the Computer Automated Surveillance System.

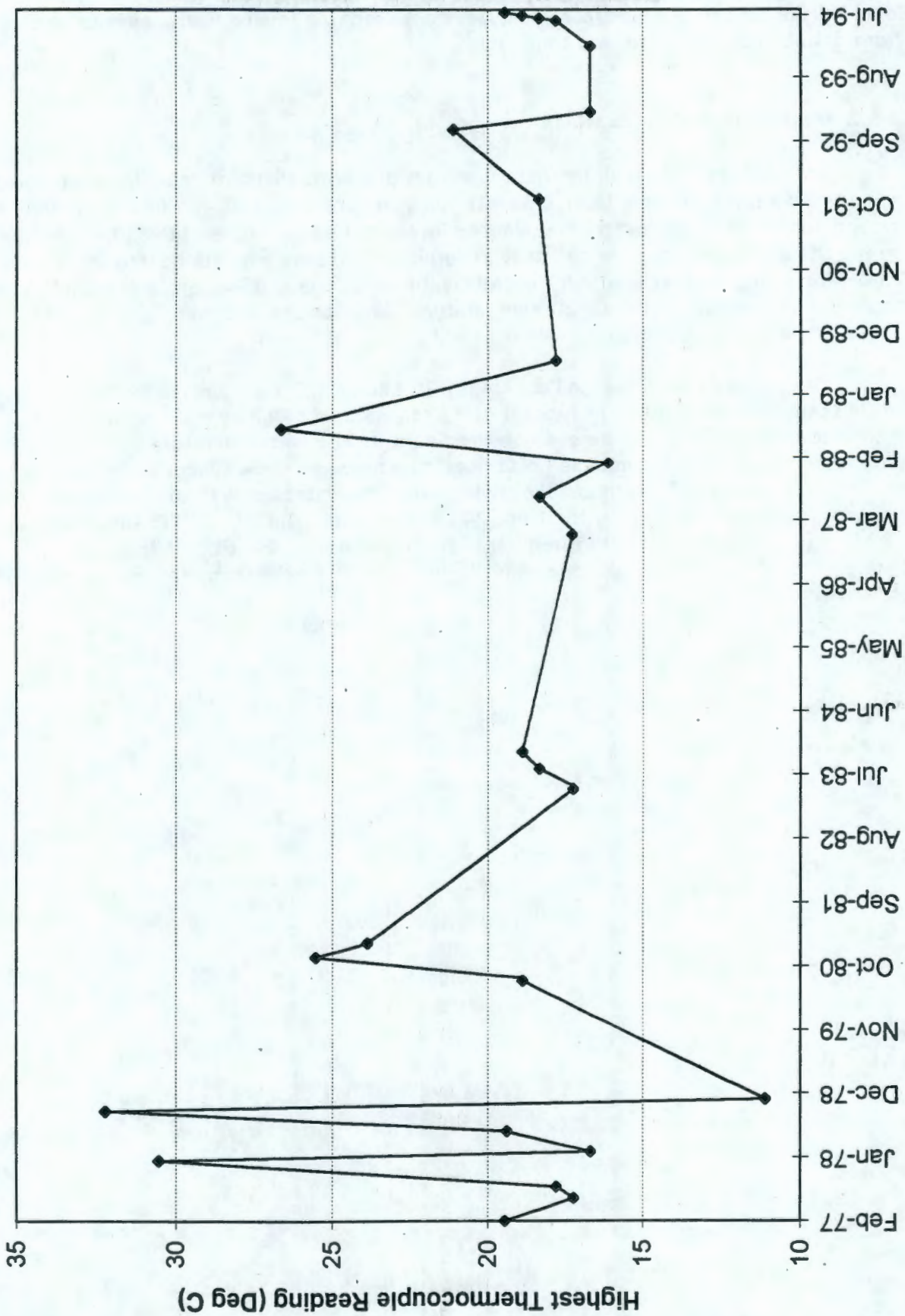
Surface level readings are currently being taken quarterly. The most recent manual tape reading available was 392.4 cm (154.5 in.) taken July 1, 1994 (Rios, 1994). The waste level in Tank 241-T-104 has remained very consistent for several years, as is to be expected from a stabilized out-of-service tank.

2.5.2 Internal Tank Temperatures

To measure local tank temperatures, a probe with 11 thermocouples assembled in a pipe (called a thermocouple tree), was inserted into Tank 241-T-104. The thermocouple tree monitors the waste temperatures at various levels in the tank. Nine of the 11 thermocouples on the thermocouple tree are currently in service. The tank was connected to TMACS (the Tank Monitoring and Acquisition Control System) in June, 1994. Since then, TMACS has continuously monitored the tank's temperature, downloading the reading once a day to the Surveillance Analysis Computer System.

Temperature readings for Tank 241-T-104 since 1977 are plotted as Figure 2-5. Each plotted temperature point is the highest of the readings recorded by the thermocouples on the thermocouple tree. As can be seen on the figure, historical temperature data points for the tank are sparse. This is because no temperature readings were taken, or temperature data sheets were misplaced and thus not available when the database was later compiled. The last available temperature reading for Tank 241-T-104 was 19.4° C (67°F) taken on July 21, 1994. Figure 2-5 illustrates that temperatures have been stable since 1980, ranging mostly between 15°C and 25°C; only occasionally since 1978 has the temperature exceeded 25°C.

Figure 2-5. Tank 241-T-104 Historical Temperature Data.



3.0 TANK SAMPLING OVERVIEW

The sampling of Tank 241-T-104 was conducted as part of an overall plan to characterize the wastes in all of the underground storage tanks on the Hanford Site. The results of these analyses will provide support for the Tank Farm Operations, safety programs, design of retrieval, pretreatment, and disposal systems, and contribute toward the fulfillment of milestones contained in the Tri-Party Agreement (Bell, 1994).

3.1 DESCRIPTION OF SAMPLING EVENT

Samples were collected on August 20 and 26, 1992 from riser 3 (Core 45), and August 27 and 28, 1992 from riser 6 (Core 46). Both risers are located near the outer edge of the tank. For a diagram of riser location, refer to Figure 2-2 in the previous chapter. Table 3-1 shows a list of tank farm and sample numbers with the date of sampling and location. Tables 3-2 and 3-3 show the Westinghouse Hanford Company 222-S Laboratory sample numbers that correspond to the Tank Farm Sample numbers. The core samples from Tank 241-T-104 were obtained using a core sampling truck that has sampling equipment mounted on a rotating platform. A stainless steel sampler was used to obtain a 48 cm (19 inch) long and 2.5 cm (1 inch) diameter core of waste (maximum volume of 187 milliliters). After the sampler was filled, it was extracted from the drill string and sealed within a stainless steel liner, to trap any liquid which might leak from the sampler. The liner was inserted into a shield shipping cask before transferral to the laboratories. Chain-of-custody forms were completed for each segment. For a further description of core sampling procedures, see the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994)

3.2 REQUESTED ANALYSES

The statement of work was not strictly followed when characterizing drainable liquids. The statement of work requires that a liquid composite sample be prepared from all segments that have 25 milliliters or more drainable aqueous liquid, and that a full characterization be performed on that composite. The statement of work also includes a provision for cases when there are not enough segments (containing greater than 25 milliliters drainable liquid) to prepare approximately 100 milliliters of liquid composite. This provision states that when not enough sample can be obtained for a liquid composite, the liquid shall be blended back into the solid composite samples.

About 25 milliliters of aqueous drainable liquid were obtained for Core 46, segment 7. Because no other aqueous drainable liquid was collected from Core 46, the statement of work indicated that the liquid was to be blended into the solid composite samples. This procedure was not followed for Core 46 drainable liquids. Instead, the liquid was saved, and the solid composites were sent out for characterization without blending the liquid in. This resulted in an aqueous sample that did not have enough volume for a full characterization.

Since not enough liquid sample was available for a full characterization, analysis was prioritized, and the sample was analyzed until there was no longer enough sample left for further characterization work.

Table 3-1. Tank 241-T-104 Sample Numbers and Locations.

Core	Riser	Segment	Tank Farm Sample Number	Shipping Sample Number	Cask	Date Sampled
45	3	1	92-051	S92-022	1008C	8-20-92
45	3	2	92-052	S92-023	C1028	8-20-92
45	3	3	92-053	S92-022	C1035	8-20-92
45	3	4	92-054	S92-022	C1019	8-20-92
45	3	5	92-055	S92-026	C1029	8-20-92
45	3	6	92-056	S92-026	C1034	8-20-92
45	3	7	92-057	S92-027	1010C	8-20-92
45	3	8	92-058	S92-027	C1023	8-20-92
45	3	9	92-059	S92-026	C1048	8-26-92
46	6	1	92-060	S92-023	C1015	8-27-92
46	6	2	92-062	S92-023	C1055	8-27-92
46	6	3	92-063	S92-023	1007C	8-27-92
46	6	4	92-064	S92-023	C1026	8-27-92
46	6	5	92-065	S92-023	1006C	8-27-92
46	6	6	92-066	S92-024	1004C	8-27-92
46	6	7	92-067	S92-024	C1036	8-28-92
46	6	8	92-068	S92-024	C1031	8-28-92
46	6	9	92-069	S92-025	C1021	8-28-92

Table 3-2. Tank 241-T-104 Segment Tracking Numbers.

Core	Segment	Homogenized Segment Tracking Numbers	Segment Analysis Tracking Numbers
45	1	K23, K24	K67, K68
45	2	K25, K26	K69, K70
45	3	K27, K28	K71, K72
45	4	K29, K30	K74, K75
45	5	K33, K34	K76, K77
45	6	K35, K36	K78, K79
45	7	K37, K38	K81, K82
45	8	K39, K40	K83, K84
45	9	K42, K43	K85, K86
46	1	K44, K45	K88, K89
46	2	K46, K47	K90, K91
46	3	K48, K49	K92, K93
46	4	K53, K54	K95, K96
46	5	K55, K56	K97, K98
46	6	K57, K58	K99, K100
46	7	K59, K60	K102, K103
46	8	K62, K63	K104, K105
46	9	K64, K65	K106, K107

Table 3-3. Tank 241-T-104 Composite and Other Tracking Numbers.

	Sample Number
45 Composite 1	K155, K156, K175
45 Composite 2	K157, K158, K176
46 Composite 1	K159, K160, K179
46 Composite 2	K161, K162, K180
Core 46 Segment 2	K146, K147
Toxicity Characteristic Leaching Procedure	K196, K198, K199, K200, K201
Hot Cell Blank	K183
Field Blank	K184

From the Pacific Northwest Laboratory, volatile organic analyses were requested on odd-numbered segment samples and rheology on even-numbered segment samples for Core 45. Volatile organic analyses were also requested for every segment from Core 46. Samples from both composites from each core were submitted for semi-volatile organic analysis, extractable organic halides, ^{63}Ni, Pu and U isotopic analyses. These samples and the requested analyses are as follows (Duchsherer, 1993):

Volatile organic analysis:	Core 45, segments 1, 3, 5, 7, 9. Core 46, segments 2, 3, 4, 5, 6, 7, 8, 9.
Semi-volatile organic analysis, Extractable organic halides:	Core 45, composites 1, 2. Core 46, composites 1, 2.
^{63}Ni, Pu and U isotopic:	Core 45, composites 1, 2. Core 46, composites 1, 2.
Volatile and semi-volatile organic analyses:	Hot cell blank. Field blank.
Rheology and Physical:	Core 45, segments 2, 4, 6, 8.

4.0 SAMPLE HANDLING AND ANALYTICAL SCHEME

The analytical procedures performed on the samples upon receipt from the tank farm sampling activity are the focus of this section.

4.1 WASTE DESCRIPTION

The samples obtained from core sampling activities in Tank 241-T-104 were a mixture of air, liquids, and solids. The following is a description of the contents of each 187 mL core segment after sampler extrusion (Duchsherer, 1993).

Core 45

Segment 1: The sampler was 5% full. There was a tiny amount of liquid, but not enough to observe characteristics. The sampler contained a small amount (approximately 25 g) of light brown, mud-like solids.

Segment 2: The sampler was 90% filled with solids, with portions of solids towards the top of the sampler separated by air gaps. The solids were light brown in color and creamy in consistency. The segment was homogeneous in appearance. There were no drainable liquids.

Segment 3: The sampler was completely full of solids and had a small amount of drainable liquid, but not enough to observe characteristics. The solids were tan to light-brown in color, with a creamy consistency. The segment was homogeneous in appearance.

Segment 4: The sampler was 75% full with no drainable liquids. The solids were tan to light brown in color and had a runny consistency. The segment was homogeneous in appearance.

Segment 5: The sampler was completely full of solids, with a trace of drainable liquid present. The solids were tan to light brown in color and had a soft, muddy consistency. The segment was homogeneous in appearance, with the exception of several places on the segment that were relatively more wet than others.

Segment 6: The sampler was 80% full with 140 mL of solids and approximately 10 mL of liquid (consisting of mostly normal paraffin hydrocarbon [NPH]) being drainable. Segment appeared moist and runny, and was light brown in color.

Segment 7: The sampler was 94% full, with 10 mL of drainable liquid and 165 mL solids. Solids were light brown in color and had a consistency similar to the previous segment. It is hypothesized that the NPH is what makes the solid so runny.

Segment 8: The sampler was 100% full with only a trace of drainable liquid. The appearance of the solids was much like all of the previous segments in color and consistency.

Segment 9: The sampler was 100% full of solids with no drainable liquids. Again, the appearance of the solids was much like all of the previous samples.

Core 46

Segment 1: No sample was present in sampler. There were no drainable liquids.

Segment 2: The sampler was 100% full with no drainable liquid. Solids were tan to light brown in color and had the consistency of "melting ice cream". The segment was completely homogeneous in appearance from top to bottom.

Segment 3: The sampler was 100% full with 112 mL of solids and the remainder filled with liquid. The segment was broken in several places, with NPH filling the voids. The volume of drainable liquid was about 75 mL. The segment, although broken, was homogeneous in appearance. The solids were light brown in color and again had the consistency of "ice cream".

Segment 4: The sampler was 100% full of solids. There was a tiny amount of drainable liquid, but not enough to observe characteristics. The color and consistency of the solids were much like segment two of this core.

Segment 5: The sampler was 100% full of solids, with no drainable liquids. Copious amounts of NPH saturated the solids. The solids were light brown in color and had the consistency of "cold ice cream". The segment was completely homogenous in appearance from top to bottom.

Segment 6: The sampler was 79% full, with 122 mL of the sampler volume occupied by solids and about 25 mL drainable liquid, which consisted of mostly NPH. The solids were light brown in color and had the consistency of "clay". The segment was homogeneous in appearance with the exception of variations in NPH content. A tiny amount of liner liquid was recovered and discarded.

Segment 7: The sampler was 98% full, with 159 mL of solids, and 25 mL aqueous liquid. The liquid was a murky light brown color. Solids were very much like segment 6, Core 46 in appearance (color, consistency, etc.); however, the solids from this segment appeared "mushy" at the top end, and became slightly thicker towards the bottom.

Segment 8: The sampler was 98% full, with 168 mL solids and about 15 mL drainable liquid, which consisted of 2 phases. The drainable liquid was determined to be primarily NPH. Solids were light brown in color, and had a "mushy" consistency.

Segment 9: The sampler was 100% full of solids, with no drainable liquid. The solids were similar (in color and consistency) to all of the other segments in Core 46 and were saturated with NPH. The segment was homogeneous in appearance.

A field blank and a hot cell blank were also taken for Tank 241-T-104.

