

3
AUG 30 1996

ENGINEERING DATA TRANSMITTAL

Page 1 of 1
1. EDT 617521

2. To: (Receiving Organization) Distribution		3. From: (Originating Organization) Data Assessment and Interpretation		4. Related EDT No.: N/A	
5. Proj./Prog./Dept./Div.: Tank 241-BY-105/Waste Management/DAI/TWRS Technical Basis		6. Cog. Engr.: Brett C. Simpson		7. Purchase Order No.: N/A	
8. Originator Remarks: This document is being released into the supporting document system for retrievability purposes.				9. Equip./Component No.: N/A	
				10. System/Bldg./Facility: 241-BY-105	
11. Receiver Remarks: For release. <i>NOT a baseline document</i>				12. Major Assm. Dwg. No.: N/A	
				13. Permit/Permit Application No.: N/A	
				14. Required Response Date: 08/14/96	

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designer	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	WHC-SD-WM-ER-598	N/A	0	Tank Characterization Report for Single-Shell Tank 241-BY-105	N/A	2	1	1

16. KEY						
Approval Designer (F)		Reason for Transmittal (G)			Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		1. Approval	4. Review	1. Approved		4. Reviewed no/comment
		2. Release	5. Post-Review	2. Approved w/comment		5. Reviewed w/comment
		3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment		6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designer for required signatures)											
(G)	(H)	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G)	(H)
2	1	Cog.Eng. B.C. Simpson	<i>Brett C. Simpson</i>	8/30/96							
2	1	Cog. Mgr. J.G. Kristofzski	<i>J.G. Kristofzski</i>	8/13/96							
		QA									
		Safety									
		Env.									
1	1	R.J. Cosh	<i>R.J. Cosh</i>	8/30/96							

18. A.E. Young <i>A.E. Young</i> 8/14/96 Signature of EDT Originator Date		19. N/A Authorized Representative Date for Receiving Organization		20. J.G. Kristofzski <i>J.G. Kristofzski</i> 8/30/96 Cognizant Manager Date		21. DOE APPROVAL (if required) Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments	
---	--	--	--	---	--	---	--

Tank Characterization Report for Single-Shell Tank 241-BY-105

Brett C. Simpson

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

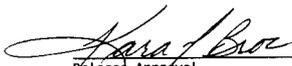
EDT/ECN: EDT-617521 UC: 2070
Org Code: 79400 Charge Code: N4G4D
B&R Code: EW 3120074 Total Pages: 136

Key Words: Tank 241-BY-105, BY Farm, Tank Characterization Report, TCR, Single-Shell Tank, SST, Waste Inventory, TPA Milestone M-44.

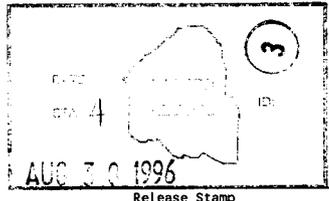
Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-BY-105. Sampling and analyses were completed to meet Safety Screening, Ferrocyanide and Historical Data Quality Objectives. This report supports the requirements of Tri-Party Agreement Milestone M-44-09.

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

Printed in the United States of America. To obtain copies of this document, contact: WHC/BSC Document Control Services, P.O. Box 1970, Mailstop H6-08, Richland WA 99352, Phone (509) 372-2420; Fax (509) 376-4989.


Release Approval

6/30/96
Date



Approved for Public Release

Tank Characterization Report for Single-Shell Tank 241-BY-105

B. C. Simpson
J. G. Field
L. M. Sasaki

Date Published
August 1996

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management



Westinghouse
Hanford Company

P.O. Box 1970
Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for public release; distribution is unlimited

EXECUTIVE SUMMARY

This tank characterization report summarizes information on the historical uses, current status, and recent sampling and analysis results of waste stored in single-shell underground tank 241-BY-105. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1996), Milestone M-44-09 and the Ferrocyanide Safety Program, Milestone T22-96-020 (WHC 1995b). According to the analyses addressed by this report, tank 241-BY-105 does not raise safety concerns based on the decision limits of the safety screening data quality objectives (DQO) (Sasaki 1996a and 1996b). However, the sampling and analysis effort associated with this tank is incomplete.

Tank 241-BY-105 is one of 12 single-shell underground waste storage tanks located in the 200 East Area BY Tank Farm on the Hanford Site. Tank 241-BY-105 began receiving metal waste through a cascade during the second quarter of 1951. In the third quarter of 1954, the metal waste was sluiced for uranium recovery. In the fourth quarter of 1954, the tank started receiving ferrocyanide waste from tanks 241-BY-107 and 241-BY-110. Until the second quarter of 1956, the tank received ferrocyanide waste intermittently from all of the ferrocyanide settling tanks. From 1954 to 1957 and 1971 to 1974, the tank occasionally received flush water from miscellaneous sources (Agnew et al. 1996). Tank 241-BY-105 received PUREX cladding waste from tanks 241-C-108 and 241-C-107 in 1961. From the second to the fourth quarter of 1966, additional cladding waste was sent to the tank. Also in 1966, 63 tons of Portland cement was added as part of a tank solidification pilot operation.

From the last half of 1967 to the fourth quarter of 1974, the tank received in-tank solidification bottoms waste.

Table ES-1 and Figure ES-1 describe tank 241-BY-105 and its status. The tank has an operating capacity of 2,870 kL (758 kgal) and presently contains 1,904 kL (503 kgal) of waste. There are approximately 598 kL (158 kgal) of sludge and 1,306 kL (345 kgal) of saltcake. No supernatant liquid remains. These values are based on surveillance information and historical data (Hanlon 1996, Grigsby et al. 1992, and Agnew et al. 1996). Section 2.4 discusses sludge and saltcake inventory differences from Hanlon (1996). The sludge is estimated to contain 727 kL (192 kgal) of drainable interstitial liquid. Waste surface level measurements have remained relatively constant for three years. Tank 241-BY-105 is on the Ferrocyanide Watch List, and it potentially contains organic complexants (WHC 1995a).

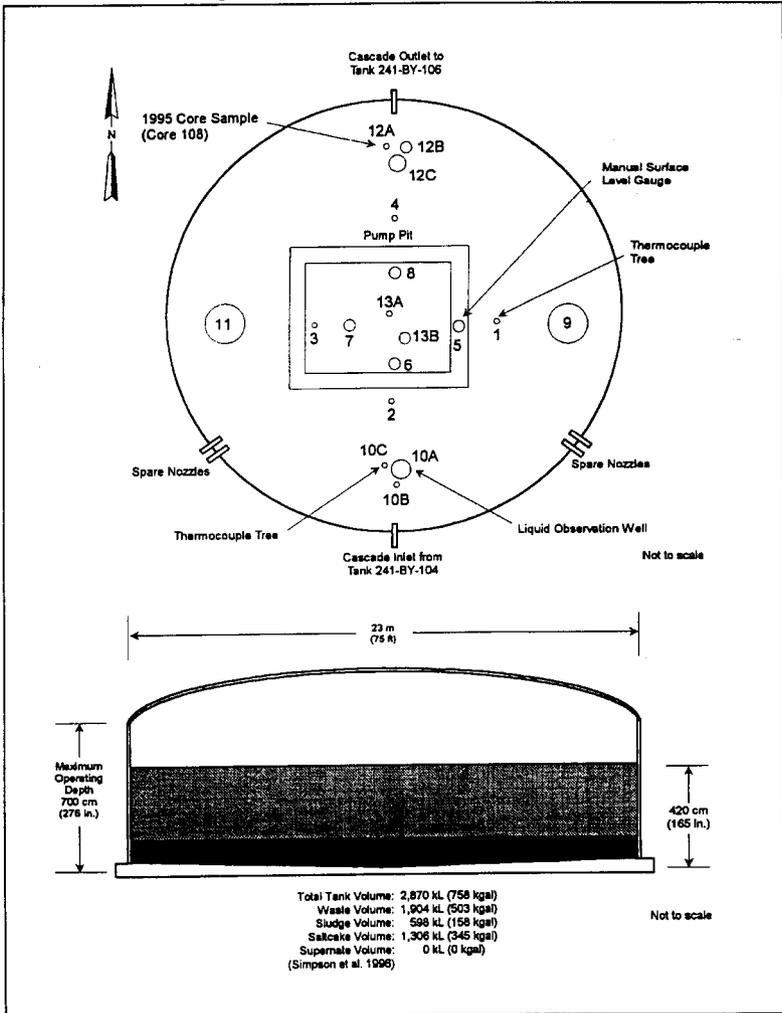
The characterization of tank 241-BY-105 is based on three sampling events: a two-part vapor sampling event that took place in May and July 1994, a grab sampling event that took place on March 22, 1995, and a core sampling event that took place between August 29 and October 6, 1995.

During the March, 1995 grab sampling event, two liquid grab samples were obtained from riser 5. Sampling and analysis were conducted in accordance with *Data Quality and Objectives for the Waste Compatibility Program* (Fowler 1995) and *Tank 241-BY-105 Tank Characterization Plan* (Schreiber 1995). Analyses included volume percent solids, specific gravity, energetics, radionuclides, and selected metals and anions. The results compared

Table ES-1. Description and Status of Tank 241-BY-105.

TANK DESCRIPTION	
Type	Single-shell
Constructed	1948 to 1949
In service	1951
Diameter	23 m (75 ft)
Maximum operating depth	7 m (23 ft)
Capacity	2,870 kL (758 kgal)
Bottom shape	Dish
Ventilation	Passive
TANK STATUS	
Waste classification	Noncomplexed
Total waste volume	1,904 kL (503 kgal)
Sludge volume	598 kL (158 kgal)
Drainable interstitial liquid	727 kL (192 kgal)
Saltcake volume	1,306 kL (345 kgal)
Waste surface level (April 1996)	420 cm (165 in.)
Temperature (Maximum, June 1996)	46 °C (114 °F)
Integrity	Assumed leaker
Watch List	Ferrocyanide
SAMPLING DATES	
Vapor sample	July 1994
Grab sample	March 22, 1995
Rotary mode core sample	August 21 to October 6, 1995
SERVICE STATUS	
Intrusion prevention	December 1982
Interim stabilized	Not completed

Figure ES-1. Profile of Tank 241-BY-105.



relatively favorably with drainable liquid results from the September 1995 core sampling event.