4.2 HOLD TIME CONSIDERATIONS

For a description of hold time considerations see the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

4.2.1 WHC 222-S Process and Analytical Chemistry Laboratory

The samples were received at the WHC 222-S Process and Analytical Chemistry Laboratory on September 14, 16, and 17, 1992 for inorganic and radiochemical analyses. Sample receipt for Tank 241-T-104 consisted of 2 cores, identified as numbers 45 and 46. Nine segments were taken for each core.

Homogenization tests are used to obtain estimates of the error resulting from homogenization techniques, and were performed on segment 2 from Core 46. Two composite samples were prepared for both Core 45 and 46. Other than segment 7 from Core 46, all drainable liquid was determined to be composed primarily of normal paraffin hydrocarbon through immiscibility tests and density measurements.

4.2.2 Pacific Northwest Laboratory - 325 Laboratory

Eighteen unhomogenized segment samples (9 from each core), 4 core composite samples (2 from each core), and a homogenization sample from segment 9 of each core were shipped to the Pacific Northwest Laboratory. Along with the segment samples, 2 field blanks were also sent. The core samples were received on February 19, 1993 and hot cell and field blank samples were received on January 21, 1993.

4.3 SAMPLE PREPARATION

For a discussion of sample preparation procedures, see the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

4.4 ANALYTICAL METHODS

This section lists the analytes and the respective analytical procedures that were used to characterize the waste in Tank 241-T-104. Procedures used for physical and rheological analyses are listed in Table 4-1. Procedures used for inorganic and radiochemical analyses are listed in Table 4-2.

4.4.1 Physical and Rheological Tests

Physical and rheological tests performed on the samples included shear strength, shear stress/shear rate, wt.% solids, settling velocity, settling behavior, and wt.% dissolved solids. Also, differential scanning calorimetry, thermogravimetric analysis, and wt % water were performed on composite samples.

Table 4-1. Physical and Rheological Tests.

Shear Strength	PNL-ALO-501
Shear Stress/Shear Rate	PNL-ALO-501/502
Wt. % Solids	PNL-ALO-504
Settling Velocity	PNL-ALO-501
Settling Behavior	PNL-ALO-501

Table 4-2. Analytical Methods.

Analyte	Method	Procedure
F^-, Cl^-, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}	Ion Chromatography	LA-533-105
NO_2^-	Spectrometric	LA-645-001
NH_3	Kjeldahl[1]	LA-634-102
OH^-	Direct	LA-212-103
CN^-	Distillation/Spectrometry	LA-695-102
TIC	Direct	LA-344-105
As, Se	GHAA[2]	LA-355-131
Hg	CVAA[3]	LA-325-102
Total Metals	Inductively Coupled Plasma	LA-505-151
^{60}Co, ^{137}Cs	Gamma Energy Analysis	LA-548-121
^{239}Pu, ^{241}Am	Alpha Spectrometric	LA-503-156
^{94}Nb	Fusion and/or diluted	
^{14}C ^{3}H ^{79}Se ^{99}Tc	Liquid Scintillation	LA-348-104 LA-218-113 LA-365-132 LA-438-101
^{90}Sr	separation/Beta[4]	LA-220-101
^{129}I	Gamma Energy Analysis	LA-378-103
^{237}Np	Alpha Proportional Counting	LA-933-141
^{244}Cm	separation/Alpha/AEA[5]	LA-508-051
Specific Gravity	Direct	
U	Laser Fluorimetry	LA-925-106
Total Alpha	Proportional Counting	LA-508-101
Total Beta	Proportional Counting	LA-508-101

[1]Ammonia analysis by caustic addition, distillation, and capture in a boric acid solution.
[2]Gaseous Hydride Atomic Absorption Spectrometry.
[3]Cold Vapor Atomic Absorption Spectrometry.
[4]Chemical separation along with Total Beta Proportional Counting.
[5]Chemical separation along with Alpha Proportional Counting and Alpha Energy Analysis.

4.4.2 Chemical and Radionuclide Constituent Analysis

Quality control procedures were conducted in accordance with the requirements listed in Bell (1994). In summary, those requirements are:

- One laboratory control standard per analytical batch.
- One blank per batch.

- One matrix spike per core per matrix.
- 100% duplicates on all homogenization test samples and core composite samples.
- One duplicate per analytical batch for direct segment samples.
- A duplicate to verify each detected exotherm for differential scanning calorimetry analysis.

Exceptions are allowed for specific analytes or procedures:

- Percent water is always run in duplicate.
- ^{90}Sr, ^{79}Se, ^{99}Tc, ^{129}I, Pu, and Am have a spike or carrier added to each sample, so no additional matrix spikes are required.
- A matrix spike for ^{237}Np is requested on each sample.
- Inductively coupled plasma, hydride atomic absorption, cold vapor atomic absorption, and ion chromatography analyses require additional, method specific quality control procedures. Instrument calibration and check standards are run according to specific procedure protocols.

4.4.3 Volatile and Semi-Volatile Organic Constituent Analysis

Both the volatile and semi-volatile organic compounds were analyzed using gas chromatography/mass spectrometry. Total organic halides/extractable organic halides were analyzed using procedure PNL-ALO-320/321. The procedures that were used for the volatile and semi-volatile organic analyses are discussed below:

- Rapid screening was performed by headspace/gas chromatography to establish laboratory dilution requirements. Pacific Northwest Laboratory (PNL) procedure PNL-ALO-331 is a modified version of EPA method 3810 (EPA, 1986).
- Gas chromatography/mass spectrometry analysis of volatile organic component was completed. PNL procedure PNL-ALO-335 follows the US EPA Contract Laboratory Program Statement of Work (EPA, 1991).
- Gas chromatography/mass spectrometry for semi-volatile component analysis was done. PNL procedure PNL-ALO-345 follows the Contract Laboratory Procedure protocol (EPA, 1991).

Quality assurance techniques of the EPA methods cited were followed as closely as technically feasible. Section 5 of this report further addresses the quality assurance sample results from the analyses performed above.

4.5 MODULE SPECIFIC ANALYSES

The characterization program for Tank 241-T-104 was intended to satisfy criteria set by the Tank Waste Remediation System (TWRS). The TWRS sample characterization objectives are to provide adequate description of physical, chemical, and radiological properties of Hanford Site tank wastes to support resolution of Unreviewed Safety Questions, other safety issues surrounding the Watch List tanks, and the design of retrieval, pretreatment, and final disposal systems (Bell, 1994). For this specific tank, analyses to provide sufficient information to confidently determine whether constituent concentrations are within safe operating limits were performed.

5.0 ANALYTICAL RESULTS AND WASTE INVENTORY

The chemical, radiochemical, and physical results associated with Tank 241-T-104 are presented within this document as shown in Table 5-1. The samples from which these results were derived were collected on Aug 20 and 26, 1992 from riser 3 (core 45) and Aug 27 and 28, 1992 from riser 6 (core 46).

Table 5-1. Analytical Data Presentation Tables.

Analysis	Tabulated Results
Metals	Table A-1
Ions	Table A-2
Radionuclides	Table A-3
Physical Properties and Miscellaneous Chemical Data	Table A-4
Organics	Table A-5
Characterization Report Results of Single-Shell Tank 241-T-104	Table 5-13

In cases where a duplicate analysis was performed on a sample, the data presented in the Appendix A tables were obtained by calculating an average concentration value from the initial and duplicate results. If an analyte was detected by the original but not by the duplicate sample evaluation, or vice-versa, only the single positive result was reported. When both sample runs failed to detect an analyte, the detection limit preceded by a less than (<) sign was recorded as the sample result.

The Appendix A tables treated the liquid and solid laboratory data separately, and a representative tank concentration for each analyte was determined for both matrices. These values were derived by calculating means from samples which yielded analyte concentrations above reported detection limits. If all sample analyses failed to detect a particular analyte, the tank concentration of the analyte was reported to be less than the highest recorded detection limit because it gives the most conservative inventory. Detection limit values were not utilized to calculate means or corresponding standard deviation values.

The projected tank inventory value for the liquid in Tank 241-T-104 was calculated by multiplying the representative tank concentration by the volume of solid in the tank at the time of sampling, 1.67E+06 L. The amount of each constituent present in the 1.89E+05 L of liquid phase waste was also estimated in the Appendix A tables. The appropriate conversion factors were included in the calculations to obtain the reported units.

5.1 CHEMICAL ANALYSES

5.1.1 Elemental Constituents

The major elemental constituents identified in the liquid phase of the waste were Al, Fe, P, Na and S; all exhibited concentrations exceeding 1000μg/g.

With respect to the solid phase of Tank 241-T-104, Al, Bi, Ca, Fe, P, Si, Na and S were all detected in concentrations exceeding 1,000 μg/g. Beryllium, Sb, and La were analyzed but not detected in the solid samples. Major elements for which solid phase historical estimates were available are listed in Table 5-2 and are compared to the solid sample data acquired from Tank-T-104 in 1992.

Table 5-2. Comparison of Analytical and Historical Data for Elemental Constituents of the Solid Phase of Tank 241-T-104.

Element	Lab Results(a) (μg/g)	Historical Estimate(b) (μg/g)	Relative Percent Difference (%) (RPD)
Na	64,500	78,100	-19
Al	16,200	24,900	-42
Fe	9,020	7,980	12
Cr	901	495	58
Bi	18,900	18,900	30
Zr	67.5	1,120	-177
U	897	8,900	-163

a = lab results from 1992
b = historical estimate
RPD = ((a-b)/(a+b)/2) * 100

5.1.2 Anions

Nitrate is the most abundant anion in both phases of the waste. For any given anion, there is a greater analyte concentration in the liquid phase rather than the solid phase with the exceptions of fluoride and sulfate. Comparisons regarding the most recent solid sample data with estimates derived from historical sources are presented in Table 5-3. Not all anions are listed in the table due to the unavailability of some historical data.

Table 5-3. Comparison of Analytical and Historical Results for Tank 241-T-104 Anions in the Solid Phase.

Analyte	Lab Results (μg/g)	Historical Estimate (μg/g)	Relative Percent Difference (%)
Nitrate	58,000	15,300	117
Nitrite	4,080	3,950	3.2
Phosphate	17,800	89,900	-134
Sulfate	3,900	2,840	31
Fluoride	8,570	5,330	47

After calculating values for phosphate and sulfate from both the liquid and solid phosphorous and sulfur data derived from the Inductively Coupled Plasma (ICP) analyses, the results were compared to the corresponding phosphate and sulfate data obtained by ion chromatography (IC). The comparison is displayed in Table 5-4, and the results show a larger phosphate value for the ICP data than the IC data regardless of the sample phase. The results show that the sulfate ion concentration is in equilibrium with the solid and aqueous phases of the waste; therefore, it is likely that the liquid is saturated with respect to sulfate. IC is done on a water leach sample while the ICP is done on an acid leach sample. Acid dissolves more phosphate than water, as evidenced by the solid phase results.

Table 5-4. Comparison of ICP and IC Phosphate Results.

Analyte	Liquid Phase		Solid Phase	
	IC Result (μg/g)	ICP Result (μg/g)	IC Result (μg/g)	ICP Result (μg/g)
Sulfate	3,770	4,500	3,900	38,400
Phosphate	22,100	29,100	17,800	75,700

5.2 RADIOLOGICAL DETERMINATIONS

The major radioactive constituents in the solid waste were ^{241}Am, ^{137}Cs, ^{154}Eu, ^{155}Eu, ^{237}Np, $^{239/240}$Pu and ^{90}Sr. The only major constituent in the liquid waste was ^{137}Cs. The europium isotopes are of lesser concern since their half-lives are short in comparison to the other listed isotopes, and a considerable amount of time has passed since their addition to the tank (40 years). Half-life is the time required for the radioactivity to fall to half its observed value at any given instant. A half-life can vary from a fraction of a second to millions of years. Table 5-5 shows selected radionuclides and their corresponding half-life.

Table 5-5. Half-lives of Selected Radionuclides.

Radionuclide	Half-life (years)
^{241}Am	432.2
^{137}Cs	30.17
^{154}Eu	8.8
^{155}Eu	4.96
^{237}Np	2.14×10^6
^{239}Pu	24,130
^{240}Pu	6,509
^{90}Sr	28.6

In addition to analytically determining their concentrations, historical inventory estimates were derived for some of the radionuclides in the solid waste. These analytical and historical results for the solid samples are compared in Table 5-6. The analytical data do not show any agreement with the historical data.

Table 5-6. Comparison of Analytical and Historical Isotopic Results.

Analyte	Lab Result (μCi/g)	Historic Estimate (μCi/g)	Relative Percent Difference(%)
$^{239/240}Pu$	0.140	0.030	129
^{137}Cs	0.199	9.05	-191
^{90}Sr	2.63	0.43	144

A comparison was also made between the gross Beta result and the sum of the individual Beta emitters. This was done to determine the level of agreement between the two values. The activity of the individual Beta emitters is summed by using the following equation: $(1.42)2(^{90}Sr) + 1.51(^{137}Cs)$. Table 5-7 shows good agreement between the total and gross beta result.

Table 5-7. Total Beta Comparison.

Analyte	Solid (μCi/g)
^{90}Sr	2.63
^{137}Cs	0.199
Total Beta sum[1]	7.77
Gross Beta Result	7.59

[1]Calculated by using the equation:
$(1.42)2(^{90}Sr) + 1.51(^{137}Cs)$
[The coefficients, 1.42 and 1.51, account for the detector efficiencies calibrated to ^{60}Co.]

The alpha results show that the ^{237}Np value may be high. The isotope was detected in only one core composite sample, and the total alpha result does not support both the ^{237}Np and $^{239/240}$ Pu data. However, there is good agreement between $^{239/240}$ Pu and total alpha Pu.

5.3 ORGANIC CONSTITUENTS

Volatile and semi-volatile organic analyses were carried out on samples obtained from Tank 241-T-104. Although these organics would not be expected to be present in the tank because of their volatile nature, some were still present. Table 5-8 shows the volatile organics that were present. These silicone derivatives are most likely chromatography column degradation products caused by the high pH of the sample matrix.

Table 5-8. Tank 241-T-104 Volatile Organic Compounds.

Volatile Organic	Result (μg/g)
Methoxytrimethyl Silane	10.1
Trimethyl Silanol	16.6
Hexamethyl Disiloxane	3.87

The appearance of several normal paraffin hydrocarbons was reported by the laboratory as tentatively identified compounds, but these constituents may be the result of head fluid contamination from the sampling process. Table 5-9 shows the hydrocarbons present.

Table 5-9. Tank 241-T-104 Semi-Volatile Organic Compounds.

Semi-volatile organics	Result (μg/g)
Dodecane	137
Tridecane	540
Tetradecane	478
Pentadecane	20.8

Data from the Total Organic Carbon (TOC) shows that organic carbon is present in Tank 241-T-104, both in the liquid (479 μg/g) and solid (760 μg/g) waste. The TOC in the solid waste is higher than in the liquid waste. The organic carbon is probably present in the form of various complexant decomposition products.

5.4 PHYSICAL MEASUREMENTS

5.4.1 Density and Percent Solids

The density measurements were carried out on the liquid and solid samples. The liquid density was 1.13 g/mL and the solid density was 1.29 g/mL. The results obtained from 222-S Laboratory were biased low, therefore PNL 325 Laboratory results were used. The density results obtained by the 222-S Laboratory are probably low because this tank was sampled when NPH was used as a hydrostatic head fluid. The density of the liquid would be expected to be greater than 1.00 g/ml since the liquid contains dissolved salts.