Based on the sampling and analysis plan (Sasaki 1995), two cores were to be taken and extruded and analyzed at the Westinghouse Hanford Company 222-S Laboratory in accordance with the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995), the *Strategy for Sampling Hanford Site Tank Wastes for Development of Disposal Technology* (Kupfer et al. 1995), the *Data Requirements for the Ferrocyanide Safety Issue Developed through the Data Quality Objectives Process* (Meacham et al. 1994), the *Test Plan for Samples From Hanford Waste Tanks 241-BY-103, BY-104, BY-105, BY-106, BY-108, BY-110, TY-103, U-105, U-107, U-108, and U-109* (Meacham 1995), *Historical Model Evaluation Data Requirements* (Simpson and McCain 1995), and *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue* (Turner et al. 1995).

During the September 1995 sampling event, core 108 was taken from tank 241-BY-105 using push and rotary core sampling methods. Only the upper portion of core 108 was sampled because the waste surface was too hard for the push core drilling method, and flammable gas restrictions were placed on all tanks in September 1995 just after starting the sampling of segment 3. The flammable gas restrictions prevented further sampling of tank 241-BY-105 using rotary core drilling. Tank safety program personnel were consulted, and a decision was made to perform only the safety screening and total organic carbon analyses on these samples because of the limited amount of material obtained (Sasaki 1996a).

Analyses included determinations for energetics, moisture content, total alpha activity, density, and total organic carbon (TOC). Metals and anions were analyzed to assess lithium and bromide ions so that hydrostatic intrusion could be determined. Because ion chromatography (IC) and inductively coupled plasma (ICP) were used for lithium and bromide analyses, results for the other IC and ICP analytes were also obtained. No sample composite or selected segment analyses were performed.

No sample obtained from tank 241-BY-105 had mean exothermic reactions (on a dry-weight basis) exceeding the safety screening and ferrocyanide DQOs limit of an enthalpy change of -480 J/g (dry weight). Although two results were substantially above the limit, subsequent triplicate analysis failed to confirm their presence. The computation of a 95 percent confidence interval on the mean for these samples (required by the safety screening DQO) indicated the highest upper limit for a liquid sample was -1,895 J/g from segment 1AR (sample S95T003418, drainable liquid).

The average water content for segment 1AR drainable liquid was 53.84 weight percent, and the TOC was 1,920 $\mu\text{g C/mL}$. The highest upper limit for a solid sample was -1,053 J/g from segment 3 (sample S99T003399, solid). The average water content was 5.7 weight percent, and the TOC was 669 $\mu\text{g C/mL}$. Mean cyanide results for these samples were low, 4.89 $\mu\text{g/g}$ (segment 1AR) and 10.7 $\mu\text{g/g}$ (segment 3). Adiabatic calorimetry results using a reactive system screening tool showed no self-heating or gas generating response for these samples (Bechtold 1996). Other sample exotherms were below the notification limit. The

mean total organic carbon results for all samples were 3,870 $\mu\text{g C/g}$ (dry), well below the notification limit of 30,000 $\mu\text{g C/g}$ (dry).

The heat load in the tank produced by radioactive decay could not be determined from the sample data, but it is estimated between 2.46 kW (8,390 Btu/hr) (Agnew et al. 1996) and 2.55 kW (8,700 Btu/hr) (Kummerer 1994). Surveillance data show that the tank temperature has gradually decreased since January 1993. On June 3, 1996, the maximum tank temperature measured was 46 °C (114 °F). The current estimated heat load and thermal history indicate that temperatures generated by tank waste are too low to initiate exothermic reactions. During core sampling, combustible gas meter readings were taken in the tank headspace as required by the safety screening DQO (Dukelow et al. 1995). The flammability level in the tank headspace for the breather filter and risers 12A and 12B was measured at 0 percent of the lower flammability limit (LFL).

Total alpha activity results were well below the safety screening limit of 1 g/L of plutonium (equivalent to 31 $\mu\text{Ci/g}$ for tank 241-BY-105 samples); the highest upper 95 percent confidence interval on the mean result was 0.06 $\mu\text{Ci/g}$. This indicates the potential for a criticality event in the upper portion of the tank is extremely low. No samples were collected from the waste at the tank bottom.

Table ES-2 shows concentrations for the most prevalent analytes and analytes of concern based on September 1995 core sample analytical results. The tank inventory was not calculated because samples were taken from only one riser and the top three tank segments.

Table ES-2. Major Analytes and Analytes of Concern¹.

Analyte		Mean Concentration	RSD (Mean)
Safety Screening Analytes			
Water Content	Solids	16.1 wt%	25.9%
	Drainable Liquid	50.2 wt%	7.77%
Total alpha activity		0.0168 $\mu\text{Ci/g}$	15.3%
Flammable gas		0%	
Metals		$\mu\text{g/g}$	Percent
Aluminum		18,400	19.9
Calcium		216	9.95
Chromium		321	5.31
Iron		476	21.0
Nickel		75.9	10.2
Sodium		198,000	2.69
Strontium		88.3	13.2
Uranium		261	8.64
Anions		$\mu\text{g/g}$	Percent
Chloride		897	30.7
Fluoride		4,100	29.6
Nitrate		491,000	15.75
Nitrite		9,410	14.4
Carbonate (TIC)		nm	nm
Oxalate		11,300	41.9
Phosphate		4,890	46.8
Sulfate		10,600	36.2
Carbon		$\mu\text{g C/g}$	Percent
Total Organic Carbon		3,250	36.0
Physical Properties		g/mL	Percent
Density		1.86	1.55

Notes:

nm = not measured

¹Sasaki (1996). These results are limited to the upper portion of one core.

CONTENTS

1.0 INTRODUCTION	1-1
1.1 PURPOSE	1-1
1.2 SCOPE	1-2
2.0 HISTORICAL TANK INFORMATION	2-1
2.1 TANK STATUS	2-1
2.2 TANK DESIGN AND BACKGROUND	2-2
2.3 PROCESS KNOWLEDGE	2-7
2.3.1 Waste Transfer History	2-7
2.3.2 Historical Estimation of Tank Contents	2-8
2.4 SURVEILLANCE DATA	2-10
2.4.1 Surface Level	2-10
2.4.2 Dry Wells	2-14
2.4.3 Internal Tank Temperatures	2-14
2.4.4 Tank 241-BY-105 Photographs	2-14
3.0 TANK SAMPLING OVERVIEW	3-1
3.1 DESCRIPTION OF THE 1995 CORE SAMPLING EVENT	3-1
3.1.1 Sample Handling	3-2
3.1.2 Sample Analysis	3-3
3.2 DESCRIPTION OF THE 1995 GRAB SAMPLE EVENT	3-3
3.3 1994 VAPOR ANALYSIS DESCRIPTION	3-7
3.4 HISTORICAL SAMPLES	3-7
4.0 ANALYTICAL RESULTS	4-1
4.1 DATA PRESENTATION	4-1
4.2 CHEMICAL DATA SUMMARY	4-2
4.2.1 Inductively Coupled Plasma and Ion Chromatography Analyses	4-2
4.2.2 Total Alpha	4-2
4.2.3 Total Organic Carbon	4-5
4.2.4 Cyanide	4-5
4.2.5 Separable Organic Layer	4-5
4.3 PHYSICAL DATA SUMMARY	4-5
4.3.1 Thermogravimetric Analysis	4-5
4.3.2 Differential Scanning Calorimetry	4-6
4.3.3 Density	4-7
4.4 ANALYSIS FOR HYDROSTATIC HEAD FLUID CONTAMINATION	4-8
4.5 HEADSPACE VAPOR SAMPLING	4-8

CONTENTS (Continued)

5.0 INTERPRETATION OF CHARACTERIZATION RESULTS 5-1

 5.1 ASSESSMENT OF SAMPLING AND ANALYTICAL RESULTS 5-1

 5.1.1 Field Observations 5-1

 5.1.2 Quality Control Assessment 5-1

 5.1.3 Data Consistency Checks 5-2

 5.2 COMPARISON OF 1995 CORE SAMPLE and GRAB SAMPLE RESULTS 5-5

 5.3 TANK WASTE PROFILE 5-6

 5.4 COMPARISON OF ANALYTICAL AND TRANSFER DATA 5-7

 5.5 SAFETY EVALUATION 5-7

6.0 CONCLUSIONS AND RECOMMENDATIONS 6-1

7.0 REFERENCES 7-1

APPENDICES:

A ANALYTICAL RESULTS FROM 1995 CORE SAMPLING A-1

B RESULTS OF HYDROSTATIC HEAD FLUID CONTAMINATION CHECK ... B-1

C MARCH 1995 GRAB SAMPLING RESULTS C-1

LIST OF FIGURES

2-1 Riser Configuration for Tank 241-BY-105 2-5

2-2 Tank 241-BY-105 Configuration 2-6

2-3 Tank Layer Model for Tank 241-BY-105 2-9

2-4 Tank 241-BY-105 Level History 2-13

2-5 Tank 241-BY-105 Weekly High Temperature Plot 2-15

LIST OF TABLES

2-1 Estimated Tank Contents 2-1

2-2 Tank 241-BY-105 Risers 2-3

2-3 Summary of Tank 241-BY-105 Waste Transfer History 2-8

2-4 Tank 241-BY-105 Inventory Estimate 2-11

3-1 Integrated Requirements for Tank 241-BY-105 3-2

3-2 Core 108 Sample Description 3-4

3-3 Analytical Procedures 3-6

4-1 Analytical Data Tables 4-1

4-2 Chemical Data Summary for Tank 241-BY-105 Saltcake 4-3

4-3 Selected Vapor Space Characterization Data 4-9

4-4 Vapor Flammability Results from 1994 Vapor Sampling and Analysis Event 4-9

5-1 Comparison of Phosphate/Phosphorous and Sulfate/Sulfur
Concentrations by Different Methods 5-3

5-2 Cation Mass and Charge Data 5-4

LIST OF TABLES (Continued)