Percent solids were measured as vol% and as wt%, on settled solids and on centrifuged solids. Four different segments from core 45, numbers 2,4,6 and 8 were analyzed. Segment 2 sample was observed to be very different from segment 4,6 and 8 in that it contained 1.5 times the amount of solids that were observed in the other 3 segments. The undissolved solids were calculated by subtracting the percentage of dissolved solids from the wt % total solids. The results for segment 4, 6, and 8 were very similar as shown in Table 5-10. Note also that the centrifuged solids and bulk sample densities were in contrast between segment 2 and segments 4, 6, and 8.

Table 5-10. Tank 241-T-104 Physical Measurements. (2 pages)

Physical Property		2	4	6	8
Density (g/mL)	Sample	*1.42	*1.24	*1.24	*1.24
	Centrifuged Supernate	1.13	1.12	1.13	1.12
	Centrifuged Solids	1.52	1.33	1.31	1.30
Settled solids	Vol%	100	86.5	82.2	87.5

Table 5-10. Tank 241-T-104 Physical Measurements. (2 pages)

Physical Property		2	4	6	8
Wt% Undissolved Solids		43.3	28.0	29.2	28.7
Wt% Solids		43.3	28.0	29.2	28.7
Centrifuged solids	Vol%	74.1	57.1	63.9	64.0
	Wt%	79.4	61.2	67.3	67.4

* PNL 325 Laboratory results

5.4.2 Particle Size

Particle size analyses are performed by passing a laser beam through a sample which has been suspended in a dispersant. The amount of light which is attenuated by the particles is a measure of the size and number of the particles in the sample. The particle size analyzer has a range of 0.5 to 150 μm, and is set up to give the short diameter of the particle, irrespective of the shape of the particle. From these data, the number and volume probability densities are calculated. The number probability density is an indication of the average size of the particles based on the number of particles measured, whereas the volume probability density is an indication of the size of the particles which occupy most of the sample volume. A small difference between the number probability density and the volume probability density is an indication of relative uniformity of particle size; conversely, a large difference indicates that most of the sample volume is occupied by a few large particles and the remaining volume is occupied by many small particles. Table 5-11 lists the results for the particle size analyses, along with standard deviations. For all segments, a relatively large difference exists between the number and the volume probability densities. This shows a large range of particle size in the sample.

Table 5-11. Tank 241-T-104 Particle Size Data. (2 pages)

Segment	Probability Number Density (μm)	Standard Deviation (μm)	Probability Volume Density (μm)	Standard Deviation (μm)
CORE 45				
1	1.04	0.78	9.08	11.1
2	1.08	0.82	37.9	41.4
3	1.25	1.40	46.8	32.8
4	1.13	0.97	31.0	28.0
5	1.03 1.05[1]	1.00 1.06[1]	30.8 33.8[1]	20.6 19.9[1]
6	1.15	1.02	27.9	29.1
7	1.01	0.81	34.4	36.7
8	1.04	0.73	6.12	5.39
9	1.06	1.06	27.4	22.7

Table 5-11. Tank 241-T-104 Particle Size Data. (2 pages)

Segment	Probability Number Density (μm)	Standard Deviation (μm)	Probability Volume Density (μm)	Standard Deviation (μm)
CORE 46				
1	---	---	---	---
2	1.04	0.85	50.9	39.5
3	1.07	0.86	12.8	18.7
4	1.01	0.81	23.4	30.7
5	0.99	0.78	49.0	51.3
6	1.13	0.91	20.2	22.0
7	0.95	0.68	6.81	7.97
8	0.81	0.38	5.14	4.73
9	1.05	0.81	16.1	19.8

[1]Duplicate sample of Core 45, Segment 5

The chemical properties of the dispersant are vital to the particle size test in that the particles can be dissolved or additional particles can be precipitated in the dispersant, thereby changing their size or number. Drainable liquid, or 'mother liquor', is a suitable choice because it is in chemical equilibrium with the solid portion of the waste, and will neither precipitate the solids nor dissolve them. In the case of Tank 241-T-104, water was used as the matrix. The choice to use water may have been made because the waste was relatively insoluble, and any error would likely be small.

An informal assessment of the Tank 241-T-104 particle size data shows no discernable trends in the vertical variation of the data.

5.4.3 Rheology

The shear strength of segments 2,4,6 and 8 was measured from core 45. Table 5-12 shows the shear strength of each segment.

Table 5-12. Shear Strength Results.

Segment Number	Shear Strength (dynes/cm^2)
2	18,800
4	3,500
6	< 500
8	13,800

Shear stress measurements were also made on the dilutions of segment samples at ambient temperature and 95°C. The water:sample 1:1 dilution at both temperatures exhibited yield pseudoplastic behavior, although segments 4, 6 and 8 had low yield points of <0.2 Pa and segment 2 had a yield point of 1 Pa. The viscosity of the sample decreased as the temperature was increased. The 3:1 dilutions for all segments exhibited newtonian behavior.

5.4.4 Energetics

Differential scanning calorimetry analyses revealed that no exotherms were associated with any of the segments for either core.

5.5 DATA PRESENTATION

The Tank Characterization Report Results reported in Table 5-13 are the final constituent estimates for this document. The values are equal to the mean values presented in Appendix A tables. If laboratory results were not available for an analyte, the Tank Characterization Report Result was, if possible, derived from historical data.

Table 5-13. Tank Characterization Report Data for Single-Shell Tank 241-T-104. (4 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Results			Total Tank Inventory	
Metals	(μg/g)	Liquid (μg/mL)	Liquid (μg/g)	Solid (μg/g)	Liquid (kg)	Solid (kg)
Aluminum (Al)	24,900	3,160	2,800	16,200	597	34,800
Antimony (Sb)	---	3.56	3.15	< 177	0.673	< 381
Arsenic (As)	---	0.615	0.544	3.61	0.116	7.76
Barium (Ba)	---	2.08	1.84	8.58	0.393	18.4
Beryllium (Be)	---	0.030	0.0265	< 1.50	0.00567	< 3.23
Bismuth (Bi)	13,900	485	429	18,900	91.7	40,600
Boron (B)	---	7.64	6.76	15.6	1.44	33.5
Cadmium (Cd)	---	0.278	0.246	5.44	0.0525	11.7
Calcium (Ca)	---	23.3	20.6	1,450	4.40	3,310
Cerium (Ce)	---	15.6	13.8	194	2.95	417
Chromium (Cr)	495	316	280	901	59.7	1,940
Cobalt (Co)	---	0.545	0.482	10.8	0.103	23.2
Copper (Cu)	---	4.61	4.08	51.0	0.871	110
Dysprosium (Dy)	---	---	---	---	---	---
Iron (Fe)	7,980	1,520	1,350	9,020	287	19,400
Lanthanum (La)	---	0.210	0.186	< 10.4	0.0397	< 22.4
Lead (Pb)	---	---	---	---	---	---

Table 5-13. Tank Characterization Report Data for Single-Shell Tank 241-T-104. (4 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Results			Total Tank Inventory	
Metals (continued)	(µg/g)	Liquid (µg/mL)	Liquid (µg/g)	Solid (µg/g)	Liquid (kg)	Solid (kg)
Lithium (Li)	---	---	---	---	---	---
Magnesium (Mg)	---	22.3	19.7	140	4.21	301
Manganese (Mn)	---	5.12	4.53	61.8	0.968	133
Mercury (Hg)	---	0.0332	0.0294	0.127	0.00627	0.273
Molybdenum (Mo)	---	---	---	---	---	---
Neodymium (Nd)	---	---	---	---	---	---
Nickel (Ni)	---	1.61	1.42	11.3	0.304	24.3
Phosphorus (P)	---	10,700	9,470	24,700	2,020	53,100
Potassium (K)	---	74.7	66.1	89.0	14.1	191
Rhenium (Re)	---	---	---	---	---	---
Rhodium (Rh)	---	---	---	---	---	---
Ruthenium (Ru)	---	---	---	---	---	---
Samarium (Sm)	---	---	---	---	---	---
Selenium (Se)	---	14.2	12.6	21.7	2.68	46.7
Silicon (Si)	---	631	558	6,520	119	14,000
Silver (Ag)	---	0.100	0.0885	6.40	0.0189	13.8
Sodium (Na)	78,100	55,400	49,000	64,500	10,500	1.39E+05
Strontium (Sr)	---	13.8	12.2	99.1	2.61	213
Sulfur (S)	---	1,700	1,500	1,280	321	2,750
Tin (Sn)	---	1.78	1.58	13.2	0.336	28.4
Tellurium (Te)	---	---	---	---	---	---
Thorium (Th)	---	---	---	---	---	---
Titanium (Ti)	---	0.995	0.881	9.67	0.188	20.8
Thallium (Tl)	---	---	---	---	---	---
Uranium (U)	8,900	5.22	4.62	897	0.987	1,930
Vanadium (V)	---	---	---	---	---	---
Zinc (Zn)	---	3.12	2.76	137	0.590	295
Zirconium (Zr)	---	3.42	3.03	67.5	0.646	145
Ions	(µg/g)	Liquid (µg/mL)	Liquid (µg/g)	Solid (µg/g)	Liquid (kg)	Solid (kg)
Ammonia (NH_3)	---	---	---	< 4,500	---	< 9,680
Carbonate (CO_3^{2-})	---	---	---	< 500	---	< 1,080
Chloride (Cl^-)	---	1,520	1,350	670	287	1,440

Table 5-13. Tank Characterization Report Data for Single-Shell Tank 241-T-104. (4 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Results			Total Tank Inventory	
Ions (continued)	(μg/g)	Liquid (μg/mL)	Liquid (μg/g)	Solid (μg/g)	Liquid (kg)	Solid (kg)
Chromium (VI) (Cr^{+6})	---	---	---	---	---	---
Cyanide (CN^-)	---	0.704	0.623	< 2.00	0.133	< 4.30
Fluoride (F^-)	5,330	4,200	3,720	8,570	794	18,400
Hydroxide (OH^-)	55,400	---	---	---	---	---
Nitrate (NO_3^-)	15,300	97,700	86,500	58,000	18,500	1.25E+05
Nitrite (NO_2^-)	3,950	6,090	5,390	4,080	1,150	8,770
Phosphate (PO_4^{3-})	89,900	25,000	22,100	17,800	4,730	38,300
Sulfate (SO_4^{2-})	2,840	4,260	3,770	3,900	805	8,390
Radionuclides	(μCi/g)	Liquid (μCi/mL)	Liquid (μCi/g)	Solid (μCi/g)	Liquid (Ci)	Solid (Ci)
^{241}Am	---	< 9.60E-04	< 8.50E-04	0.0173	< 0.181	37.2
^{14}C	---	---	---	< 4.50E-05	---	< 0.0968
^{137}Cs	9.05	0.0808	0.0715	0.199	15.3	428
^{60}Co	---	< 1.31E-04	< 1.16E-04	< 3.00E-04	< 0.0248	< 0.645
^{154}Eu	---	< 3.47E-04	< 3.07E-04	0.00410	< 0.0656	8.82
^{155}Eu	---	< 4.12E-04	< 3.65E-04	0.00342	< 0.0779	7.35
^{129}I	---	---	---	< 0.0464	---	< 99.8
^{237}Np	---	---	---	0.137	---	295
^{238}Pu	---	< 1.80E-04	1.59E-04	< 0.0180	< 0.0340	< 38.7
$^{239/240}Pu$	0.030	0.00345	0.00305	0.140	0.652	301
^{79}Se	---	---	---	< 1.75E-04	---	< 0.376
^{90}Sr	0.43	---	---	2.63	---	5,660
^{99}Tc	---	---	---	5.79E-04	---	1.24
^{3}H	---	---	---	< 3.38E-04	---	< 0.727
^{238}U	---	---	---	2.98E-06	---	0.00641
Total Alpha	---	---	---	0.109	---	234
Total Alpha Plutonium	---	---	---	0.124	---	267
Total Beta	---	---	---	7.59	---	16,300

Table 5-13. Tank Characterization Report Data for Single-Shell Tank 241-T-104. (4 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Results			Total Tank Inventory	
Physical Properties		**Liquid**	**Liquid**	**Solid**	**Liquid**	**Solid**
pH	---		---	9.99	---	---
Thermogravimetric Analysis	---		---	70.8 %	---	1.40E+06 kg
Percent Water	66.5%		---	70.5 %	---	1.40E+06 kg
Wt % Solid	---		---	32.3 %	---	---
Wt% Undissolved Solid	---		---	27.1 %	---	---
Liquid Density	---	1.13 g/mL	---	---	---	------
Solid Density	1.36 g/mL	---	---	1.29 g/mL	---	------
TOC	---	541 μg/mL	479 μg/g	706 μg/g	102 kg	1,520 kg

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6.0 ANALYTICAL RESULTS INTERPRETATION

6.1 TANK WASTE PROFILE

Examination of the analytical results reveals that the waste in Tank 241-T-104 is sludge composed of approximately 71% water and 29% solids. Na, Al, Bi, Fe, Si, F^-, NO_2^-, NO_3^-, PO_4^{3}, and SO_4^{2-} and nitrate ions were the major non-water constituents present in the liquid and solid phases of the tank. The ^{137}Cs isotope demonstrated the greatest activity among radioactive constituents in the water matrix, while most of the activity associated with the solid portion of the waste was attributed to ^{137}Cs and ^{90}Sr.

Visual observations regarding the segment samples of Tank 241-T-104 showed that core 45 had a small amount of water and light brown, mud-like solids. Segment samples from core 46 were 100% solids. All the segments were homogeneous in appearance.

Tables 5-10 and 5-12 indicate a difference in density, % solids, and shear strength between segment 2 data and segment 4-8 data. A possible explanation for this is found in the tank fill history. Figure 6-1 gives a visual presentation of the waste additions to the tank based on the historical information given in Chapter 2. The difference between segment 2 and segments 4-8 data is possibly due to changes in the composition of 1C waste. As discussed in Section 2.3, coating waste and stack drainage were added to 1C after May 1951. Consequently, the upper layer of the tank waste, consisting of post-1951 1C waste, may be physically different that the pre-1951 1C waste comprising the lower layer of the tank.