5-3 Anion Mass and Charge Data 5-4

5-4 Mass Balance Totals 5-5

5-5 Comparison of 1995 core sample and grab sample results 5-6

5-6 Comparison of BY Saltcake Fingerprint Analytes with Analytical Results 5-7

5-7 Comparison of DSC Analytical Results Exceeding the Threshold Limit with
TOC and Cyanide Results 5-9

LIST OF TERMS

ANOVA	analysis of variance
Btu	British thermal units
C	carbon
Ci	curies
cm	centimeter
cm ³	cubic centimeters
c/	counts per second
DL	drainable liquid
DQO	data quality objective
DSC	differential scanning calorimetry
ft	feet
g	gram
HTCE	Historical Tank Content Estimate
IC	ion chromatography
ICP/AES	inductively coupled plasma/atomic emission spectrometry
in.	inches
ITS	in-tank solidification
J	joule
kg	kilogram
kgal	kilogallon
kL	kiloliter
kW	kilowatt
L	liter
LFL	lower flammability limit
m	meter
M	molar
mg	milligram
mL	milliliter
mR/hr	milliroentgen per hour
N	Newton
PFeCN1	type 1 in-plant ferrocyanide
PFeCN2	type 2 in-plant ferrocyanide
PNNL	Pacific Northwest National Laboratory
ppm	parts per million
ppmv	parts per million by volume
RPD	relative percent difference
RSD	relative standard deviation
SAP	sampling and analysis plan
TIC	total inorganic carbon
TGA	thermogravimetric analysis
TLM	Tank Layer Model
TOC	total organic carbon

LIST OF TERMS (Continued)

W	watts
WSTRS	Waste Status and Transaction Record Summary
wt%	weight percent
°C	degrees Celsius
°F	degrees Fahrenheit
μ	micro
μCi	microcurie
μg	microgram
μeq	microequivalent

1.0 INTRODUCTION

This tank characterization report summarizes the information on the historical uses, current status, and sampling and analysis results of waste stored in single-shell tank 241-BY-105. The tank waste was push and rotary core sampled between August and October 1995 to satisfy the requirements of the following documents: the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995), the *Data Requirements for the Ferrocyanide Safety Issue Developed through the Data Quality Objectives Process* (Meacham et al. 1994), the *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue* (Turner et al. 1995), *Test Plan for Samples From Hanford Waste Tanks 241-BY-103, BY-104, BY-105, BY-108, BY-110, TY-103, U-105, U-107, U-108, and U-109* (Meacham 1995), the *Historical Model Evaluation Data Requirements* (Simpson and McCain 1995), and the *Strategy for Sampling Hanford Site Tank Wastes for Development of Disposal Technology* (Kupfer et al. 1995). Grab sampling was completed in March 1995 to satisfy the requirements of *Data Quality and Objectives for the Waste Compatibility Program* (Fowler 1995). A previous vapor sample event was taken in May and July 1994 to address sampling operations and industrial safety and health concerns (Huckaby and Bratzel 1995). This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*, Milestone M-44-09 (Ecology et al. 1996) and Ferrocyanide Safety Program, Milestone T22-96-020 (WHC 1995b).

Tank 241-BY-105 has been removed from service, and intrusion prevention has been completed. Interim stabilization is not completed yet, but it is unlikely that waste removals or additions will occur until pretreatment and retrieval activities commence. Sampling and analysis of this tank is not complete. The concentration estimates reported in this document reflect the current composition of the saltcake waste based on available data.

Tank 241-BY-105 is on the Ferrocyanide Watch List and is an assumed leaker. In addition, it potentially contains organic complexants (WHC 1995a).

1.1 PURPOSE

This report summarizes information about the use and contents of tank 241-BY-105. When possible, this information will be used to assess issues associated with safety, operations, environmental, and process activities.

1.2 SCOPE

In May and July 1994, vapor samples were taken from the headspace of tank 241-BY-105 to address sampling operations and industrial safety and health concerns. On March 22, 1995, two grab samples were taken from riser 5 for compatibility analyses. Between August and October 1995, push and rotary mode samples were taken from the upper portion of the waste. Only the upper portion of one core was obtained because of difficulties in using the push core drilling method. Poor sample retrieval and flammable gas restrictions placed on all tanks during the tank 241-BY-105 sampling event prevented further attempts using rotary core drilling. As a result of these constraints, tank safety program personnel were consulted, and a decision was made to perform only the safety screening and total organic carbon analysis on these partial samples (Sasaki 1996a). Consequently, the data quality objectives (DQOs) for this tank were not fully met.

A full vapor characterization of the tank headspace gases was done prior to the sampling event. Primary analyses performed on the partial core samples obtained included the following: differential scanning calorimetry (DSC) to evaluate fuel level and energetics, thermogravimetric analysis (TGA) to determine moisture content, total alpha activity analysis and density to evaluate criticality potential, persulfate oxidation to determine the TOC concentration, and ICP metals and IC anions to assess potential intrusion of wash solution (lithium bromide traced water).

2.0 HISTORICAL TANK INFORMATION

This section describes tank 241-BY-105 based on historical information. It details the current condition of the tank and provides information on the tank design and transfer history and the process sources that contributed to the tank waste, including an estimate of the current contents based on the process history. It includes information that may be related to tank safety issues, such as potentially hazardous tank contents or off-normal operating temperatures. This section also summarizes available surveillance data for the tank. Solid and liquid level data are used to determine tank integrity (leaks) and to provide clues to internal activity in the solid layers of the tank. Temperature data are provided to evaluate the heat generating characteristics of the waste.

2.1 TANK STATUS

As of February 29, 1996, tank 241-BY-105 contained an estimated 1,904 kL (503 kgal) of waste classified as noncomplexed (Hanlon 1996). Liquid waste volume is estimated by photographic evaluation. Solid waste volume is estimated using a manual tape and by photographic evaluation. The total solids volume was last updated on April 28, 1982. The amounts of existing waste phases in the tank are shown in Table 2-1.

Table 2-1. Estimated Tank Contents.

Waste Form	Estimated Volume ¹	
	Kiloliters	(Kilogallons)
Total Waste	1,904	(503)
Supernatant liquid	0	(0)
Sludge ²	598	(158)
Saltcake ²	1,306	(345)
Drainable interstitial liquid	727	(192)
Drainable liquid remaining	727	(192)
Pumpable liquid remaining	640	(169)

Notes:

¹For definitions and calculation methods, refer to Hanlon (1996).

²For data used to make these determinations, see Section 2.4.1

Tank 241-BY-105 is out of service as are all single-shell tanks. The tank was declared an assumed leaker in 1984 with an estimated leak volume of 30 kL (8 kgal). The tank was partially isolated in December 1982, but interim stabilization has not been completed. The tank is on the Ferrocyanide Watch List. The tank is passively ventilated. All monitoring systems were in compliance with documented standards as of February 29, 1996 (Hanlon 1996).

2.2 TANK DESIGN AND BACKGROUND

The 241-BY Tank Farm was constructed between 1948 and 1949 in the 200 East Area of the Hanford Site. The 241-BY Tank Farm contains 12 type II 100-series tanks. The tanks have a 2,870 kL (758 kgal) capacity, 23 m (75 ft) diameter, and a 7 m (23 ft) operating depth (Leach and Stahl 1993). Built as one of the second generation tank farms, the 241-BY Tank Farm was designed for nonboiling waste with a maximum fluid temperature of 104 °C (220 °F). This tank is part of a six tank cascade that includes tanks 241-BX-104, 241-BX-105, 241-BX-106, BY-104, 241-BY-105, and BY-106. Tank 241-BX-106 cascades across tank farms to tank 241-BY-104. However, anecdotal evidence indicates that the cascade from the BX farm to the BY farm did not function well. As a result, the BX Farm and BY Farm cascades often operated separately. In the BY Farm a 7.5 cm (3 in.) cascade overflow line connects tank 241-BY-105 as second in a three-tank cascade series that includes tanks 241-BY-104 and 241-BY-106. The cascade overflow height is approximately 6.9 m (22.7 ft) from the tank bottom and 0.6 m (2 ft) below the top of the steel liner.

These tanks have dished bottoms with 1.2 m (4 ft) radius knuckles. Similar to all other single-shell tank farms, the tanks in the BY Tank Farm are built with primary mild steel liners and concrete domes with various risers. The tanks are set on reinforced concrete foundations. Lead flashing was used to protect the joint where the steel liner meets the concrete dome. The tanks were waterproofed on the sides and top with tar and welded-wire reinforced gunite. Each tank is covered with approximately 2.6 m (8 ft) of overburden.

Tank 241-BY-105 has 21 risers including three "caissons" that are labeled risers. These risers range in size from 10 cm (4 in.) to 1.1 m (42 in.) in diameter. Table 2-2 shows riser and nozzle numbers, sizes and descriptions. Figure 2-1 shows the riser configuration. The tank has three air-lift circulators. Figure 2-2 is a tank cross section that shows the approximate waste level and a schematic of the tank equipment.

Table 2-2. Tank 241-BY-105 Risers.^{1, 2, 3, 4} (2 sheets)

Riser Number	Diameter (In.)	Description and Comments
1	4	Thermocouple tree, B-221
2	4	Covered with concrete, below grade
3	4	Drain
4	4	Blind flange (breather filter [dog leg riser] ECN-617142, November 14, 1993)
5	12	Observation port/B-221 (liquid level reel on 4 spool CEO-39569, July 15, 1987)
6	12	Covered with concrete
7	12	Saltwell pump (observation port CEO-39569, July 15, 1987)
8	12	Covered with concrete
9	42	Sluice pit
10	42	Caisson with cover plate
10A	4	Liquid observation well
10B	18	Air duct
10C	14	Thermocouple tree
11	42	Sluice pit, weather covered
12	42	Caisson with cover plate
12A	4	Breather filter (vapor assembly/breather offset ECN-189223L March 10, 1994) (spare ECN-617142 November 14, 1993)
12B	18	Air duct
12C	14	Air lift circulator, below grade
13	42	Caisson cover plate
13A	4	Observation port (not used CEO-39569 July 15, 1987)
13B	12	Air circulator saltwell riser CEO-39569 July 15, 1987)

Table 2-2. Tank 241-BY-105 Risers.^{1, 2, 3, 4} (2 sheets)

Nozzle Number	Diameter (In.)	Description and Comments
N1	3	Spare inlet, capped
N2	3	Spare inlet, capped
N3	3	Spare inlet, capped
N4	3	Spare inlet, capped
N5	3	Overflow inlet
N6	3	Overflow outlet

Notes:

CEO = change engineering order

ECN = engineering change notice

¹Alstad (1993)

²Tran (1993)

³WHC (1988)

⁴WHC (1976)

Figure 2-1. Riser Configuration for Tank 241-BY-105.