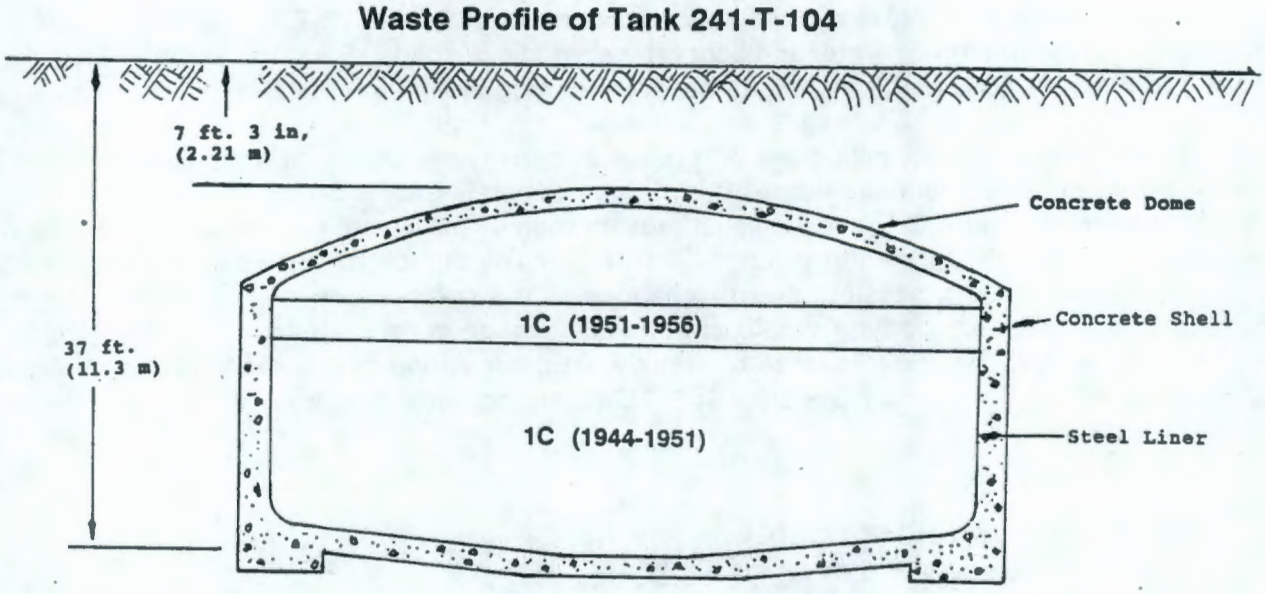
6.2 PROJECTED TANK HEAT LOAD

Temperature information for Tank 241-T-104 was given in Section 2.5. The amount of heat resulting from radioactivity in the tank was calculated in Table 6-1. Detection limits for some of the analytes were included in the calculation in order to obtain the most conservative estimate possible. The reported tank heat load is 60.3 Watts. The tank temperature has fluctuated between 15.6°C (60°F) and 26.7°C (80°F) over the past 15 years. Since the heat generated by radioactive decay is quite modest, the fluctuations in temperature can largely be attributed to changes in ambient temperature.

6.3 PROGRAM ELEMENT SPECIFIC ANALYSES

The sampling and analysis of Hanford Site waste tanks is driven by the need to satisfy the characterization requirements of the various Tank Waste Remediation System (TWRS) program elements. These characterization needs are implemented and documented through the Data Quality Objective (DQO) process, and expressed in a series of program specific DQO documents. The data needs are summarized in the *TWRS Tank Waste Analysis Plan* (Bell, 1994).

Figure 6-1. Waste Profile of Tank 241-T-104.



Total Capacity: 530,000 gals. (2,010,000 L)

Total Waste: 445,000 gals. (1,680,000 L)

1C: 1st cycle decontamination-$BiPO_4$ process. Often including cladding waste. Held 10% of Fission Product Waste, 1% of Plutonium.

Table 6-1. Tank 241-T-104 Projected Heat Load.

Radionuclide	Ci	Watts	Ci	Watts
	Liquid		Solids	
^{241}Am	< 0.181	< 0.00594	37.2	1.22
^{137}Cs	15.3	0.0722	428	2.02
^{60}Co	< 0.0248	< 3.82E-04	< 0.645	0.00993
^{154}Eu	< 0.0656	< 5.92E-04	8.82	0.0796
^{155}Eu	< 0.0779	< 5.66E-05	7.35	0.00534
^{129}I	NA	NA	< 99.8	< 0.0467
^{237}Np	NA	NA	295	8.50
^{238}Pu	< 0.0340	< 0.00111	< 38.7	< 1.26
$^{239/240}Pu$	0.652	0.0199	301	9.18
^{90}Sr	NA	NA	5,660	37.9
^{238}U	NA	NA	0.00641	1.60E-04
^{99}Tc	NA	NA	1.24	6.21E-04
Watts	**0.100**		**60.2**	
Total Watts	**60.3**			

NA: Not analyzed.

This Tank Characterization Report is the final step in the characterization of Tank 241-T-104. According to the process and issue based data requirements, the inventory estimates and waste properties contained in this report can be applied to the data requirements of the various program elements. Contained in Table 6-2 is a summary of which program data needs are fulfilled through this characterization of the waste in Tank 241-T-104, based on a review of the stated sampling and analysis requirements. In the future, the applicability of Tank Characterization Report results to each TWRS program element will be documented in tank specific Tank Characterization Plans, prior to the tank sampling.

Table 6-2. Applicability of Characterization Information to the Data Needs of the TWRS Program Elements.

Data Quality Objective	Applicability to Characterization of Tank 241-T-104
Tank Safety Screening	applies[1]
Ferrocyanide Safety Issue	does not apply
Flammable Gas Tanks Crust Burn Issue	does not apply
Generic Tank Vapor Issue Resolution	not addressed
Flammable Gas Tank	not completed
Waste Compatibility	does not apply
Organic Fuel Rich Tank	does not apply
Rotary Core Vapor Sampling	does not apply
Evaporator Operations	not completed
Process Control	not completed
Waste Tank Retrieval	not completed
Waste Tank Pretreatment	not completed
High-Level Waste Immobilization	not completed
Low-Level Waste Immobilization	not completed
Solid, Low-Level Waste Disposal	not completed
RCRA Part B Permit Application	not completed
Tank C-106 High-Heat Safety Issue	does not apply
Organic Layer Sampling of Tank C-103	does not apply
Tank C-103 Vapor and Gas Sampling	does not apply

[1]The sampling requirement for the Safety Screening Data Quality Objective (Babad, 1994) calls for both vertical waste samples and a vapor space sample. The sampling and analysis of Tank 241-T-104 supports full characterization of the waste in the tank; vapor space sampling or characterization was not conducted as part of this activity.

applies - The data needs expressed in this Data Quality Objectives document are fulfilled through this characterization report.

does not apply - The data needs expressed in this Data Quality Objectives document do not apply to the waste in Tank 241-T-104.

not addressed - The data needs expressed in this Data Quality Objectives document were not addressed by this characterization report.

not complete - At the date of preparation of this report, this Data Quality Objectives document has not yet been completed.

7.0 STATISTICAL INTERPRETATION

7.1 MASS AND CHARGE BALANCE

The main objective for performing a mass and charge balance is to determine if the measurements are self-consistent. In calculating the balances, only analytes listed in Table 5-13 which were detected at a concentration of 1000 μg/g or greater in the solid phase of the waste were considered. As a note, all values in Tables 7-1, 7-2, and 7-3 were rounded to three significant figures.

With the exception of sodium, all analytes listed in Table 7-1 were assumed to be present in the tank waste as hydroxide, oxide, or phosphate precipitates, and the concentrations of the assumed species were calculated stoichiometrically. For example, 16,200 μg/g of aluminum were detected in the solid phase of the tank, and this translated into 46,800 μg/g of aluminum hydroxide as demonstrated by the following equation.

$$46{,}800\ \mu g/g\ Al(OH)_3 = 16{,}200\ \mu g/g\ Al \div 27\ \mu g/\mu mol\ Al * 78\ \mu g/\mu mol\ Al(OH)_3$$

The concentrations of the assumed species, which are summed in Table 7-1, were ultimately utilized to calculate the mass balance. Since precipitates are neutral species, all positive charge was attributed to the sodium cation.

Table 7-1. Cation Mass and Charge Data.

	Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge μmol/g
Aluminum	16,200	$Al(OH)_3$	46,800	0
Bismuth	18,900	$BiPO_4$	27,500	0
Calcium	1,450	CaO	2,030	0
Iron	9,020	$FePO_4$	24,300	0
Silicon	6,520	SiO_2	14,000	0
Sodium	64,500	Na^+	64,500	2,800
Totals			179,000	2,800

The anionic analytes listed in Table 7-2 were assumed to be present as sodium salts and were expected to balance the positive charge exhibited by sodium in Table 7-1. The phosphate concentration listed in Table 7-2 was derived as follows. The ICP phosphorous result translated, stoichiometrically, into 75,700 μg/g of phosphate. However, approximately 23,900 μg/g of phosphate were required to account for the bismuth and iron salts assumed in Table 7-1. Therefore, the concentration of remaining phosphate, 51,800 μg/g, was reported in Table 7-2.

Table 7-2. Anion Mass and Charge Data.

	Concentration (μg/g)	Charge (μmol/g)
Fluoride	8,570	451
Nitrate	58,000	935
Nitrite	4,080	89
Excess Phosphate	51,800	1,640
Sulfate	3,900	81
Totals	126,000	3,200

A charge imbalance was observed due to an excess of negative charge. This imbalance may have resulted by erroneously assuming that the phosphorous in the waste exists only as phosphate. Since the pH of the waste is approximately 10, some of the phosphorous should actually exist as hydrogen phosphate and induce a lower net negative charge. Despite the charge imbalance, the concentrations of the anionic species, which are summed in Table 7-2, were utilized to calculate the mass balance in Table 7-3.

The following equation illustrates that the sum of the total concentration of the assumed species in Table 7-1, the total concentration of anionic analytes in Table 7-2, and the laboratory derived value for percent water, 70.5%, should equal 1,000,000 μg/g.

$$1{,}000{,}000\ \mu g/g = Al(OH)_3 + BiPO_4 + CaO + FePO_4 + SiO_2 + Na^+ + F^- + NO_3^- + NO_2^- + PO_4^{3-} + SO_4^{2-} + H_2O$$

Table 7-3 demonstrates that the calculated mass balance exhibited an error of only 1%. The accuracy of the mass balance supports the previous discussion theorizing the presence of both phosphate and hydrogen phosphate in the waste.

Table 7-3. Mass Balance Totals.

	Concentration (μg/g)
Total From Table 7-1	179,000
Total From Table 7-2	126,000
Water	705,000
Grand Total	1,010,000

7.2 STATISTICAL ANALYSIS

As mentioned in section 3.1, two core samples were taken from Tank 241-T-104. Two core composite samples were made for each core from the homogenized solid segment waste, and primary and duplicate results were obtained from each core composite. Due to the incomplete core sample recovery, the estimates given in this report are somewhat biased. The magnitude of this bias is unknown.

The statistics in this section were calculated for analytes with concentrations greater than 10 times their detection limits (DL). Personnel within the TWRS Information Management Systems identified a list of "special analytes" that have exception to this rule (Table 7-4). Statistics were calculated for these analytes if the concentrations were greater than 3 times their DL (Jensen, 1994). For a number of analytes, the concentrations of some samples were greater than a particular limit (3 or 10 times the DL), while the other samples were less than that limit. In these cases, the statistics were calculated using all of the data whether it was above or below the particular limit (3 or 10 times the DL). The above rules do not apply to alpha or beta/gamma counting methods.

Table 7-4. Special Analyte List.

Aluminum	Nitrate
Bismuth	Nitrite
Calcium	Phosphate
Chromium	Carbonate
Iron	Fluoride
Silicon	Chloride
Sodium	Total Organic Carbon
Zirconium	Cyanide

Using the hierarchical structure of the core composite data, estimates of the spatial variance (σ^2(S)), compositing variance (σ^2(C)), and analytical measurement variance (σ^2(A)) were obtained for each analyte. The spatial variance is a measure of the variability between cores. The compositing variance measures the variability between composite samples within the same core. The analytical measurement variance measures the difference between the analytical results from the sample and duplicate samples.

To test the significance of the variance components, an analysis of variance (ANOVA) was calculated (Jensen, 1994). The mean square error terms in the ANOVA table were used to test the spatial and composite variability. The estimates of each component of variability along with the p-values (significance level) are given in Table 7-5. A p-value less than 0.05 indicate that σ^2(S) or σ^2(C) are significantly different from zero at the 0.05 significance level.

The p-values from the tests on σ^2(S) showed significant differences for 13 out of 34 analytes tested. In order to assess the magnitude of the concentration differences for these 13 analytes, the highest mean from the four duplicate pairs analyzed was divided by the lowest mean. The results for zinc were largest, with the highest mean being 2.7 times the value of the lowest mean. The average magnitude of mean difference for all 13 analytes was 1.5. This value does not appear large; thus, it could be said that the tank contents are generally homogeneous.

The p-values from the tests on σ^2(C) were less than 0.05 for 7 out of 34 analytes tested. This indicates that, relative to the analytical error, differences between composite samples were significant for 7 analytes.

Table 7-5. Variance Component Estimates. (2 pages)

Analyte	σ^2 (S)	Test: σ^2 (S) = 0 p-value	σ^2 (C)	Test: σ^2 (C) = 0 p-value	σ^2 (A)
[1]ICP.a.Al	2.55E+06	0.004*	3.76E+05	0.139	3.19E+05
[2]ICP.f.Ba	8.78E-21	0.482	5.94E-25	0.743	3.47E-01
ICP.a.Bi	9.44E+04	0.294	3.15E-12	0.554	6.02E+05
ICP.a.B	3.77E-14	0.527	1.27E-13	0.659	1.86E+01
ICP.f.Ca	1.40E-04	0.395	1.34E+05	0.408	4.45E+06
ICP.a.Ce	1.11E+02	0.010*	1.32E+02	0.037*	3.54E+01
ICP.a.Cr	8.91E+02	0.116	8.11E+02	0.257	1.72E+03
ICP.f.Cu	2.40E+02	0.041*	1.36E+02	0.178	1.57E+02
ICP.a.Fe	8.09E+04	0.147	4.84E+04	0.325	1.90E+05
ICP.a.K	7.25E-01	0.403	1.08E-23	0.766	1.99E+01
ICP.f.Mg	1.65E+02	0.289	2.45E+02	0.388	2.34E+03
ICP.f.Mn	6.31E-18	0.911	4.79E-13	0.522	5.13E+01
ICP.a.Na	4.71E+05	0.042*	1.74E+07	0.038*	4.75E+06
ICP.f.Ni	1.93E+06	0.249	1.24E+06	0.391	1.26E+07
ICP.f.P	8.94E+06	0.001*	1.63E+05	0.290	4.56E+05
[3]ICP.w.S	1.71E-14	0.338	9.37E+02	0.080	6.75E+02
ICP.f.Si	2.99E+04	0.047*	5.69E+04	0.096	3.29E+04
ICP.f.Sr	1.80E+01	0.008*	1.55E+01	0.039*	4.35E+00
ICP.f.Ti	1.05E-17	0.855	4.01E-15	0.573	1.66E+01
ICP.f.Zn	4.14E+03	0.042*	1.97E-13	0.557	1.90E+03
ICP.a.Zr	8.89E+02	0.001*	4.72E+01	0.185	5.70E+01
[4]IC.w.Cl^-	6.14E-14	0.429	3.27E-19	0.590	8.42E+02
IC.w.F^-	2.68E-17	0.548	9.17E+04	0.028*	3.17E+04
IC.w.NO_2^-	1.47E-13	0.957	7.50E+02	0.237	3.71E+03
IC.w.NO_3^-	4.92E-13	0.145	1.67E+06	0.110	1.20E+06
IC.w.PO_4^{3-}	1.43E+06	0.003*	5.75E+04	0.266	1.31E+05
IC.w.SO_4^{2-}	2.52E-39	0.929	9.48E-27	0.837	7.77E+03
% Water	7.02E-02	0.052	9.44E-18	0.523	3.92E-02
^{241}Am	3.65E-28	0.292	2.40E-06	0.046*	1.10E-06
^{137}Cs	4.75E-05	0.002*	2.91E-05	0.018*	4.88E-06
^{155}Eu	2.03E-25	0.360	6.77E-08	0.275	2.39E-07

Table 7-5. Variance Component Estimates. (2 pages)

Analyte	σ^2 (S)	Test: σ^2 (S) = 0 p-value	σ^2 (C)	Test: σ^2 (C) = 0 p-value	σ^2 (A)
^{90}Sr	1.04E-01	0.000*	1.89E-02	0.005*	1.46E-03
U	2.05E-23	0.767	3.74E-14	0.515	3.15E+03
^{238}U	1.36E-04	0.027*	2.01E-21	0.484	4.85E-05

1: ICP.a = Inductively Coupled Plasma, acid digestion
2: ICP.f = Inductively Coupled Plasma, KOH/Nickel fusion dissolution
3: ICP.w = Inductively Coupled Plasma, water leach
4: IC = Ion Chromatography, water digestion
5: * = significant at the α = 0.05 level

7.3 ANALYTICAL ERROR ESTIMATION

An attempt is always made to quantify the different sources of error possible during the chemical analysis of a sample. When these errors are summarized, they give a strong indication of data reliability. If one or more of the error estimates are outside the acceptable limits, the accuracy of the concentration estimate is drawn into question. Possible sources of error are sample contamination, matrix interferences, analytical method error, and poor instrument calibration.

Analytical error is composed of two parts, random and systematic. Table 7-6 gives both the analytical and systematic error estimates for Tank 241-T-104, organized by analyte.

7.3.1 Systematic Analytical Error

Systematic error estimates are determined from the analysis of reference standards or spike recoveries. Reference standards are samples used to estimate the accuracy of the analytical method, and are analyzed in conjunction with the duplicate samples. They are prepared by adding a known amount of a particular analyte at a concentration other than that used for equipment calibration. The laboratory measurement control system has set a quality control criterion for standards run in conjunction with the analytical samples; standards must be less than three times the historical result. These values are listed in column 4 of Table 7-6. Matrix spikes are used to estimate the bias of the analytical method due to matrix interferences. Spike samples are prepared by splitting a sample into two aliquots and adding a known amount of a particular analyte to one aliquot to calculate a percent recovery. The quality control criterion for spikes is 100 ± 25% recovery. The numbers listed in column 5 of Table 7-65 are the relative standard deviations (RSD) of the spikes for each analyte.

Several of the metals listed in Table 7-6 had one or more spikes that were outside the 100 ± 25% limits. Aluminum, bismuth, chromium, iron, sodium, zirconium, ^{241}Am, and $^{239/240}Pu$ had all three spikes outside the prescribed limits, while uranium had just one of two outside the limits. Several of these elements were metals found in relatively high concentrations in the tank. Spike failures for major elements in general are frequently caused by a high element concentration in the sample. When the added spike concentration is

insignificant compared to the concentration present in the sample, a failure usually occurs. Also, the standard results for aluminum, bismuth, boron, and sodium (column 4 data) exceeded the criteria of three times the historical results (column 3 data), which may indicate a problem with the analytical method.

7.3.2 Random Analytical Error

The random analytical error can be estimated from the historical base of reference standards or from the analytical results (variation between duplicate samples). These reference standards are determined the same way as the ones for systematic error, but are typically derived from 50 samples and updated every year (column 3). To determine the error due to the analytical results of the duplicate samples (column 2), a relative percent difference (RPD) is calculated for each duplicate pair. The RPD is a measure of variability and is defined as the absolute value of one duplicate minus the other, divided by the mean. An RSD is then calculated by taking the standard deviation of the two or more duplicate pairs and dividing by the overall analyte mean. The RSD is a unitless measure of variability and allows the comparison of variation across constituents whose magnitudes may vary widely. The laboratory measurement control system has set the quality control criterion of no RPD being larger than three times the RSD for a given analyte. All data presented in this section were calculated for analytes with detected values only (no "non-detects").

Of the analytes listed in Table 7-6, only copper had an RPD value exceeding the criterion of three times the random analytical error from sample results. This was possibly due to the analytical blank value being over half the concentration value. The results for duplicate samples generally gave very good precision.

Table 7-6. Measurement Error Estimates for Tank 241-T-104. (2 pages)

Analyte	Analytical error estimate - 1 RSD (%)		Systematic error estimate - 1 RSD (%)	
	From sample results	From standard results	From standard results*	From spike analyses
Aluminum	3.5	2.7	4,800	490
Arsenic	8.4	2.8	8.3	1.9
Barium	7.9	2.5	3.0	3.2
Bismuth	4.3	3.4	14	440
Boron	31	3.7	62	7.6
Cadmium	29	3.6	0.6	2.7
Calcium	150	3.7	4.8	4.5
Cerium	3.1	3.5	9.1	7.8
Chromium	4.6	3.2	3.8	45
Cobalt	12	3.0	2.1	3.0
Copper	25	2.4	2.1	3.9
Iron	4.8	2.8	1.7	950
Magnesium	34	2.7	3.1	3.3

Table 7-6. Measurement Error Estimates for Tank 241-T-104. (2 pages)

Analyte	Analytical error estimate - 1 RSD (%)		Systematic error estimate - 1 RSD (%)	
	From sample results	From standard results	From standard results*	From spike analyses
Manganese	13	2.5	4.9	6.3
Nickel	34	2.8	1.1	13
Phosphorus	2.7	4.5	5.3	4.0
Potassium	5.7	4.5	9.4	5.1
Silicon	2.8	5.1	2.1	6.2
Sodium	3.4	2.6	65	1,300
Strontium	2.1	2.7	2.1	2.4
Sulfur	2.0	4.1	4.1	7.0
Tin	10	3.2	5.1	3.3
Titanium	48	3.3	1.2	1.0
Uranium	6.9	7.9	3.6	52
Zinc	34	2.6	1.5	1.0
Zirconium	11	3.5	5.9	63
Chlorine	4.7	4.7	6.1	8.9
Fluorine	2.1	4.9	3.7	8.0
Nitrate	1.9	4.2	2.9	2.2
Nitrite	3.1	5.0	0.6	12
Phosphate	2.0	5.4	4.8	5.0
Sulfate	2.9	4.0	5.4	13
% Water	0.3	0.9	NA	NA
pH	0.5	0.4	NA	NA
^{241}Am	6.1	9.3	9.3	56
^{137}Cs	1.1	2.1	2.5	NA
^{154}Eu	11	NA	NA	NA
^{155}Eu	14	NA	NA	NA
$^{239/240}Pu$	6.1	8.5	6.4	52
^{90}Sr	1.5	4.4	4.1	8.9

* Calculated from the laboratory measurement control system standards analyzed in conjunction with the samples.
NA = data not available.

7.4 DATA VALIDATION FINDINGS

The primary objective of data validation is to ensure the usability and defensibility of the data produced for the tank. This was accomplished through a detailed examination of the data package which attempted to verify that proper and acceptable analytical techniques had been applied. Evaluations such as instrument calibration checks, matrix spikes, duplicates, and blank analyses were reviewed, and the corresponding results were compared to relevant quality control criteria. Additionally, the data package was checked for the correct submission of required deliverables, correct transcription of raw data to the summary forms, and for proper calculation of a number of parameters. Data which failed to satisfy the established quality objectives were qualified as reported in Duchsherer (1993).

8.0 RECOMMENDATIONS

8.1 SAFETY ISSUES

Characterization of Tank 241-T-104 supports the classification of the tank as non-Watch List. Given the current tank inventory of fissionable radionuclides and organic or exothermic waste constituents, no credible potential exists for further loss of tank integrity or release of radioactivity due to in-tank processes. Tank 241-T-104 is within established operating safety requirements, as defined by applicable Data Quality Objectives.

Tank 241-T-104 is considered sound and non-leaking (Hanlon, 1994), and examination of the waste volume history supports this conclusion (ICF Kaiser Hanford, 1994). Thermocouple data support the conclusion that there are no significant heat-generating processes within the tank waste; there is no credible risk of self-boiling or excessive heating of the current tank contents. Given the present tank integrity and waste properties, continued storage of the waste in Tank 241-T-104 poses no unreasonable risk to personnel, the public, or the environment.

8.2 FURTHER CHARACTERIZATION NEEDS

Characterization of the solid and liquid contents of Tank 241-T-104 has been performed in this report. While the current characterization is quite extensive, further sampling and analysis of the contents of Tank 241-T-104 is suggested for the following waste properties:

- An analysis of the tank vapor space would allow final resolution of any safety concerns regarding the presence of flammable or noxious fumes.

- Since Tank 241-T-104 received only first cycle decontamination waste, resampling the tank waste (or reanalysis of the archived sample) in order to obtain detailed segment data, especially the first and second segments, would provide a better understanding regarding the changes in first cycle waste as a function of depth, and hence time. This deeper understanding may substantially contribute to determining the inventory of other tanks that received first cycle decontamination waste.

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APPENDIX A

ANALYTICAL RESULTS

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A.1 INTRODUCTION

A.1.1 Appendix A presents the chemical and radiological characteristics of Tank 241-T-104 in a tabular form, in terms of the specific concentrations of metals, anions, radionuclides, physical properties, organic complexants and volatile and semivolatile compounds.

The data table for each analyte lists laboratory sample identification, an analytical data result for each sample, range of results, standard deviation, an evaluated data result, and a projected tank inventory for the particular analyte. The projected tank inventory column is not applicable for the specific gravity, pH, or percent water data. The data are listed in standard notation for values >.001 and <100,000. Values outside these limits are listed in scientific notation.

A.2 TABLE DESCRIPTION

A.2.1 Abbreviations

Standard abbreviations are used to describe analytical methods.

Metals:	ICP - Inductively Coupled Plasma (generic for all metals unless otherwise known)
	GHAA - Gaseous Hydride Atomic Absorption
	CVAA - Cold Vapor Atomic Absorption
Anions:	IC - Ion Chromatography
	KTN - Kjeldahl Total Nitrogen
Radionuclides:	GEA - Gamma Energy Analysis
	AEA - Alpha Energy Analysis
	APC - Alpha Proportional Counting
	BPC - Beta Proportional Counting
	LSC - Liquid Scintillation Counting
Physical Properties:	DM - Direct Measurement
	DSC - Differential Scanning Calorimetry
	TGA - Thermogravimetric Analysis

A.3 Column Headings

A.3.1 The "Analyte" column contains, in addition to the name of the analyte or physical characteristic, information about the method of measurement, and in the case of the metals, information about the sample preparation method. The sample preparation method is listed for the metals, because unlike the other analytes, different digestion procedures are typically used for the same metal.

Possible preparation methods are: d - direct; a - acid digestion; w - water leach; and f - potassium hydroxide fusion, followed by acid digestion.

The analyte and method are presented as follows: "method.analyte," or, (in the case of a metal) "method.digestion.analyte." For example, the specific concentration of ^{90}Sr was measured with a beta proportional counter and is listed "BPC.^{90}Sr." A specific concentration of Pb was determined by the inductively coupled plasma method which was preceded by acid digestion, and is listed as "ICP.a.Pb."

A.3.2 The "Laboratory Sample Identification" column lists the samples for which the analyte was measured; this identification number is different from the number assigned to the samples at the tank farm. Sampling rationale, locations, and descriptions of sampling events are contained in Section 3.0.

A.3.3 "Analytical Data Result" is the specific concentration of the analyte determined at different sampling points. No quality control data such as matrix spikes, serial dilutions, or duplicate analyses are listed. This information may be obtained from the Tank 241-T-104 data package (Duchsherer, 1993). Data which was qualified as estimated (denoted by "J" or "UJ" in the data package) will be enclosed in parentheses, i.e., (395) μg/ml. Unusable data (denoted by "R" in the data package) will be entered with a strikeout, i.e., ~~395~~ μg/ml. Unqualified data will be entered in standard form.

A.3.4 The "Range of Values" column lists the highest and the lowest values for a particular analyte.

A.3.5 The Evaluated Data Result is derived as discussed in Section 5.0

A.3.6 Column 6, "Standard Deviation" of the mean is computed for those results greater than the detection limit.

A.3.7 Column 7, "Projected Inventory," is the product of the concentration of the analyte and the volume of the waste in the tank (442,000 gallons or 1.67E+06 L solid; 50,000 gallons or 1.89E+05 L liquid).

Preferred Digestion Method for Assessing Tank 241-T-104 Constituents

Analyte	Digestion	Analyte	Digestion	Analyte	Digestion
Al	ICP.a	K	ICP.a	^{241}Am	GEA.f
Sb	ICP.f	Se	ICP.a	^{14}C	LSC
As	ICP.a	Si	ICP.f	^{137}Cs	GEA.f
Ba	ICP.f	Ag	ICP.f	^{60}Co	GEA.f
Be	ICP.f	Na	ICP.a	^{154}Eu	GEA.f
Bi	ICP.a	Sr	ICP.f	^{155}Eu	GEA.f
B	ICP.a	S	ICP.a	^{129}I	GEA.f
Cd	ICP.f	Sn	ICP.f	^{237}Np	AEA.f
Ca	ICP.f	Ti	ICP.f	^{238}Pu	Alpha
Ce	ICP.a	U	LF	$^{239/240}Pu$	Alpha
Cr	ICP.a	Zn	ICP.f	^{79}Se	LSC
Co	ICP.f	Zr	ICP.a	^{90}Sr	Beta
Cu	ICP.f	NH_3	KTN	^{99}Tc	LSC
Fe	ICP.a	CO_3^{2-}	TOC/TIC	^{3}H	LSC
La	ICP.f	Cl^-	IC	^{238}U	LF
Mg	ICP.f	CN^-	Dist/Spec	Total α	APC
Mn	ICP.f	F^-	IC	Total α Pu	APC
Hg	CVAA	NO_3^-	IC	Total α Pu + Am	APC
Ni	ICP.f	NO_2^-	IC	Total β	BPC
P	ICP.f	PO_4^{3-}	IC	Total β Cs + Sr	BPC
		SO_4^{2-}	IC		

LIST OF TABLES FOR APPENDIX A

Table A-1. Tank 241-T-104 Analytical Data:
Aluminum A-6
Antimony A-6
Arsenic A-7
Barium A-8
Beryllium A-8
Bismuth A-9
Boron A-9
Cadmium A-10
Calcium A-10
Cerium A-11
Chromium A-11
Cobalt A-12
Copper A-12
Iron A-13
Lanthanum A-13
Magnesium A-14
Manganese A-14
Mercury A-15
Nickel A-15
Phosphorus A-16
Potassium A-16
Selenium A-17
Silicon A-18
Silver A-18
Sodium A-19
Strontium A-19
Sulfur A-20
Tin A-20
Titanium A-21
Uranium A-21
Zinc A-22
Zirconium A-22

Table A-2. Tank 241-T-104 Analytical Data:
Ammonia A-23
Carbonate A-23
Chloride A-23
Cyanide A-24
Fluoride A-24
Nitrate A-24
Nitrite A-25
Phosphate A-25
Sulfate A-26

LIST OF TABLES FOR APPENDIX A (continued)

Table A-3. Tank 241-T-104 Analytical Data: Americium-241 . . . . . A-26
Carbon-14 . . . . . A-27
Cesium-137 . . . . . A-27
Cobalt-60 . . . . . A-27
Europium-154 . . . . . A-28
Europium-155 . . . . . A-28
Iodine-129 . . . . . A-28
Neptunium-237 . . . . . A-29
Plutonium-238 . . . . . A-29
Plutonium-239/240 . . . . . A-30
Selenium-79 . . . . . A-30
Strontium-90 . . . . . A-30
Technicium-99 . . . . . A-31
Tritium A-31
Uranium-238 . . . . . A-31
Total Alpha A-32
Total Alpha Plutonium A-32
Total Beta A-32

Table A-4. Tank 241-T-104 Analytical Data:
Percent Water A-33
Weight Percent Solid A-33
Weight Percent Undissolved Solid A-33
Thermogravimetric Analysis A-34
pH A-34
Total Organic Carbon A-34

Table A-5. Tank 241-T-104 Analytical Data:
Volatile Organic Analyses A-35
Tentatively Identified Compound A-36

Table A-6. Tank 241-T-104 Analytical Data:
Semivolatile Organic Analyses A-38
Tentatively Identified Compound A-39