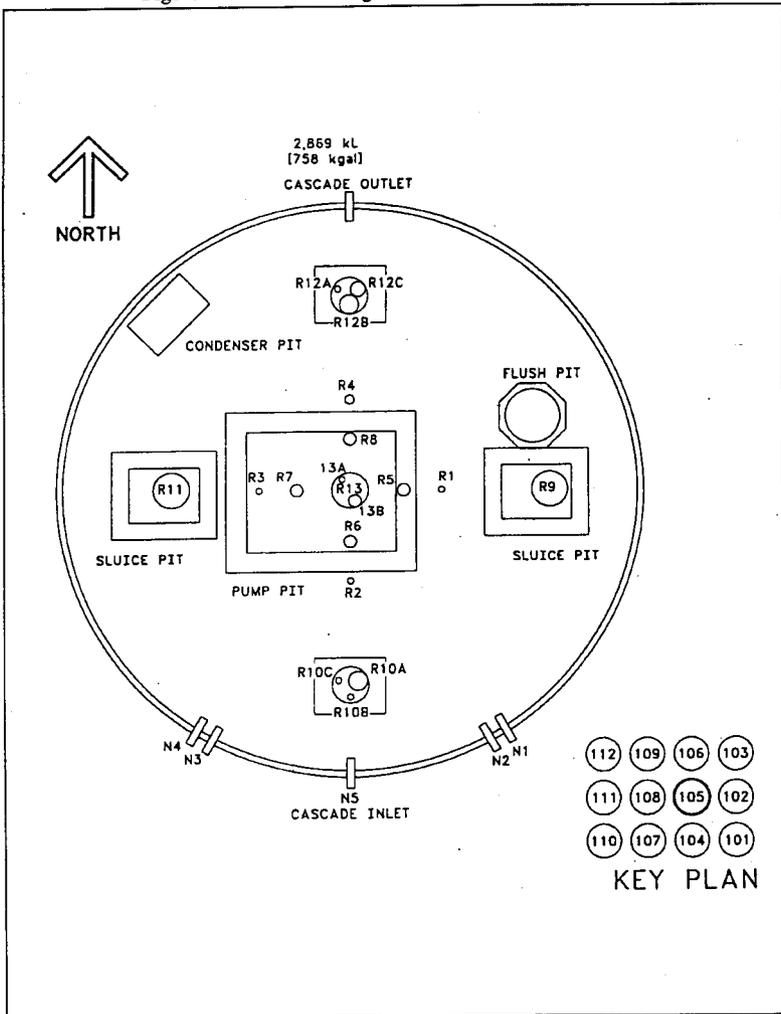
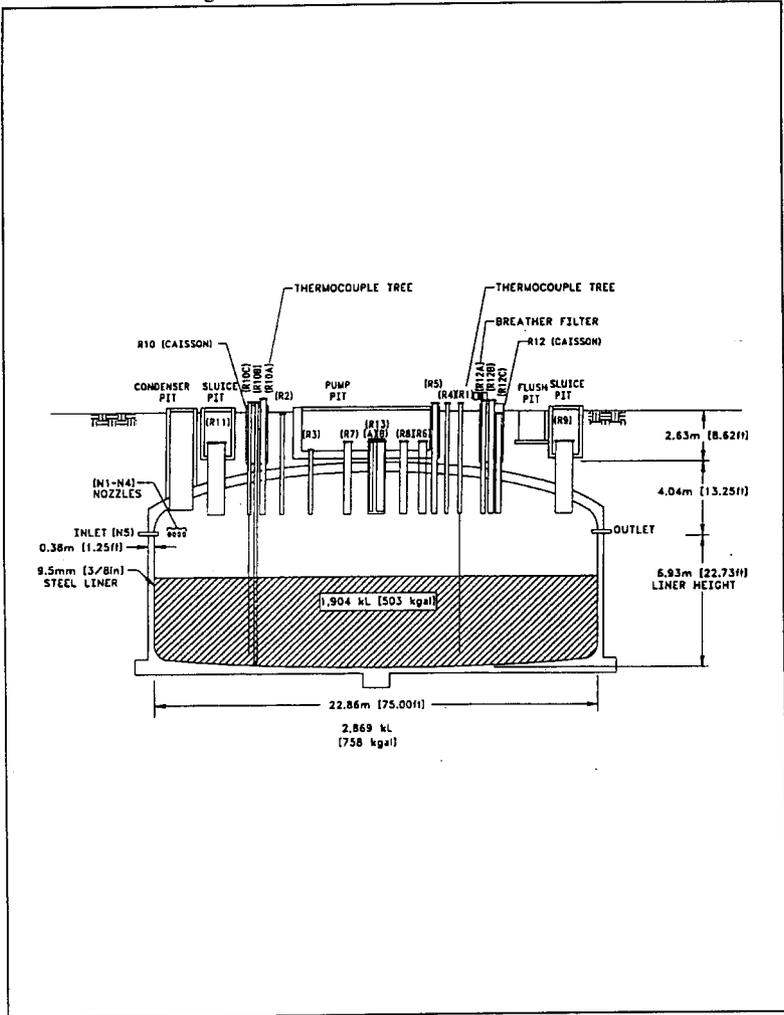


Figure 2-2. Tank 241-BY-105 Configuration.



2.3 PROCESS KNOWLEDGE

This section describes the transfer history of tank 241-BY-105 and the process wastes that made up the transfers. This is followed by an estimate of current tank contents based on transfer history. Table 2-3 summarizes the waste transfers for tank 241-BY-105.

2.3.1 Waste Transfer History

In 1951, metal waste cascaded to tank 241-BY-105 from tank 241-BY-104. Tank 241-BY-105 was sluiced during the third quarter of 1954, and a small heel of metal waste was assumed to remain. From 1954 to 1956, tank 241-BY-105 was a sludge collection tank and received in-plant ferrocyanide waste from tanks 241-BY-106, 241-BY-107, 241-BY-108 and 241-BY-110. However in 1956, the ferrocyanide scavenged waste had completely settled and the supernatant was transferred to 100-B and 100-C area cribs. Flush water from miscellaneous sources was added to tank 241-BY-105 during 1957.

PUREX cladding waste was received by tank 241-BY-105 in 1961. Additional cladding waste originating from tanks 241-C-107, 241-C-108, and 241-BY-101 was received in 1966. In November 1966, the tank received 63 tons of Portland cement as part of a tank solidification effort (Hodgson 1995). In 1967, tank 241-BY-105 was designated as an in-tank solidification (ITS) bottoms receiver. From 1968 until 1974, tank 241-BY-105 received ITS waste, ITS evaporator bottoms waste and evaporator bottoms waste from tanks 241-BY-102, 241-BY-109, or 241-BY-112. During 1971 and 1974, flush water from miscellaneous sources was added to tank 241-BY-105. The *Waste Status and Transaction Record Summary (WSTRS) for the Northeast Quadrant* (Agnew et al. 1995b) has recorded the addition of BY saltcake waste to tank 241-BY-105 in 1976. It is believed this addition was a further concentration of the ITS waste. Anderson (1990) reported that 63 tons of Portland cement were added in 1977. This is probably incorrect because Anderson also reported the 1966 transfer of cement to the tank. Two cement additions are not consistent with analytical results, and no reference could be found to support the 1977 addition. Approximately 1,904 kL (503 kgal) of waste were left in tank 241-BY-105 after the final transfer from it in 1982.

Table 2-3. Summary of Tank 241-BY-105 Waste Transfer History^{1, 2}.

Transfer Source	Waste Type Received	Time	Waste Volume	
			kL	kgal
241-BY-104	Metal waste	1951	2,078	(549)
241-BY-107	In-plant (U Plant) ferrocyanide scavenged waste	1954 to 1956	1,620	(428)
241-BY-110	In-plant (U Plant) ferrocyanide scavenged waste	1954 to 1956	1,321	(349)
241-BY-108	In-plant (U Plant) ferrocyanide scavenged waste	1955 to 1956	636	(168)
241-BY-106	In-plant (U Plant) ferrocyanide scavenged waste	1956	79	(21)
241-C-108	Cladding waste PUREX	1961	344	(91)
241-C-107	Cladding waste PUREX	1961	727	(192)
241-BY-101	Cladding waste	1966	450	(119)
241-BY-102	In-tank solidification evaporator bottoms waste	1968 to 1971	11,110	(2,935)
241-BY-109	Evaporator bottoms waste/ in-tank solidification evaporator bottoms waste	1970 to 1974	2,797	(739)
241-BY-112	In-tank solidification waste	1971 to 1974	386	(102)

Notes:

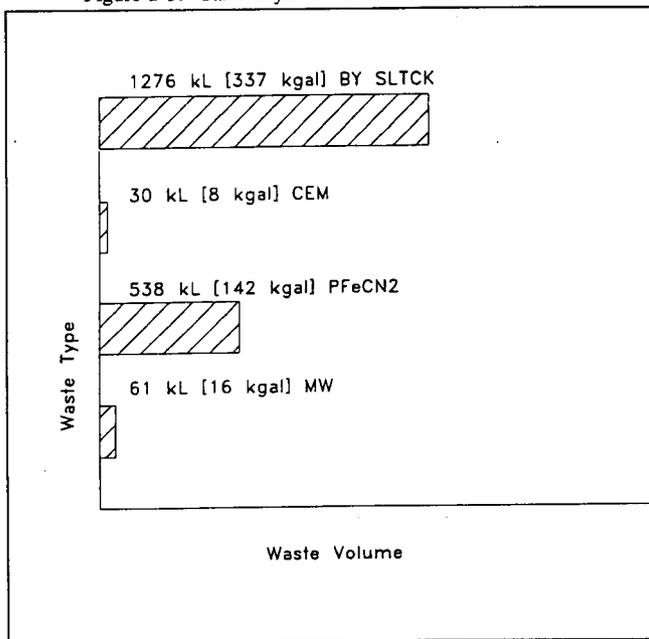
¹Waste volumes and types are best estimates based on historical data.²Agnew et al. (1995b)**2.3.2 Historical Estimation of Tank Contents**

The historical data used to estimate the contents of tank 241-BY-105 are from the *Waste Status and Transaction Record Summary for the Northeast Quadrant* (Agnew et al. 1995b), the *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 3* (Agnew et al. 1996), the *Tank Layer Model for Northeast, Southwest, and Northwest Quadrants* (Agnew et al. 1995a), and the tank inventory composition estimates to be placed in the updates of the *Historical Tank Content Estimate (HTCE) for the Northeast Quadrant of the Hanford 200 East Area* (Brevick et al. 1995). The Waste Status and Transaction Record Summary (WSTRS) is a compilation of available waste transfer and volume status data. The Hanford

Defined Waste (HDW) provides the assumed typical compositions for Hanford waste types. In most cases, the available data are incomplete thereby reducing the reliability of the transfer data and the derived modeling results. The Tank Layer Model (TLM), uses the WSTRS data to model the waste deposition processes and from the HDW (which may introduce more error), to generate an estimate of the tank contents. Because of the possibility of introducing errors, these model predictions can only be considered an estimate that requires further evaluation using analytical data.