Table A-1. Tank 241-T-104 Analytical Data: Aluminum

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Al	Sample K-204	(3,160)	N/A	3,160	N/A	597
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Al	Sample K-175	(16,700)	14,900 to 18,100	16,200	1,190	34,800
	Sample K-176	(18,100)				
	Sample K-179	15,100				
	Sample K-180	14,900				
ICP.f.Al	Sample K-175	17,900	13,700 to 17,900	15,600	1,890	
	Sample K-176	17,100				
	Sample K-179	(13,800)				
	Sample K-180	(13,700)				
ICP.w.Al	Sample K-175	(124)	124 to 179	158	12.8	
	Sample K-176	(166)				
	Sample K-179	(163)				
	Sample K-180	(179)				

Table A-1. Tank 241-T-104 Analytical Data: Antimony

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Sb	Sample K-204	(3.56)	N/A	3.56	N/A	0.673
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Sb	Sample K-175	(< 34.2)	< 34.2 to < 51.7	< 51.7	N/A	< 381
	Sample K-176	(< 51.7)				
	Sample K-179	(< 35.5)				
	Sample K-180	(< 35.2)				
ICP.f.Sb	Sample K-175	(< 176)	< 75.4 to < 177	< 177	N/A	
	Sample K-176	(< 177)				
	Sample K-179	(< 75.8)				
	Sample K-180	(< 75.4)				
ICP.w.Sb	Sample K-175	(< 36.1)	< 35.9 to < 36.3	< 36.3	N/A	
	Sample K-176	(< 36.3)				
	Sample K-179	(< 36.2)				
	Sample K-180	(< 35.9)				

Table A-1. Tank 241-T-104 Analytical Data: Arsenic

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.As	Sample K-204	(0.615)	N/A	0.615	N/A	0.116
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.As	Sample K-175	(3.53)	3.34 to < 4.50	3.61	0.312	7.76
	Sample K-176	(< 4.50)				
	Sample K-179	(3.95)				
	Sample K-180	(3.34)				
ICP.f.As	Sample K-175	(< 15.3)	< 15.3 to < 19.5	< 19.5	N/A	
	Sample K-176	(< 15.4)				
	Sample K-179	(< 19.5)				
	Sample K-180	(< 19.3)				
ICP.w.As	Sample K-175	(< 3.15)	< 3.12 to < 3.77	< 3.77	N/A	
	Sample K-176	(< 3.16)				
	Sample K-179	(< 3.77)				
	Sample K-180	(< 3.12)				

Table A-1. Tank 241-T-104 Analytical Data: Arsenic

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
HYAA.As	Sample K-175	(0.850)	0.707 to 0.850	0.756	0.0817	1.63
	Sample K-176	(0.707)				
	Sample K-179	(0.710)				

Table A-1. Tank 241-T-104 Analytical Data: Barium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Ba	Sample K-204	(2.08)	N/A	2.08	N/A	0.393
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Ba	Sample K-175	(6.96)	6.96 to 8.27	7.64	0.275	18.4
	Sample K-176	(7.84)				
	Sample K-179	(7.51)				
	Sample K-180	(8.27)				
ICP.f.Ba	Sample K-175	(8.49)	8.38 to 9.03	8.58	0.208	
	Sample K-176	(9.03)				
	Sample K-179	(8.40)				
	Sample K-180	(8.38)				
ICP.w.Ba	Sample K-175	(0.322)	< 0.305 to 0.325	0.309	N/A	
	Sample K-176	(0.325)				
	Sample K-179	(< 0.305)				
	Sample K-180	(0.306)				

Table A-1. Tank 241-T-104 Analytical Data: Beryllium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Be	Sample K-204	0.030	N/A	0.030	N/A	0.00567
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Be	Sample K-175	(< 0.288)	< 0.288 to < 0.435	< 0.435	N/A	< 3.23
	Sample K-176	(< 0.435)				
	Sample K-179	(< 0.299)				
	Sample K-180	< 0.296				
ICP.f.Be	Sample K-175	(< 1.48)	< 1.48 to < 1.50	< 1.50	N/A	
	Sample K-176	(< 1.49)				
	Sample K-179	< 1.50				
	Sample K-180	< 1.49				
ICP.w.Be	Sample K-175	(< 0.304)	< 0.302 to < 0.306	< 0.306	N/A	
	Sample K-176	(< 0.306)				
	Sample K-179	(< 0.305)				
	Sample K-180	(< 0.302)				

Table A-1. Tank 241-T-104 Analytical Data: Bismuth

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Bi	Sample K-204	(485)	N/A	485	N/A	91.7
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Bi	Sample K-175	(19,000)	18,100 to 19,400	18,900	349	40,600
	Sample K-176	(19,400)				
	Sample K-179	(18,100)				
	Sample K-180	(19,000)				
ICP.f.Bi	Sample K-175	(18,700)	16,200 to 18,700	17,400	1,100	
	Sample K-176	(18,200)				
	Sample K-179	(16,200)				
	Sample K-180	(16,300)				
ICP.w.Bi	Sample K-175	(129)	129 to 194	168	14.0	
	Sample K-176	(194)				
	Sample K-179	(173)				
	Sample K-180	(177)				

Table A-1. Tank 241-T-104 Analytical Data: Boron

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.B	Sample K-204	(7.64)	N/A	7.64	N/A	1.44
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.B	Sample K-175	(14.5)	13.8 to 19.1	15.6	1.52	33.5
	Sample K-176	(19.1)				
	Sample K-179	(15.1)				
	Sample K-180	(13.8)				
ICP.f.B	Sample K-175	(< 9.39)	< 4.96 to < 9.44	< 9.44	N/A	
	Sample K-176	(< 9.44)				
	Sample K-179	(< 4.99)				
	Sample K-180	(< 4.96)				
ICP.w.B	Sample K-175	(10.7)	10.7 to 12.5	11.5	0.625	
	Sample K-176	(11.1)				
	Sample K-179	(12.5)				
	Sample K-180	(11.7)				

Table A-1. Tank 241-T-104 Analytical Data: Cadmium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Cd	Sample K-204	(0.278)	N/A	0.278	N/A	0.0525
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Cd	Sample K-175	(1.89)	1.53 to 1.89	1.69	0.0799	11.7
	Sample K-176	(1.53)				
	Sample K-179	(1.66)				
	Sample K-180	(1.70)				
ICP.f.Cd	Sample K-175	(3.88)	3.88 to 7.48	5.44	1.87	
	Sample K-176	(< 4.57)				
	Sample K-179	(6.57)				
	Sample K-180	(7.48)				
ICP.w.Cd	Sample K-175	(< 0.710)	< 0.706 to < 0.714	< 0.714	N/A	
	Sample K-176	(< 0.714)				
	Sample K-179	(< 0.713)				
	Sample K-180	(< 0.706)				

Table A-1. Tank 241-T-104 Analytical Data: Calcium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Ca	Sample K-204	(23.3)	N/A	23.3	N/A	4.40
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Ca	Sample K-175	(203)	203 to 341	262	37.1	3,310
	Sample K-176	(247)				
	Sample K-179	(258)				
	Sample K-180	(341)				
ICP.f.Ca	Sample K-175	(3,740)	573 to 3,740	1,450	767	
	Sample K-176	(573)				
	Sample K-179	(786)				
	Sample K-180	(689)				
ICP.w.Ca	Sample K-175	(172)	158 to 194	171	11.9	
	Sample K-176	(194)				
	Sample K-179	(162)				
	Sample K-180	(158)				

Table A-1. Tank 241-T-104 Analytical Data: Cerium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Ce	Sample K-204	(15.6)	N/A	15.6	N/A	2.95
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Ce	Sample K-175	(177)	177 to 213	194	9.62	417
	Sample K-176	(192)				
	Sample K-179	(194)				
	Sample K-180	(213)				
ICP.f.Ce	Sample K-175	(137)	137 to 196	160	14.0	
	Sample K-176	(196)				
	Sample K-179	(166)				
	Sample K-180	(138)				
ICP.w.Ce	Sample K-175	(< 8.73)	< 8.67 to < 8.77	< 8.77	N/A	
	Sample K-176	(< 8.77)				
	Sample K-179	(< 8.75)				
	Sample K-180	(< 8.67)				

Table A-1. Tank 241-T-104 Analytical Data: Chromium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Cr	Sample K-204	316	N/A	316	N/A	59.7
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Cr	Sample K-175	843	843 to 960	901	29.4	1,940
	Sample K-176	899				
	Sample K-179	900				
	Sample K-180	960				
ICP.f.Cr	Sample K-175	862	833 to 921	867	19.1	
	Sample K-176	833				
	Sample K-179	850				
	Sample K-180	921				
ICP.w.Cr	Sample K-175	136	136 to 149	144	4.63	
	Sample K-176	143				
	Sample K-179	149				
	Sample K-180	148				

Table A-1. Tank 241-T-104 Analytical Data: Cobalt

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Co	Sample K-204	0.545	N/A	0.545	N/A	0.103
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Co	Sample K-175	(1.40)	1.40 to 2.04	1.75	0.264	23.2
	Sample K-176	(1.80)				
	Sample K-179	(2.04)				
	Sample K-180	(1.75)				
ICP.f.Co	Sample K-175	11.0	< 9.42 to 13.4	10.8	N/A	
	Sample K-176	13.4				
	Sample K-179	< 9.48				
	Sample K-180	< 9.42				
ICP.w.Co	Sample K-175	(< 1.22)	< 1.21 to < 1.22	< 1.22	N/A	
	Sample K-176	(< 1.22)				
	Sample K-179	(< 1.22)				
	Sample K-180	(< 1.21)				

Table A-1. Tank 241-T-104 Analytical Data: Copper

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Cu	Sample K-204	4.61	N/A	4.61	N/A	0.871
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Cu	Sample K-175	11.7	11.7 to 13.4	12.5	0.361	110
	Sample K-176	13.4				
	Sample K-179	(12.4)				
	Sample K-180	(12.3)				
ICP.f.Cu	Sample K-175	77.6	31.9 to 77.6	51.0	13.2	
	Sample K-176	50.7				
	Sample K-179	(31.9)				
	Sample K-180	(43.6)				
ICP.w.Cu	Sample K-175	(< 0.609)	< 0.605 to < 0.612	< 0.612	N/A	
	Sample K-176	(< 0.612)				
	Sample K-179	(< 0.611)				
	Sample K-180	(< 0.605)				

Table A-1. Tank 241-T-104 Analytical Data: Iron

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Fe	Sample K-204	(1,520)	N/A	1,520	N/A	287
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Fe	Sample K-175	9,090	8,420 to 9,490	9,020	276	19,400
	Sample K-176	9,490				
	Sample K-179	8,420				
	Sample K-180	9,060				
ICP.f.Fe	Sample K-175	(9,760)	8,060 to 9,760	8,840	616	
	Sample K-176	(9,160)				
	Sample K-179	8,060				
	Sample K-180	8,380				
ICP.w.Fe	Sample K-175	(65.3)	65.3 to 93.2	80.8	5.79	
	Sample K-176	(93.2)				
	Sample K-179	(81.5)				
	Sample K-180	(83.1)				

Table A-1. Tank 241-T-104 Analytical Data: Lanthanum

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.La	Sample K-204	(0.210)	N/A	0.210	N/A	0.0397
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.La	Sample K-175	(< 2.02)	< 2.02 to < 3.05	< 3.05	N/A	< 22.4
	Sample K-176	(< 3.05)				
	Sample K-179	(< 2.10)				
	Sample K-180	(< 2.08)				
ICP.f.La	Sample K-175	(< 10.4)	< 9.92 to < 10.4	< 10.4	N/A	
	Sample K-176	(< 10.4)				
	Sample K-179	(< 9.98)				
	Sample K-180	(< 9.92)				
ICP.w.La	Sample K-175	(< 2.13)	< 2.12 to < 2.14	< 2.14	N/A	
	Sample K-176	(< 2.14)				
	Sample K-179	(< 2.14)				
	Sample K-180	(< 2.12)				

Table A-1. Tank 241-T-104 Analytical Data: Magnesium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Mg	Sample K-204	(22.3)	N/A	22.3	N/A	4.21
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Mg	Sample K-175	96.1	96.1 to 114	103	3.97	301
	Sample K-176	(114)				
	Sample K-179	(99.9)				
	Sample K-180	(104)				
ICP.f.Mg	Sample K-175	199	117 to 199	140	20.9	
	Sample K-176	124				
	Sample K-179	(122)				
	Sample K-180	(117)				
ICP.w.Mg	Sample K-175	7.22	4.54 to 7.55	6.06	1.33	
	Sample K-176	7.55				
	Sample K-179	(4.54)				
	Sample K-180	(4.92)				

Table A-1. Tank 241-T-104 Analytical Data: Manganese

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Mn	Sample K-204	5.12	N/A	5.12	N/A	0.968
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Mn	Sample K-175	30.7	28.8 to 31.7	30.6	0.643	133
	Sample K-176	31.1				
	Sample K-179	28.8				
	Sample K-180	31.7				
ICP.f.Mn	Sample K-175	64.2	58.0 to 66.2	61.8	2.53	
	Sample K-176	58.6				
	Sample K-179	(58.0)				
	Sample K-180	66.2				
ICP.w.Mn	Sample K-175	< 0.304	< 0.304 to 0.398	0.379	N/A	
	Sample K-176	0.398				
	Sample K-179	0.380				
	Sample K-180	0.436				

Table A-1. Tank 241-T-104 Analytical Data: Mercury

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
TCLP.Hg	Sample K-196	(< 0.00250)	< 0.00250 to 0.0332	0.0332	N/A	0.00627
	Sample K-201	(0.0332)				
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
CVAA.Hg	Sample K-175	0.127	< 0.125 to 0.127	0.127	N/A	0.273
	Sample K-176	(< 0.125)				
	Sample K-179	(< 0.125)				
	Sample K-180	(< 0.125)				

Table A-1. Tank 241-T-104 Analytical Data: Nickel

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Ni	Sample K-204	(1.61)	N/A	1.61	N/A	0.304
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Ni	Sample K-175	(11.0)	8.45 to 16.9	11.3	1.94	24.3
	Sample K-176	(8.45)				
	Sample K-179	(16.9)				
	Sample K-180	(8.80)				
ICP.w.Ni	Sample K-175	(< 1.83)	< 1.81 to < 1.84	< 1.84	N/A	
	Sample K-176	(< 1.84)				
	Sample K-179	(< 1.83)				
	Sample K-180	(< 1.81)				

Table A-1. Tank 241-T-104 Analytical Data: Phosphorus

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.P	Sample K-204	(10,700)	N/A	10,700	N/A	2,020
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.P	Sample K-175	(23,700)	23,300 to 25,300	24,000	525	53,100
	Sample K-176	(25,300)				
	Sample K-179	(23,300)				
	Sample K-180	(23,600)				
ICP.f.P	Sample K-175	(26,200)	22,300 to 27,400	24,700	2,140	
	Sample K-176	(27,400)				
	Sample K-179	(22,300)				
	Sample K-180	(22,700)				
ICP.w.P	Sample K-175	(5,870)	5,870 to 6,710	6,410	214	
	Sample K-176	(6,510)				
	Sample K-179	(6,710)				
	Sample K-180	(6,530)				

Table A-1. Tank 241-T-104 Analytical Data: Potassium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.K	Sample K-204	74.7	N/A	74.7	N/A	14.1
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.K	Sample K-175	(88.8)	87.2 to 91.6	89.0	1.69	191
	Sample K-176	91.6				
	Sample K-179	87.2				
	Sample K-180	87.5				
ICP.w.K	Sample K-175	(33.3)	33.3 to 37.4	35.9	1.24	
	Sample K-176	(37.4)				
	Sample K-179	37.1				
	Sample K-180	(35.9)				