Agnew et al. (1996) estimates that tank 241-BY-105 contains 61 kL (16 kgal) of type 2 metal waste (MW2) from the bismuth phosphate (BiPO_4) process, 538 kL (142 kgal) of type 2 in-plant ferrocyanide scavenged waste (PFeCN2), 1,276 kL (337 kgal) of BY saltcake waste (BYSLTCK), and 30 kL (8 kgal) of cement. Tank 241-BY-105 contains the following waste layers from the bottom to the top: MW2, PFeCN2, BYSLTCK, and a top layer of cement. Figure 2-3 is a graphical representation of the estimated waste types and volumes for the tank layers. Table 2-4 shows an estimate of the expected waste types and quantities in the tank.

Figure 2-3. Tank Layer Model for Tank 241-BY-105.



2.4 SURVEILLANCE DATA

Tank 241-BY-105 surveillance includes surface level measurements (liquid and solid) and temperature monitoring inside the tank (waste and headspace). The data provide the basis for determining tank integrity.

Liquid level measurements may indicate a tank leak. Solid surface level measurements may indicate physical changes and the consistency of solid layers in a tank. Drywells around the perimeter of the tank may show increased radioactivity because of a leak to the soil.

2.4.1 Surface Level

The tank 241-BY-105 waste surface level is monitored quarterly with a manual tape through riser 5. The liquid waste volume is determined by photographic evaluation and the solid waste by a manual tape surface level gauge and photographic evaluation. The maximum allowable increase from the 4.62 m (15.2 ft) baseline is 5 cm (2 in.). The criterion for decrease does not apply to this tank. Tank 241-BY-105 has a liquid observation well located in riser 10A. To determine interstitial liquid levels, the tank is monitored weekly with a neutron probe. It is also monitored on request with a gamma probe. On April 4, 1996, the waste surface level reading was 4.2 m (13.9 ft). Figure 2-4 shows the tank volume history based on Hanlon (1966) and Brevick et al. (1995). Swaney (1993) identified discrepancies between the waste surface level measurement and tank volumes reported in Hanlon (1996) and stated that the Hanlon report cannot be updated until new in-tank photographs are taken.

The volumes of saltcake and sludge presently documented in Hanlon (1966) do not agree with historical records or gamma and neutron scans of waste through the salt well. The transfer records of Agnew et al. (1995b) indicated that substantial heels of ferrocyanide waste were transferred to this tank, the sludge was allowed to settle, and supernatant was subsequently disposed to the 100-B and 100-C areas. Agnew et al. specifies a retained sludge heel of 598 kL (158 kgals [61 kL metal waste and 539 kL in-plant-2 ferrocyanide waste]). Although Hodgson (1995) indicated that ferrocyanide sludge may have been removed from the tank, no tank sluicing was reported between 1965 and 1970 (Rodenhizer 1987); therefore this report assumes the sludge was retained. This value closely corresponds to an estimate derived from interpreting the gamma and neutron scans of Grigsby et al. (1992). There is a substantial drop off in gamma (gross and ¹³⁷Cs) and neutron activity at the 1.6 m (5.25 ft) mark corresponding to approximately 655 kL (173 kgals). Similar behavior was observed in the gamma and neutron traces from tanks 241-BY-108 and 241-BY-110; the corresponding visual cues and analytical observations in these tanks confirm the presence of sludge indicated by the gamma/neutron probes. Given the minor difference in sludge inventory obtained from the two methods (RPD = 9 percent), the sludge inventory of tank 241-BY-105 will be taken to be 598 kL (158 kgal [matching the Agnew model estimate]), and the balance of the waste, 1,306 kL (345 kgals), will be designated saltcake. Forthcoming issues of Hanlon reports will update the change in inventory estimates.

Table 2-4. Tank 241-BY-105 Inventory Estimate^{1, 2, 3}. (2 sheets)

Physical Properties			
Total solid waste	2.97E+06 kg (503 kgal)		
Heat load	2.46 kW (8.39E+03 BTU/hr)		
Bulk density	1.56 g/mL		
Water wt%	42.5		
TOC wt% Carbon (wet)	0.416		
Chemical Constituents	mole/L	ppm	kg
Na ⁺	9.55	1.41E+05	4.18E+05
Al ³⁺	1.47	2.54E+04	7.53E+04
Fe ³⁺ (total Fe)	0.293	1.05E+04	3.11E+04
Cr ³⁺	3.48E-02	1.16E+03	3.45E+03
Bi ³⁺	8.11E-02	1.09E+04	3.23E+04
La ³⁺	2.16E-06	0.193	0.572
Hg ²⁺	2.43E-05	3.13	9.27
Zr (as ZrO(OH) ₂)	1.99E-04	11.6	34.5
Pb ²⁺	3.80E-03	505	1.50E+03
Ni ²⁺	4.57E-02	1.72E+03	5.11E+03
Sr ²⁺	2.41E-06	0.135	0.401
Mn ⁴⁺	2.18E-03	76.9	228
Ca ²⁺	0.470	1.21E+04	3.59E+04
K ⁺	3.00E-02	752	2.23E+03
OH ⁻	8.08	8.82E+04	2.62E+05
NO ₃ ⁻	4.98	1.98E+05	5.88E+05
NO ₂ ⁻	1.21	3.59E+04	1.06E+05
CO ₃ ²⁻	0.482	1.86E+04	5.50E+04
PO ₄ ³⁻	0.173	1.06E+04	3.13E+04

Table 2-4. Tank 241-BY-105 Inventory Estimate^{1, 2, 3}. (2 sheets)

Chemical Constituents	mole/L	ppm	kg
SO ₄ ²⁻	0.190	1.17E+04	3.47E+04
Si (as SiO ₃ ²⁻)	0.172	3.11E+03	9.21E+03
F	9.48E-02	1.16E+03	3.43E+03
Cl	0.107	2.43E+03	7.21E+03
citrate	1.61E-02	1.95E+03	5.79E+03
EDTA ⁴⁻	3.61E-03	667	1.98E+03
HEDTA ³⁻	4.87E-04	85.7	254
glycolate	1.13E-02	545	1.62E+03
acetate	2.15E-02	813	2.41E+03
oxalate	1.85E-06	0.105	0.310
DBP	1.71E-02	2.92E+03	8.65E+03
Butanol	1.71E-02	812	2.41E+03
NH ₃	7.00E-03	76.4	227
Fe(CN) ₆ ⁴⁻	2.21E-02	3.83E+03	1.14E+04
Radiological Constituents			
Pu		7.50E-02 (μCi/g)	3.70 (kg)
U	0.115 (M)	1.26E+03 (μg/g)	5.22E+04 (kg)
Cs	0.149 (Ci/L)	95.5 (μCi/g)	2.83E+05 (Ci)
Sr	8.81E-02 (Ci/L)	56.6 (μCi/g)	1.68E+05 (Ci)

Notes:

¹Agnew et al. (1996)

²The HTCE predictions have not been validated and should be used with caution.

³Small differences appear to exist among these values and the inventories calculated from the two sets of concentrations. These differences are being evaluated.

2.4.2 Dry Wells

Tank 241-BY-105 has three dry wells. Dry wells 22-05-01 (not active prior to 1990 but with two erratic readings > 50 c/s) and 22-05-09 (active prior to 1990, current readings < 200 c/s) have or have had readings greater than the 50 c/s background radiation. For a graphical representation of dry well data from January 1990 to the present, refer to Brevick et al. (1994).

2.4.3 Internal Tank Temperatures

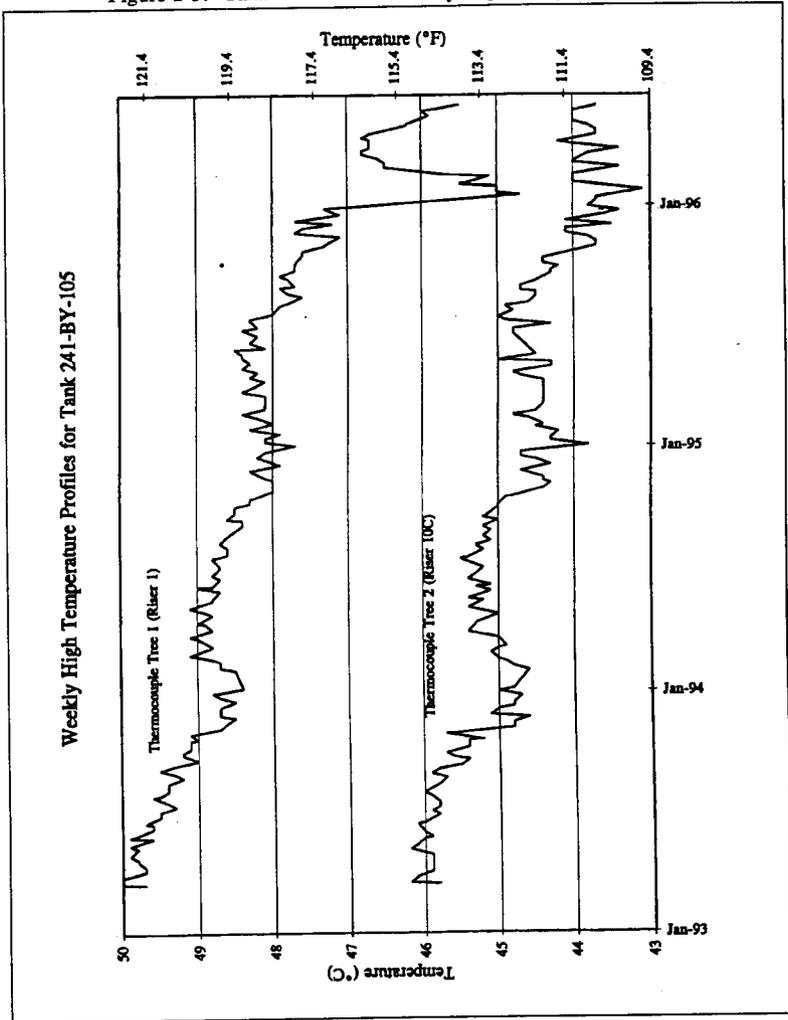
Tank 241-BY-105 has two thermocouple trees: tree 1 (riser 1) has 16 thermocouples and tree 2 has 12 thermocouples to record the tank temperature. Lipnicki (1996), Drawing H-2-90342 (WHC 1987), riser configuration drawings, and the Surveillance Analysis Computer System (SACS) provide conflicting data about the location of thermocouple tree 2. For this report, it is assumed that thermocouple tree 2 is located in riser 10A (Lipnicki 1996). Elevations are known for all thermocouples except 15 and 16 (tree 1) and 7 through 12 (tree 2). Between January 1993 and June 1996, the mean temperature for thermocouple tree 1 was 36.1 °C (96.9 °F), the minimum temperature was 24.82 °C (76.68 °F) and the maximum temperature was 50.0 °C (122 °F). The mean temperature for thermocouple tree 2 was 38.4 °C (101.2 °F), and the maximum temperature was 46.4 °C (115.6 °F). On June 3, 1996, the high temperature in the tank was 46 °C (114 °F) for tree 1, thermocouple 1 (located in the waste); the low temperature was 25 °C (77 °F) for tree 1, thermocouples 8, 9, and 12 (located in the vapor space).

Figure 2-5 shows a plot of the weekly high temperature profiles for each thermocouple tree. The plot shows that since January 1993 temperatures were consistently higher for thermocouple tree 1 (riser 1) than for tree 2 (riser 10C). The reason is believed to be the influence of the tank boundary on the thermocouple measurements. Heat transfer from the tank wall maintains a lower temperature near the tank wall (riser 10C) than at the center (riser 1). The plot also shows that since January 1993, temperatures for all risers have decreased with time. For plots of individual thermocouple readings for tank 241-BY-105, refer to Brevick et al. 1994.

2.4.4 Tank 241-BY-105 Photographs

The July 1982 photographic montage (see Figure 2-6) of the tank 241-BY-105 interior indicates a light tan to light brown saltcake surface with a pool of yellowish liquid in the saltwell screen. Visible equipment includes a saltwell screen, a temperature probe, and an airlift circulator descending into a depression in the crust. The tank waste volume at the time of the photographs was 2,067 kL (546 kgals) of waste, which corresponds to a depth of 5.2 m (17.2 ft).

Figure 2-5. Tank 241-BY-105 Weekly High Temperature Plot.

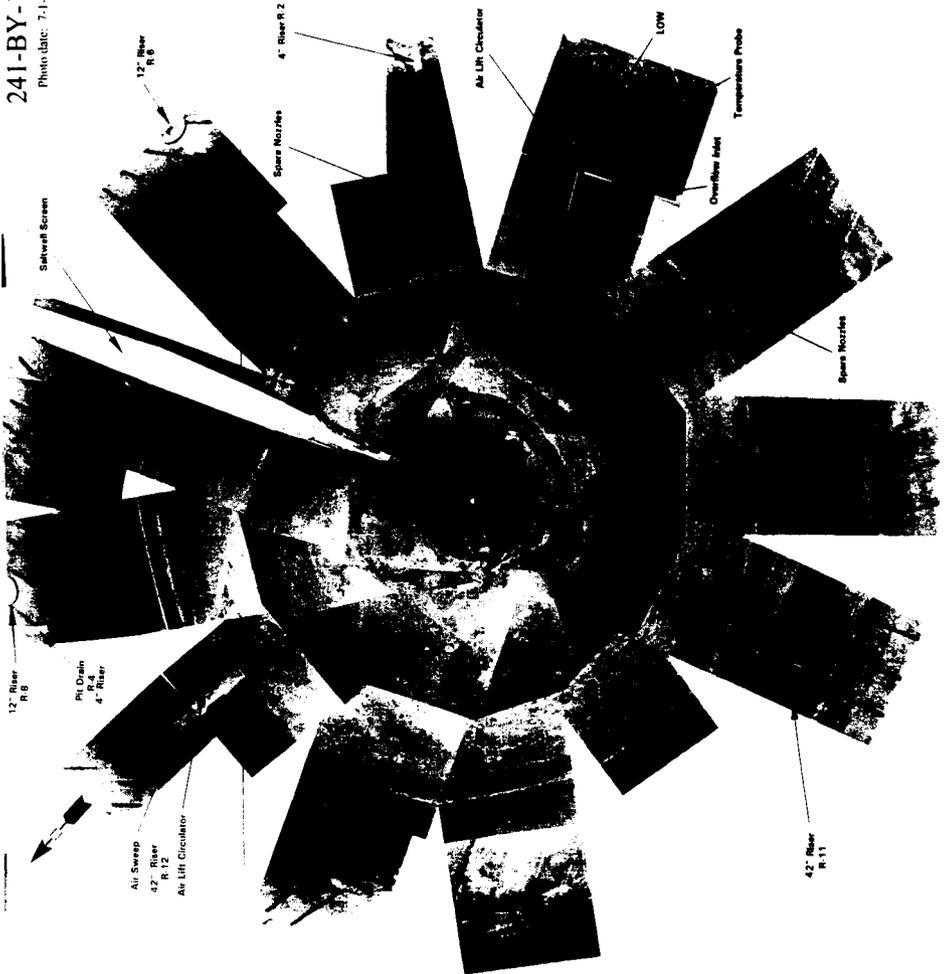


This page intentionally left blank.

Figure 2-6. Photographic Montage of Tank 241-BY-105 for July 1986.

241-BY-105

Photo date: 7-1-86



This page intentionally left blank.

3.0 TANK SAMPLING OVERVIEW

This section describes the August through October 1995 core sampling and analysis, the March 1995 compatibility grab sample event, and the 1994 vapor sample event for tank 241-BY-105. No historical sample information was available. Analytical results for 1995 core samples, 1995 grab samples, and 1994 vapor samples are presented in Appendices A, B, and C, respectively. Table 3-1 summarizes the applicable DQOs and their respective sampling and analysis requirements. For further discussions of the sampling and analysis procedures, refer to the *Tank Characterization Reference Guide* (DeLorenzo et al. 1994).

3.1 DESCRIPTION OF THE 1995 CORE SAMPLING EVENT

One push/rotary mode core sample was collected from tank 241-BY-105 between August and October 1995. Only the top 120 cm (47 in.) of core 108 from riser 12A was sampled because of difficulties in using the push core drilling method. This is within 25.4 cm (10 in.) of the level of waste after cement was added in 1966. Poor sample retrieval and flammable gas restrictions placed on all tanks during the 241-BY-105 sampling event prevented further attempts using rotary core drilling.

Segments 1, 1A, and 1B, the top 40.6 cm (16 in.) of the waste, were obtained in push mode. Sampling of segment 1B stopped when the sampling downforce reached 2,455 N (2,800 pounds) and a switch to a rotary sampling bit was made. Segment 1C was obtained at the same location starting from the waste surface: the first 31.8 cm (12.5 in) of sampling was in push mode, and the last 16.5 cm (6.5 in) was in rotary mode. Segments 2 and 3 were obtained in rotary mode. After segment 3 was completed, flammable gas restrictions were placed on all tanks, thereby prohibiting further rotary mode sampling. Sampling operations were stopped until a decision was made to try to complete core sampling using only push mode. Starting from the waste surface again, segments 1R (R= resample), 1AR, 2R and 2AR were obtained before a hard material was encountered, and sampling was abandoned.

As a result of these difficulties, tank safety program personnel were consulted, and a decision was made to perform only the safety screening and total organic carbon analysis on these partial core samples (Sasaki 1996b). Consequently, the safety screening, ferrocyanide, organic, and historical data quality objectives (DQOs) for this tank (Sasaki 1995) were not fully met.

Nitrogen gas was used to maintain hydrostatic head pressure during sampler changeout. Water was used to wash the drill string between core sampling operations. A tracer (lithium bromide) was added to the wash water to gauge contamination of the segments by the wash water. A field blank obtained during the sampling operation and a lithium bromide blank were sent to the 222-S Laboratory for analysis.

Table 3-1. Integrated Requirements for Tank 241-BY-105.¹

Sampling Event	Applicable DQOs	Sampling Requirements	Applicable References
Push/Rotary mode core sampling	<p>SAFETY SCREENING</p> <ul style="list-style-type: none"> - Energetics - Moisture Content - Total Alpha - Flammable Gas <p>FERROCYANIDE</p> <p>ORGANIC</p> <p>SAFETY TEST PLAN</p> <p>HISTORICAL</p> <p>PRETREATMENT</p>	Core samples from a minimum of two risers separated radially to the maximum extent possible.	<p>Dukelow et al. (1995)</p> <p>Meacham et al. (1994)</p> <p>Turner et al. (1995)</p> <p>Meacham (1995)</p> <p>Simpson and McCain (1995)</p> <p>Kupfer et al. (1995)</p>
Grab sampling	COMPATIBILITY	3 grab samples	Fowler (1995)
Vapor	SAFETY SCREENING GENERIC VAPOR	Multiple samples from the dome space	Dukelow et al. (1995) Osborne et al. (1994)

Note:

¹Sasaki (1995)

3.1.1 Sample Handling

A portion of core 108 was received by the Westinghouse Hanford Company 222-S Laboratory. Samples were extruded between September 11 and October 12, 1995. All core samples were manually homogenized prior to analysis by the 222-S Laboratory. The sample was composed of 3 segments identified as samples 95-197 to 95-199. No liner liquid was collected for any segments or subsegments. Drainable liquid was observed in segments 1, 1A, 1AR, and 2AR.