Table A-1. Tank 241-T-104 Analytical Data: Selenium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Se	Sample K-204	(14.2)	N/A	14.2	N/A	2.68
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Se	Sample K-175	15.0	< 12.9 to 28.4	21.7	N/A	46.7
	Sample K-176	(28.4)				
	Sample K-179	(< 13.1)				
	Sample K-180	(< 12.9)				
ICP.f.Se	Sample K-175	(< 64.7)	< 64.7 to < 70.4	< 70.4	N/A	
	Sample K-176	(< 65.1)				
	Sample K-179	(< 70.4)				
	Sample K-180	(< 69.9)				
ICP.w.Se	Sample K-175	(< 13.3)	< 13.2 to < 13.4	< 13.4	N/A	
	Sample K-176	(< 13.4)				
	Sample K-179	(< 13.3)				
	Sample K-180	(< 13.2)				

Table A-1. Tank 241-T-104 Analytical Data: Selenium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
TCLP.Se	Sample K-196	(0.0200)	0.0200 to 0.203	0.112	N/A	0.0212
	Sample K-200	(0.203)				
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
HYAA.Se	Sample K-175	(< 0.500)	N/A	< 0.500	N/A	< 1.08
	Sample K-176	(< 0.500)				
	Sample K-179	(< 0.500)				
	Sample K-180	(< 0.500)				

Table A-1. Tank 241-T-104 Analytical Data: Silicon

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Si	Sample K-204	(631)	N/A	631	N/A	119
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Si	Sample K-175	(666)	666 to 1,170	1,020	146	14,000
	Sample K-176	(1,080)				
	Sample K-179	(1,160)				
	Sample K-180	(1,170)				
ICP.f.Si	Sample K-175	6,970	6,290 to 6,970	6,520	182	
	Sample K-176	6,430				
	Sample K-179	6,290				
	Sample K-180	6,380				
ICP.w.Si	Sample K-175	(165)	163 to 174	167	1.32	
	Sample K-176	(163)				
	Sample K-179	(174)				
	Sample K-180	(167)				

Table A-1. Tank 241-T-104 Analytical Data: Silver

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Ag	Sample K-204	(0.100)	N/A	0.100	N/A	0.0189
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Ag	Sample K-175	(< 0.960)	< 0.960 to < 1.45	< 1.45	N/A	13.8
	Sample K-176	(< 1.45)				
	Sample K-179	(< 0.998)				
	Sample K-180	(< 0.988)				
ICP.f.Ag	Sample K-175	< 4.94	< 4.46 to 6.40	6.40	N/A	
	Sample K-176	(6.40)				
	Sample K-179	(< 4.49)				
	Sample K-180	(< 4.46)				
ICP.w.Ag	Sample K-175	(2.51)	< 1.01 to 2.51	2.51	N/A	
	Sample K-176	(< 1.02)				
	Sample K-179	(< 1.02)				
	Sample K-180	(< 1.01)				

Table A-1. Tank 241-T-104 Analytical Data: Sodium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Na	Sample K-204	(55,400)	N/A	55,400	N/A	10,500
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Na	Sample K-175	(62,300)	61,800 to 71,200	64,500	2,280	1.39E+05
	Sample K-176	(71,200)				
	Sample K-179	(62,600)				
	Sample K-180	(61,800)				
ICP.f.Na	Sample K-175	64,500	60,700 to 64,500	62,100	1,280	
	Sample K-176	62,200				
	Sample K-179	(60,700)				
	Sample K-180	(60,800)				
ICP.w.Na	Sample K-175	44,500	44,500 to 47,700	46,500	1,010	
	Sample K-176	46,500				
	Sample K-179	47,700				
	Sample K-180	47,300				

Table A-1. Tank 241-T-104 Analytical Data: Strontium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Sr	Sample K-204	(13.8)	N/A	13.8	N/A	2.61
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Sr	Sample K-175	(87.1)	87.1 to 106	96.8	5.10	213
	Sample K-176	(93.6)				
	Sample K-179	(97.9)				
	Sample K-180	(106)				
ICP.f.Sr	Sample K-175	(98.2)	92.7 to 106	99.1	3.66	
	Sample K-176	(92.7)				
	Sample K-179	(99.6)				
	Sample K-180	106				
ICP.w.Sr	Sample K-175	(1.26)	0.928 to 1.40	1.16	0.164	
	Sample K-176	(1.40)				
	Sample K-179	(0.928)				
	Sample K-180	(1.08)				

Table A-1. Tank 241-T-104 Analytical Data: Sulfur

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.S	Sample K-204	(1,700)	N/A	1,700	N/A	321
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.S	Sample K-175	(1,250)	1,250 to 1,340	1,280	23.3	2,750
	Sample K-176	(1,340)				
	Sample K-179	(1,260)				
	Sample K-180	(1,250)				
ICP.f.S	Sample K-175	(1,300)	1,230 to 1,300	1,270	31.3	
	Sample K-176	(1,290)				
	Sample K-179	(1,230)				
	Sample K-180	(1,240)				
ICP.w.S	Sample K-175	(1,230)	1,230 to 1,310	1,280	17.9	
	Sample K-176	(1,310)				
	Sample K-179	(1,310)				
	Sample K-180	(1,280)				

Table A-1. Tank 241-T-104 Analytical Data: Tin

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Sn	Sample K-204	(1.78)	N/A	1.78	N/A	0.336
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Sn	Sample K-175	(9.96)	9.96 to 14.6	11.6	1.05	28.4
	Sample K-176	(14.6)				
	Sample K-179	(10.5)				
	Sample K-180	(11.4)				
ICP.f.Sn	Sample K-175	(17.0)	< 8.93 to 17.9	13.2	N/A	
	Sample K-176	(17.9)				
	Sample K-179	(< 8.98)				
	Sample K-180	(< 8.93)				
ICP.w.Sn	Sample K-175	(< 1.62)	< 1.61 to < 1.63	< 1.63	N/A	
	Sample K-176	(< 1.63)				
	Sample K-179	(< 1.63)				
	Sample K-180	(< 1.61)				

Table A-1. Tank 241-T-104 Analytical Data: Titanium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Ti	Sample K-204	0.995	N/A	0.995	N/A	0.188
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Ti	Sample K-175	5.22	4.08 to 5.22	4.56	0.259	20.8
	Sample K-176	4.08				
	Sample K-179	4.22				
	Sample K-180	4.72				
ICP.f.Ti	Sample K-175	(8.65)	7.43 to 12.5	9.67	1.44	
	Sample K-176	(10.0)				
	Sample K-179	(12.5)				
	Sample K-180	7.43				
ICP.w.Ti	Sample K-175	(< 0.507)	< 0.504 to < 0.510	< 0.510	N/A	
	Sample K-176	(< 0.510)				
	Sample K-179	< 0.509				
	Sample K-180	(< 0.504)				

Table A-1. Tank 241-T-104 Analytical Data: Uranium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
LF.U	Sample K-189	2.24	2.24 to 8.20	5.22	N/A	0.987
	Sample K-191	8.20				
Metal (Solid		µg/g	µg/g	µg/g	µg/g	kg
LF.U	Sample K-175	880	866 to 942	897	19.8	1,930
	Sample K-176	901				
	Sample K-179	866				
	Sample K-180	942				

Table A-1. Tank 241-T-104 Analytical Data: Zinc

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Zn	Sample K-204	(3.12)	N/A	3.12	N/A	0.590
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Zn	Sample K-175	(23.5)	19.9 to 25.6	23.5	1.41	295
	Sample K-176	(25.6)				
	Sample K-179	(19.9)				
	Sample K-180	(25.1)				
ICP.f.Zn	Sample K-175	(208)	76.3 to 208	137	48.1	
	Sample K-176	(161)				
	Sample K-179	(76.3)				
	Sample K-180	(101)				
ICP.w.Zn	Sample K-175	(< 2.54)	< 2.52 to 9.80	9.80	N/A	
	Sample K-176	(9.80)				
	Sample K-179	(< 2.54)				
	Sample K-180	(< 2.52)				

Table A-1. Tank 241-T-104 Analytical Data: Zirconium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Metal (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
ICP.a.Zr	Sample K-204	(3.42)	N/A	3.42	N/A	0.646
Metal (Solid)		µg/g	µg/g	µg/g	µg/g	kg
ICP.a.Zr	Sample K-175	(38.6)	38.6 to 93.8	67.5	21.5	145
	Sample K-176	(53.2)				
	Sample K-179	(84.2)				
	Sample K-180	(93.8)				
ICP.f.Zr	Sample K-175	(30.7)	30.7 to 42.3	37.5	2.86	
	Sample K-176	(42.3)				
	Sample K-179	(39.4)				
	Sample K-180	(37.5)				
ICP.w.Zr	Sample K-175	(2.41)	2.15 to 2.55	2.45	0.147	
	Sample K-176	(2.69)				
	Sample K-179	(2.15)				
	Sample K-180	(2.55)				

Table A-2. Tank 241-T-104 Analytical Data: Ammonia

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Cation (Solid)		µg/g	µg/g	µg/g	µg/g	kg
KTN.NH_3	Sample K-175	(< 1,330)	< 800 to < 4,500	< 4,500	N/A	< 9,680
	Sample K-176	(< 800)				
	Sample K-179	(< 4,500)				
	Sample K-180	(< 4,500)				

Table A-2. Tank 241-T-104 Analytical Data: Carbonate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Anion (Solid)		µg/g	µg/g	µg/g	µg/g	kg
TOC/TIC.CO_3^{2-}	Sample K-175	(< 500)	N/A	< 500	N/A	< 1,080
	Sample K-176	(< 500)				
	Sample K-179	(< 500)				
	Sample K-180	(< 500)				

Table A-2. Tank 241-T-104 Analytical Data: Chloride

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Anion (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
IC.d.Cl^-	Sample K-204	(1,520)	N/A	1,520	N/A	287
Anion (Solid)		µg/g	µg/g	µg/g	µg/g	kg
IC.w.Cl^-	Sample K-175	(659)	659 to 697	670	10.2	1,440
	Sample K-176	(661)				
	Sample K-179	(697)				
	Sample K-180	(662)				

Table A-2. Tank 241-T-104 Analytical Data: Cyanide

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Anion (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
Dist/Spec.CN^-	Sample K-204	0.704	N/A	0.704	N/A	0.133
Anion (Solid)		µg/g	µg/g	µg/g	µg/g	kg
Dist/Spec.CN^-	Sample K-175	(< 2.00)	N/A	< 2.00	N/A	< 4.30
	Sample K-176	(< 2.00)				
	Sample K-179	(< 2.00)				
	Sample K-180	(< 2.00)				

Table A-2. Tank 241-T-104 Analytical Data: Fluoride

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Anion (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
IC.d.F^-	Sample K-204	(4,200)	N/A	4,200	N/A	794
Anion (Solid)		µg/g	µg/g	µg/g	µg/g	kg
IC.w.F^-	Sample K-175	(8,840)	8,200 to 8,860	8,570	164	18,400
	Sample K-176	(8,390)				
	Sample K-179	(8,860)				
	Sample K-180	(8,200)				

Table A-2. Tank 241-T-104 Analytical Data: Nitrate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Anion (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
IC.d.NO_3^-	Sample K-204	(97,700)	N/A	97,700	N/A	18,500
Anion (Solid)		µg/g	µg/g	µg/g	µg/g	kg
IC.w.NO_3^-	Sample K-175	(56,200)	56,200 to 59,800	58,000	753	1.25E+05
	Sample K-176	(58,500)				
	Sample K-179	(59,800)				
	Sample K-180	(57,700)				

Table A-2. Tank 241-T-104 Analytical Data: Nitrite

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Anion (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
IC.d.NO_2^-	Sample K-204	(6,090)	N/A	6,090	N/A	1,150
Anion (Solid)		µg/g	µg/g	µg/g	µg/g	kg
IC.w.NO_2^-	Sample K-175	(4,030)	4,030 to 4,130	4,080	25.5	8,770
	Sample K-176	(4,130)				
	Sample K-179	(4,050)				
	Sample K-180	(4,120)				

Table A-2. Tank 241-T-104 Analytical Data: Nitrite

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Anion (Solid)		µg/g	µg/g	µg/g	µg/g	kg
Spec.NO_2^-	Sample K-175	(4,100)	4,100 to 4,340	4,240	46.6	9,120
	Sample K-176	(4,340)				
	Sample K-179	(4,290)				
	Sample K-180	(4,170)				

Table A-2. Tank 241-T-104 Analytical Data: Phosphate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Anion (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
IC.d.PO_4^{3-}	Sample K-204	(25,000)	N/A	25,000	N/A	4,730
Anion (Solid)		µg/g	µg/g	µg/g	µg/g	kg
IC.w.PO_4^{3-}	Sample K-175	(16,600)	16,600 to 18,700	17,800	863	38,300
	Sample K-176	(17,300)				
	Sample K-179	(18,700)				
	Sample K-180	(18,700)				

Table A-2. Tank 241-T-104 Analytical Data: Sulfate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Anion (Liquid)		µg/mL	µg/mL	µg/mL	µg/mL	kg
IC.d.SO_4^{2-}	Sample K-204	(4,260)	N/A	4,260	N/A	805
Anion (Solid)		µg/g	µg/g	µg/g	µg/g	kg
IC.w.SO_4^{2-}	Sample K-175	(3,880)	3,870 to 3,920	3,900	31.2	8,390
	Sample K-176	(3,920)				
	Sample K-179	(3,920)				
	Sample K-180	(3,870)				

Table A-3. Tank 241-T-104 Analytical Data: Americium-241

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Liquid)		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA.^{241}Am	Sample K-204	< 9.60E-04	N/A	< 9.60E-04	N/A	< 0.181
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
GEA.^{241}Am	Sample K-175	0.0117	0.0117 to 0.0156	0.0142	9.00E-04	30.5
	Sample K-176	0.0149				
	Sample K-179	0.0146				
	Sample K-180	0.0156				

Table A-3. Tank 241-T-104 Analytical Data: Americium-241

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
Alpha Spec. ^{241}Am	Sample K-175	(0.0194)	0.0161 to 0.0194	0.0173	8.59E-04	37.2
	Sample K-176	(0.0161)				
	Sample K-179	0.0157				
	Sample K-180	0.0180				

Table A-3. Tank 241-T-104 Analytical Data: Carbon-14

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
LSC.^{14}C	Sample K-175	(< 4.50E-05)	< 4.45E-05 to < 4.50E-05	< 4.50E-05	N/A	< 0.0968
	Sample K-176	(< 4.50E-05)				
	Sample K-179	(< 4.49E-05)				
	Sample K-180	(< 4.45E-05)				

Table A-3. Tank 241-T-104 Analytical Data: Cesium-137

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Liquid)		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA.^{137}Cs	Sample K-204	0.0808	N/A	0.0808	N/A	15.3
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
GEA.^{137}Cs	Sample K-175	0.197	0.191 to 0.210	0.199	0.00562	428
	Sample K-176	0.191				
	Sample K-179	0.200				
	Sample K-180	0.210				

Table A-3. Tank 241-T-104 Analytical Data: Cobalt-60

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Liquid)		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA.^{60}Co	Sample K-204	< 1.31E-04	N/A	< 1.31E-04	N/A	< 0.0248
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
GEA.^{60}Co	Sample K-175	< 2.27E-04	< 2.27E-04 to < 3.00E-04	< 3.00E-04	N/A	< 0.645
	Sample K-176	< 3.00E-04				
	Sample K-179	< 2.81E-04				
	Sample K-180	< 2.94E-04				