Segments 1A, 1B, 1AR, and 2AR were collected separately as partial segments. The letters A and B denote the relative position of the segment portion; A was at the top of the segment, and B was at the bottom. As stated previously, the letter R identifies resampled segments.

Table 3-2 describes the segments obtained from core 108, including segment numbers, phase (solid or liquid), color, texture, and amount of material recovered.

3.1.2 Sample Analysis

The analytical data provided by the analysis of core 108 were limited to the requirements of the safety program (total alpha activity, energetics, water content, flammable gas, lithium and bromide), TOC, and analysis of additional anions and metals obtained on an opportunistic basis as a result of primary safety analyses for bromide and lithium hydrostatic head fluid intrusion (Kristofzski 1995).

Core 108 was analyzed at the Westinghouse Hanford Company 222-S Laboratory. All solid sample analyses were performed on homogenized samples. Weight percent water was determined by thermogravimetric analysis (TGA). The fuel content of the waste was determined by differential scanning calorimetry (DSC). Metals were measured using ICP/atomic emission spectroscopy (AES); prior to analysis the subsamples were prepared by fusion and acid digestion. Anions were measured on water-leached samples using IC. Total organic carbon was measured using hot persulfate oxidation and coulometry. Total alpha activity and gamma energy analysis was performed on fusion-digested samples. Density was measured using centrifugation. Secondary safety screening analyses performed were cyanide and the adiabatic calorimetry reactive system screening tool tests. Table 3-3 provides information about the laboratory procedures used in the analysis of these samples.

A complete data set including the segments, segment portions, individual sample numbers, and the analyses performed on each sample is included in Appendix A.

3.2 DESCRIPTION OF THE 1995 GRAB SAMPLE EVENT

On March 22, 1995, two liquid grab samples were obtained from riser 5. Sampling and analysis were conducted in accordance with *Data Quality and Objectives for the Waste Compatibility Program* (Fowler 1995) and *Tank 241-BY-105 Tank Characterization Plan* (Schreiber 1995). Analyses included volume percent solids, specific gravity, energetics, radionuclides, and selected metals and anions. Results are included in Appendix C. The results compare favorably with drainable liquid results from the September 1995 core sampling event (see Section 5.0).

Table 3-2. Core 108 Sample Description.¹

Segment	Sample ID	Expected Sample Length (cm)	Sample Weight (g)		Segment Description
			Solid	Liquid	
1	95-197	24	56.2	123.0	Extruded 15 cm of sample. Sample was a beige slurry with crystalline solids. Drainable liquid was recovered.
1A	95-197A	11.5	51.1	50.8	Extruded 2.5 cm of sample. Sample was beige, a mixture of sludge and crystalline solids. Drainable liquid was recovered.
1B	95-197B	5.0	72.1	0	Extruded 5 cm of sample. Sample was beige, a mixture of sludge a crystalline solids. No drainable liquid was recovered.
1C	95-197C	48	< 2	< 5 mL	Extruded less than 5 mL drainable liquid; less than 2 g beige solids observed on the end of the sampler piston. Insufficient sample was recovered for analysis.
2	95-198	48	18.5	0	Extruded about 2.5 cm of gray/brown slushy looking material. The material appeared crystalline and wet, but could be broken up with the tip of a spatula. No drainable liquid was recovered.
3	95-199	48	43.0	< 15 mL	Near the end of the extrusion, extruded a small amount of gray/brown slushy looking material that appeared similar to segment 2 of this core. The material ranged from clear crystals to dark chunks resembling small pieces of gravel. Observed less than 15 mL of drainable liquid which could not be collected separately.
1R	95-197R	18	240.0	0	About 23 cm of wet saltcake were extruded. The first half was light brown and looked like a light colored brown sugar. The second half was a little darker, crystalline and fell off in chunks onto the sample tray. The solids were wet and broke apart easily, but there was no drainable liquid.

Table 3-2. Core 108 Sample Description.¹

Segment	Sample ID	Expected Sample Length (cm)	Sample Weight (g)		Segment Description
			Solid	Liquid	
1AR	95-197AR	1.3	14.5	149.5	Cloudy light brown drainable liquid was collected when the sampler valve was opened. A small amount of light brown crystalline solids were extruded in about the first 10 cm. Wet light brown crystalline solids (similar to solids in segment 1A, but wetter) were extruded in the last 5 cm.
2R	95-198R	24	105.9	0	A small amount of brown liquid with some solids came out of the sampler when the valve was opened. Slushy crystalline solids and some liquid were extruded in the last 15 to 18 cm of the extrusion. Solids and liquids were brown with a small amount of light colored soils mixed in. Liquid could not be collected separate from the solids.
2AR	95-198AR	24	126.6	306.8	Cloudy light brown liquid drained from the sampler when the sample valve was opened. A small amount of solids were extruded in the first 3 cm. Yellowish-brown drainable liquid was observed. 10 to 13 cm of saltcake were extruded at the end. Solids were a mix of light and medium brow. The texture was similar to segment 1R and 1AR. Solids contained a few dark hard chunks that looked like rocks.

Note:

¹Sasaki (1996a)

Table 3-3. Analytical Procedures¹.

Analysis	Instrument	Preparation Procedure	Procedure Number
Energetics by DSC	Mettler ² Perkin-Elmer ³	Direct	LA-514-113, Rev. B-1 LA-514-114, Rev. B-0
Percent water by TGA	Mettler ² Perkin-Elmer ³	Direct	LA-560-112, Rev. A-2 LA-514-114, Rev. B-0
Total alpha activity	Alpha proportional counter	LA-549-141, Rev. D-0	LA-508-101, Rev. D-2
Flammable gas	Combustible gas analyzer	Direct	WHC-IP-0030 IH 1.4 and IH-2.1 ⁴
TOC	Coulometer	Persulfate oxidation	LA-342-100, Rev. C-0
Metals by ICP/AES	Inductively coupled plasma spectrometer	LA-549-141, Rev. D-0	LA-505-151, Rev. D-2 LA-505-161, Rev. A-1
Anions by IC	Ion chromatograph		LA-533-105, Rev. C-2 LA-533-105, Rev. D-1
Cyanide	Microdistillation	Direct	LA-695-102, Rev. E-0
Reactive System Screening Tool	Adiabatic calorimeter	Direct	WHC-SD-WM-TP-104 ⁵

Notes:

¹Sasaki (1995)

²Mettler is registered trademark of Mettler Electronics, Anaheim, California.

³Perkin-Elmer is a registered trademark of Perkins Research and Manufacturing Company, Inc., Canoga Park, California.

⁴WHC (1992)

IH 1.4, Industrial Hygiene Direct Reading Instrument Survey

IH 2.1, Standard Operating Procedure, MSA Model 260 Combustible Gas and Oxygen Analyzer.

⁵Bechtold (1992)

3.3 1994 VAPOR ANALYSIS DESCRIPTION

Tank 241-BY-105 headspace gas and vapor samples were collected and analyzed to help determine the potential risks of fugitive emissions to tank farm workers. The drivers and objectives of waste tank headspace sampling and analysis are discussed in *Program Plan for the Resolution of Tank Vapor Issues* (Osborne and Huckaby 1994). Tank 241-BY-105 headspace was sampled in May 1994 in accordance with the *Safety Assessment for Gas Sampling All Ferrocyanide Tanks* (Farley 1991) using the in situ sampling method. However, because the in situ sample volume flow measurement used was less accurate than the vapor sampling system method (Huckaby et al. 1995), and other not fully understood discrepancies existed between the in situ sampling and vapor sampling system methods, these sample results are suspect and are not reported here (Huckaby 1994).

Tank 241-BY-105 was vapor sampled in July 1994 using the vapor sampling system method. Samples were collected in accordance with the *Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution* (Osborne et al. 1994). Samples are thought to represent the tank headspace when the tank was sampled (Meacham et al. 1995). The sample analyses were designed to provide a reasonably accurate and complete characterization of the significant headspace constituents. No assessment was made of how tank 241-BY-105 headspace composition changed, although studies of other tanks suggest that composition changes probably occur very slowly in passively ventilated tanks such as tank 241-BY-105 (Huckaby and Story 1994). Section 4.5 discusses the results.

3.4 HISTORICAL SAMPLES

No historical records indicating that the tank has been previously sampled and analyzed were available for tank 241-BY-105.

This page intentionally left blank.

4.0 ANALYTICAL RESULTS

This section provides the analytical results associated with the September 1995 sampling of tank 241-BY-105 and selected vapor results from the 1994 vapor sampling event. See Section 5.0 for comparisons with March 1995 grab sample analyses.

Except as noted in Section 3.0, sampling and analysis were performed as directed in the *Tank 241-BY-105 Rotary Mode Core Sampling and Analysis Plan (SAP)* (Sasaki 1995). The SAP integrated all documents related to sampling and analytical requirements including applicable DQOs. Sampling and analytical requirements were taken from the safety screening DQO (Dukelow et al. 1995), the ferrocyanide DQO (Meacham et al. 1994), the historical model evaluation data requirements (Simpson and McCain 1995), the organic DQO (Turner et al. 1995), and the safety program test plan (Meacham 1995). Because of drilling difficulties, only the top 1.2 m (3.94 ft) of one core sample from riser 12A were taken, and only safety screening and total organic carbon analyses were performed. Analysis of the samples was performed at the Westinghouse Hanford Company 222-S Laboratory.