Table A-3. Tank 241-T-104 Analytical Data: Europium-154

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Liquid)		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA. ^{154}Eu	Sample K-204	< 3.47E-04	N/A	< 3.47E-04	N/A	< 0.0656
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
GEA. ^{154}Eu	Sample K-175	< 7.70E-04	< 7.70E-04 to 0.00443	0.00410	4.90E-04	8.82
	Sample K-176	0.00443				
	Sample K-179	0.00354				
	Sample K-180	0.00434				

Table A-3. Tank 241-T-104 Analytical Data: Europium-155

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Liquid)		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA. ^{155}Eu	Sample K-204	< 4.12E-04	N/A	< 4.12E-04	N/A	< 0.0779
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
GEA. ^{155}Eu	Sample K-175	0.00325	0.00294 to 0.00395	0.00342	2.17E-04	7.35
	Sample K-176	0.00395				
	Sample K-179	0.00294				
	Sample K-180	0.00355				

Table A-3. Tank 241-T-104 Analytical Data: Iodine-129

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
GEA. ^{129}I	Sample K-175	< 0.0120	< 0.0118 to < 0.0464	< 0.0464	N/A	< 99.8
	Sample K-176	< 0.0118				
	Sample K-179	< 0.0261				
	Sample K-180	< 0.0464				

Table A-3. Tank 241-T-104 Analytical Data: Neptunium-237

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
AEA. ^{237}Np	Sample K-175	(< 0.0216)	< 0.0108 to 0.137	0.137	N/A	295
	Sample K-176	(< 0.0108)				
	Sample K-179	(< 0.0269)				
	Sample K-180	0.137				

Table A-3. Tank 241-T-104 Analytical Data: Plutonium-238

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Liquid)		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
Alpha Spec. ^{238}Pu	Sample K-189	< 1.80E-04	< 9.01E-05 to < 1.80E-04	< 1.80E-04	N/A	< 0.0340
	Sample K-191	< 1.80E-04				
	Sample K-204	< 9.01E-05				
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
Alpha Spec. ^{238}Pu	Sample K-175	(< 0.0180)	< 0.0179 to < 0.0180	< 0.0180	N/A	< 38.7
	Sample K-176	(< 0.0180)				
	Sample K-179	(< 0.0180)				
	Sample K-180	< 0.0179				

Table A-3. Tank 241-T-104 Analytical Data: Plutonium-239/240

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Liquid)		**µCi/mL**	**µCi/mL**	**µCi/mL**	**µCi/mL**	**Ci**
Alpha Spec. $^{239/240}Pu$	Sample K-189	0.00101	4.04E-04 to 0.00894	0.00345	N/A	0.652
	Sample K-191	4.04E-04				
	Sample K-204	0.00894				
Radionuclide (Solid)		**µCi/g**	**µCi/g**	**µCi/g**	**µCi/g**	**Ci**
Alpha Spec. $^{239/240}Pu$	Sample K-175	(0.146)	0.133 to 0.147	0.140	N/A	301
	Sample K-176	(0.147)				
	Sample K-179	(0.133)				
	Sample K-180	0.133				

Table A-3. Tank 241-T-104 Analytical Data: Selenium-79

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
LSC. ^{79}Se	Sample K-175	(< 1.73E-04)	< 1.32E-04 to < 1.75E-04	< 1.75E-04	N/A	< 0.376
	Sample K-176	< 1.75E-04				
	Sample K-179	< 1.41E-04				
	Sample K-180	< 1.32E-04				

Table A-3. Tank 241-T-104 Analytical Data: Strontium-90

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
BPC. ^{90}Sr	Sample K-175	(2.34)	2.34 to 3.00	2.63	0.239	5,660
	Sample K-176	2.44				
	Sample K-179	(2.74)				
	Sample K-180	3.00				

Table A-3. Tank 241-T-104 Analytical Data: Technicium-99

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
LSC.^{99}Tc	Sample K-175	5.79E-04	< 4.71E-04 to < 7.59E-04	5.79E-04	N/A	1.24
	Sample K-176	< 4.71E-04				
	Sample K-179	< 7.59E-04				
	Sample K-180	< 7.38E-04				

Table A-3. Tank 241-T-104 Analytical Data: Tritium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
LSC.^{3}H	Sample K-175	(< 3.36E-04)	< 3.34E-04 to < 3.38E-04	< 3.38E-04	N/A	< 0.727
	Sample K-176	(< 3.38E-04)				
	Sample K-179	(< 3.37E-04)				
	Sample K-180	(< 3.34E-04)				

Table A-3. Tank 241-T-104 Analytical Data: Uranium-238

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
LF.^{238}U	Sample K-175	1.21E-06	1.21E-06 to 4.77E-06	2.98E-06	N/A	0.00641
	Sample K-176	4.77E-06				
	Sample K-179	2.50E-06				
	Sample K-180	3.43E-06				

Table A-3. Tank 241-T-104 Analytical Data: Total Alpha

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
APC.Total Alpha	Sample K-175	(0.102)	0.102 to 0.118	0.109	0.00475	234
	Sample K-176	(0.107)				
	Sample K-179	0.118				
	Sample K-180	0.110				

Table A-3. Tank 241-T-104 Analytical Data: Total Alpha Plutonium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
APC.Total Alpha Plutonium	Sample 93-01809	0.155	0.00803 to 0.160	0.124	N/A	267
	Sample 93-01810	0.155				
	Sample 93-01807	0.111				
	Sample 93-01808	0.00803				
	Sample 93-01811	0.155				
	Sample 93-01812	0.160				

Table A-3. Tank 241-T-104 Analytical Data: Total Beta

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Radionuclide (Solid)		µCi/g	µCi/g	µCi/g	µCi/g	Ci
BPC.Total Beta	Sample K-175	(6.61)	6.61 to 9.17	7.59	0.826	16,300
	Sample K-176	(6.93)				
	Sample K-179	7.66				
	Sample K-180	9.17				

Table A-4. Tank 241-T-104 Analytical Data: Percent Water

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)
Physical Property		%	%	%	%
% H_2O	Sample K-156	70.4	70.3 to 70.9	70.5	0.200
	Sample K-158	70.3			
	Sample K-179	70.6			
	Sample K-161	70.9			

Table A-4. Tank 241-T-104 Analytical Data: Weight Percent Solid

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)
Physical Property		wt%	wt%	wt%	wt%
Wt% Solid	Sample 93-01791	43.3	28.0 to 43.3	32.3	N/A
	Sample 93-01793	28.0			
	Sample 93-01795	29.2			
	Sample 93-01797	28.7			

Table A-4. Tank 241-T-104 Analytical Data: Weight Percent Undissolved Solid

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)
Physical Property		wt%	wt%	wt%	wt%
Wt% Solid	Sample 93-01791	39.7	21.9 to 39.7	27.1	N/A
	Sample 93-01793	21.9			
	Sample 93-01795	23.6			
	Sample 93-01797	23.2			

Table A-4. Tank 241-T-104 Analytical Data: Thermogravimetric Analysis

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)
Physical Property		%	%	%	%
TGA	Sample K-175	67.1	64.15 to 83.55	70.8	N/A
	Sample K-176	69.55			
	Sample K-179	64.15			
	Sample K-180	69.55			
	Sample K-204	83.55			

Table A-4. Tank 241-T-104 Analytical Data: pH

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)
Physical Property					
pH	Sample K-175	10.0	9.95 to 10.0	9.99	N/A
	Sample K-176	10.0			
	Sample K-179	10.0			
	Sample K-180	9.99			
	Sample K-204	9.95			

Table A-4. Tank 241-T-104 Analytical Data: Total Organic Carbon

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Physical Property		µg/mL	µg/mL	µg/mL	µg/mL	kg
TOC (Liquid)	Sample K-204	541	N/A	541	N/A	102
		µg/g	µg/g	µg/g	µg/g	kg
TOC (Solid)	Sample K-175	706	< 550 to 706	706	N/A	1,520
	Sample K-176	< 550				
	Sample K-179	(< 550)				
	Sample K-180	(< 550)				

Table A-5. Tank 241-T-104 Analytical Data: Volatile Organic Analyses

Volatile Organic Compound	Result (μg/g) *	Volatile Organic Compound	Result (μg/g) *
Chloromethane	ND	1,2-Dichloropropane	ND
Bromomethane	ND	cis-1,3-Dichloropropene	ND
Vinyl Chloride	ND	Trichloroethene	ND
Chloroethane	ND	Dibromochloromethane	ND
Methylene Chloride	ND	1,1,2-Trichloroethane	ND
Acetone	ND	Benzene	ND
Carbon Disulfide	ND	trans-1,3-Dichloropropene	ND
1,1-Dichloroethene	ND	Bromoform	ND
1,1-Dichloroethane	ND	4-Methyl-2-Pentanone	ND
1,2-Dichloroethene (total)	ND	2-Hexanone	ND
Chloroform	ND	Tetrachloroethene	ND
1,2-Dichloroethane	ND	1,1,2,2-Tetrachloroethane	ND
2-Butanone	ND	Toluene	ND
1,1,1-Trichloroethane	ND	Chlorobenzene	ND
Carbon Tetrachloride	ND	Ethlybenzene	ND
Vinyl Acetate	ND	Styrene	ND
Bromodichloromethane	ND	Xylene (total)	ND

* ND = Not Detected

Table A-5. Tank 241-T-104 Analytical Data: Tentatively Identified Compound

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Volatile Organic		µg/g	µg/g	µg/g	µg/g	kg
Methoxytri methyl Silane	Sample 93-01790	3.80	3.80 to 21.0	10.1	N/A	21.7
	Sample 93-01792	9.50				
	Sample 93-01794	7.60				
	Sample 93-01796	12.0				
	Sample 93-01798	18.0				
	Sample 93-01799	11.0				
	Sample 93-01801	5.70				
	Sample 93-01800	17.0				
	Sample 93-01802	6.10				
	Sample 93-01803	4.00				
	Sample 93-01804	3.00				
	Sample 93-01805	13.0				
	Sample 93-01806	21.0				

Table A-5. Tank 241-T-104 Analytical Data: Tentatively Identified Compound

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Volatile Organic		µg/g	µg/g	µg/g	µg/g	kg
Trimethyl Silanol	Sample 93-01790	6.80	6.80 to 31.0	16.6	N/A	35.7
	Sample 93-01792	17.0				
	Sample 93-01794	9.60				
	Sample 93-01796	12.0				
	Sample 93-01798	20.0				
	Sample 93-01799	14.0				
	Sample 93-01801	18.0				
	Sample 93-01800	17.0				
	Sample 93-01802	20.0				
	Sample 93-01803	28.0				
	Sample 93-01804	10.0				
	Sample 93-01805	13.0				
	Sample 93-01806	31.0				

Table A-5. Tank 241-T-104 Analytical Data: Tentatively Identified Compound

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Volatile Organic		µg/g	µg/g	µg/g	µg/g	kg
Hexamethyl Disiloxane	Sample 93-01790	3.10	1.60 to 8.10	3.87	N/A	8.32
	Sample 93-01792	4.50				
	Sample 93-01794	2.40				
	Sample 93-01796	3.50				
	Sample 93-01798	4.40				
	Sample 93-01801	2.60				
	Sample 93-01802	3.30				
	Sample 93-01803	5.20				
	Sample 93-01804	1.60				
	Sample 93-01806	8.10				

Table A-6. Tank 241-T-104 Analytical Data: Semivolatile Organic Analyses

Semivolatile Organic Compound	Result (µg/g) *	Semivolatile Organic Compound	Result (µg/g) *
Phenol	ND	3-Nitroaniline	ND
bis(2-Chloroethyl)ether	ND	Acenaphthene	ND
2-Chlorophenol	ND	2,4-Dinitrophenol	ND
1,3-Dichlorobenzene	ND	4-Nitrophenol	ND
1,4-Dichlorobenzene	ND	Dibenzofuran	ND
Benzyl alcohol	ND	2,4-Dinitrotoluene	ND
1,2-Dichlorobenzene	ND	Diethylphthalate	ND
2-Methylphenol	ND	4-Chlorophenyl-phenylether	ND
bis(2-Chloroisopropyl)ether	ND	Flourene	ND
4-Methylphenol	ND	4-Nitroanaline	ND
N-Nitroso-di-n-propylamine	ND	4,6-Dinitro-2-methylphenol	ND
Hexachloroethane	ND	N-Nitrosodiphenylamine	ND
Nitrobenzene	ND	4-Bromophenyl-phenylether	ND
Isophorone	ND	Hexachlorobenzene	ND
2-Nitrophenol	ND	Pentachlorophenol	ND
2,4-Dimethylphenol	ND	Phenanthrene	ND
Benzoic acid	ND	Anthracene	ND
bis(2-Chloroethoxy)methane	ND	Di-n-butylphthalate	ND
2,4-Dichlorophenol	ND	Fluoranthene	ND
1,2,4-Trichlorobenzene	ND	Pyrene	ND
Naphthalene	ND	Butylbenzylphthalate	ND
4-Chloroaniline	ND	3,3'-Dichlorobenzidine	ND
Hexachlorobutadiene	ND	Benzo(a)anthracene	ND
4-Chloro-3-methylphenol	ND	Chrysene	ND
2-Methylnaphthalene	ND	Bis(2-Ethylhexyl)phthalate	ND
Hexachlorocyclopentadiene	ND	di-n-octylphthalate	ND
2,4,6-Trichlorophenol	ND	Benzo(b)fluoranthene	ND
2,4,5-Trichlorophenol	ND	Benzo(k)fluoranthene	ND
2-Chloronaphthalene	ND	Benzo(a)pyrene	ND
2-Nitroaniline	ND	Indeno(1,2,3-cd)pyrene	ND
Dimethylphthalate	ND	Dibenz(a,h)anthracene	ND
Acenaphthylene	ND	Benzo(g,h,i)perylene	ND
2,6-dinitrotoluene	ND		

* ND = Not Detected

Table A-6. Tank 241-T-104 Analytical Data: Tentatively Identified Compound

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Semi-Volatile Organic Compound		µg/g	µg/g	µg/g	µg/g	kg
Dodecane	Sample 93-01809	190	67.0 to 190	137	N/A	295
	Sample 93-01810	170				
	Sample 93-01811	67.0				
	Sample 93-01812	120				

Table A-6. Tank 241-T-104 Analytical Data: Tentatively Identified Compound

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Semi-Volatile Organic Compound		µg/g	µg/g	µg/g	µg/g	kg
Tridecane	Sample 93-01809	700	340 to 700	540	N/A	1,160
	Sample 93-01810	630				
	Sample 93-01811	340				
	Sample 93-01812	490				

Table A-6. Tank 241-T-104 Analytical Data: Tentatively Identified Compound

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Semi-Volatile Organic Compound		µg/g	µg/g	µg/g	µg/g	kg
Tetradecane	Sample 93-01809	600	330 to 600	478	N/A	1,030
	Sample 93-01810	540				
	Sample 93-01811	330				
	Sample 93-01812	440				

Table A-6. Tank 241-T-104 Analytical Data: Tentatively Identified Compound

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	Standard Deviation (Mean)	Projected Inventory
Semi-Volatile Organic Compound		µg/g	µg/g	µg/g	µg/g	kg
Pentadecane	Sample 93-01809	27.0	13.0 to 27.0	20.8	N/A	44.7
	Sample 93-01810	25.0				
	Sample 93-01811	13.0				
	Sample 93-01812	18.0				

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