4.1 DATA PRESENTATION

Analytical results are indexed in Table 4-1. Analytical data may also be found in Sasaki (1996a) or the Tank Characterization Database.¹

Table 4-1. Analytical Data Tables.

Data Type	Location
Chemical Data Summary	Table 4-2
1994 Vapor Space Analytical Data	Table 4-3
Flammable Gas	Table 4-4
Percent Moisture	Table A-47
Energetics	Table A-48
September 1995 Push Core Analytical Data	Appendix A
March 1995 Grab Sample Results	Appendix C
Hydrostatic Head Fluid contamination check data	Appendix B

¹Described in Adams (1996). The database is accessible on the internet at URL:
<http://twins.pnl.gov:8001/refmain.htm>

Data from core 108 samples were combined to calculate a mean for each segment and an overall mean based on the three segment means. Restricted maximum likelihood (REML) methods were used to calculate means and a relative standard deviation (RSD) of the mean for each analyte (Hartley et al. 1995). The estimates are based on a statistical analysis of variance (ANOVA) method. Projected inventories were not calculated because data could only be obtained for the top three segments. The usefulness of mean concentrations and uncertainty estimates is limited because of the incomplete data set. Based on tank transfer information and Agnew et al. (1996), the lower segments in the tank are not assumed to be similar to the three segments sampled. Drainable liquid results were separated from the solids results, and separate means and RSDs were calculated.

4.2 CHEMICAL DATA SUMMARY

Table 4-2 shows the tank average (REML mean) and RSD analytical results for metals, anions, total alpha and total organic carbon. Segment results and drainable liquid results are shown in Appendix A.

4.2.1 Inductively Coupled Plasma and Ion Chromatography Analyses

Metals and cations were detected using ICP/AES analyses. The only metals found at a concentration of 10,000 $\mu\text{g/g}$ or higher were aluminum and sodium. All other metals and cations were found at mean concentrations less than 750 $\mu\text{g/g}$. Tables A-1 to A-36 show segment level ICP analytical results. Anions in all segments were detected using IC analyses. High concentrations ($> 10,000 \mu\text{g/g}$) of nitrate, sulfate, and oxalate were observed. The nitrate/nitrite ratio is about 52:1 (mass basis). Segment level IC analytical results are shown in Tables A-37 to A-43.

4.2.2 Total Alpha

Total alpha analyses were performed on a fusion digested sample with an alpha proportional counter according to procedure LA-508-101, Rev. D-2. All total alpha results were well below the DQO notification limit of 33.1 $\mu\text{Ci/g}$. Based on a density of 1.86 g/mL , the saltcake solids average for total alpha was 0.019 $\mu\text{Ci/g}$, and the RSD was 14 percent. The highest observed value (average of sample and duplicate) was 0.031 $\mu\text{Ci/g}$ for sample number S95T003403 (segment 2). The upper limit to a one-sided 95 percent confidence interval on the mean for this sample was 0.043 $\mu\text{Ci/g}$; approximately 0.13 percent of the notification threshold. Table A-44 shows segment data for total alpha from tank 241-BY-105. Four RPD values exceeded 20 percent. However, no reruns were requested because all results were well below the notification limit.

Table 4-2. Chemical Data Summary for Tank 241-BY-105 Saltcake.¹ (2 sheets)

Analyte	REML Mean Concentration	Relative Standard Deviation
METALS	µg/g	Percent
Aluminum	18,400	19.9
Antimony	< DL	n/a
Arsenic	< DL	n/a
Barium	< DL	n/a
Beryllium	< DL	n/a
Bismuth	55.6	17.8
Boron	< DL	n/a
Cadmium	6.54	25.3
Calcium	216	9.95
Cerium	< DL	n/a
Chromium	321	12.4
Cobalt	8.75	6.73
Copper	7.57	31.1
Iron	476	21.0
Lanthanum	< DL	n/a
Lead	50.3	10.72
Magnesium	<DL	n/a
Manganese	54.8	30.3
Molybdenum	< DL	n/a
Neodymium	< DL	n/a
Nickel	75.9	10.2
Phosphorus	1,010	17.7
Potassium	712	10.7
Samarium	< DL	n/a
Selenium	< DL	n/a
Silicon	180	12.4
Silver	17.4	8.61
Sodium	198,000	2.69
Strontium	88.3	13.2

Table 4-2. Chemical Data Summary for Tank 241-BY-105 Saltcake.¹ (2 sheets)

Analyte	REML Mean Concentration	Relative Standard Deviation
METALS (Cont'd)	µg/g	Percent
Sulfur	3,140	30.6
Thallium	< DL	n/a
Titanium	<DL	n/a
Uranium	261	8.64
Vanadium	< DL	n/a
Zinc	36.8	22.6
Zirconium	5.23	8.29
ANIONS	µg/g	Percent
Chloride	897	30.7
Cyanide	4.89	14.5
Fluoride	4,100	29.6
Nitrate	491,000	15.8
Nitrite	9,410	14.4
Oxalate	11,300	41.9
Phosphate (total)	4,890	46.8
Sulfate	10,600	36.2
RADIONUCLIDES	µCi/g	Percent
Total alpha	0.0168	15.3
CARBON	µg C/g	Percent
Total organic carbon	3,250	36.0
MOISTURE CONTENT	Weight Percent	Percent
Water	16.1	25.9

Notes:

n/a = not applicable

<DL = below analytical detection limits

¹Sasaki (1996)

4.2.3 Total Organic Carbon

Total organic carbon for the solids samples ranged between 668 $\mu\text{g C/g}$ to 6,970 $\mu\text{g C/g}$ (wet). The mean concentration was 3,250 $\mu\text{g C/g}$ (wet). The mean TOC concentration on a dry basis is 3,680 $\mu\text{g C/g}$, approximately 10 percent of the notification threshold. For drainable liquids TOC ranged between 1,920 $\mu\text{g C/mL}$ and 2,240 $\mu\text{g C/mL}$ with a mean concentration of 2,090 $\mu\text{g C/mL}$ (see Table A-45).

4.2.4 Cyanide

Cyanide analysis was performed on two samples that exceeded the notification limit for exothermic reactions. Results for these samples were 4.9 and 10.7 $\mu\text{g/g}$, well below the 39,000 $\mu\text{g/g}$ notification limit for cyanide.

4.2.5 Separable Organic Layer

No evidence of a separable organic layer was observed in any sample.

4.3 PHYSICAL DATA SUMMARY

Physical analyses required by the sampling and analysis plan (Sasaki 1995) included TGA, DSC, and bulk density. Percent solids, particle size, and rheology were not requested and not performed.

4.3.1 Thermogravimetric Analysis

In a TGA, the mass of a sample is measured while its temperature is increased at a constant rate. A gas, such as nitrogen or air, is passed over the sample during the heating to remove any gaseous matter. Any decrease in the mass of a sample represents a loss of gaseous matter from the sample through evaporation or through a reaction that forms gas phase products. The decrease in mass is assumed to be caused by a moisture loss.

Weight percent water by TGA was performed by the 222-S Laboratory under a nitrogen purge using procedures LA-560-112 and LA-514-114.

Table A-47 shows the TGA percent water data for tank 241-BY-105 (16.1 weight percent with an RSD of 25.9 percent). No trends were observed in the data. Seven samples exhibited percent water means below the safety screening DQO notification limit of 17 weight percent. The fact that several samples were below 17 weight percent does not in itself constitute an unsafe condition. The energetics values for these samples must also exceed the safety screening notification limits for the tank to be considered unsafe. Solids average

segment results ranged from 5.73 to 26.96 weight percent water. Drainable liquid average results ranged from 46.27 to 54.22 weight percent water. Triplicate analyses were run for five samples with the highest RPDs; however, results did not improve indicating that samples within a segment were not homogeneous.

Section 4.3.4 briefly discusses the tracer used to determine whether a sample has been contaminated. There were no indications that wash water contamination occurred. For more information regarding the correction method, refer to Winkelman (1996).

Potentially, the boiling performed as part of the in-tank solidification process could have contributed to unusual moisture distributions. Other tanks in BY farm, which were part of that process and or the self-boiling tanks in S Farm have exhibited unexpected behavior. However, the addition of Portland cement makes this particular tank even more atypical. Additional and more complete samples (top to bottom) are necessary to assess the moisture content and waste distribution in the tank.

4.3.2 Differential Scanning Calorimetry

In a DSC analysis, heat absorbed or emitted by a substance is measured while the temperature of the substance is increased. The onset temperature for an endothermic event (characterized by or causing the absorption of heat) or exothermic event (characterized by or causing the release of heat) is measured with thermocouples and displayed graphically.

The DSC analyses were performed under a nitrogen atmosphere using procedure LA-514-113, Rev. B-1 and a Mettler™ Model 20 differential scanning calorimeter and procedure LA-514-114, Rev. B-0 and Perkin-Elmer™ equipment. No quality control problems were noted.

The DSC results are provided in Appendix A. The sample number, sample location, sample weight, temperature at maximum enthalpy change, and the magnitude of the enthalpy change are provided for each transition. A negative enthalpy change in Table A-48 indicates an energy release or exotherm. A positive enthalpy change indicates energy absorbed or an endotherm.

The first transition, which was ambient to approximately 150 °C, represented the endothermic reaction associated with the evaporation of free and interstitial water. The enthalpy changes for the endotherms ranged from 240 J/g to over 1,300 J/g.

In the second transition, which took place between 180 and 330 °C, endothermic and exothermic reactions were observed. The enthalpy changes for endotherms were not as large as in the first transition (between 15 and 400 J/g) and probably represented the energy (heat) required to remove bound water from hydrated compounds such as aluminum hydroxide or to melt salts such as sodium nitrate. Such results are usually found in the upper (saltcake) portions of the core sample. Exotherms were found in three drainable liquid samples

(enthalpy changes of -105, -120, and -676 J/g) and only one very dry solid sample (-760 J/g). This finding is generally consistent with the hypothesis that states that higher energy organics are mostly soluble and usually found in liquid, and lower energy organics are found in the solid waste matrices. The exotherms were probably caused by the fuel components of the sample reacting with the nitrate salts.

The DSC results are reported on a wet weight basis. The safety screening DQO, however, requires that exothermic reactions be evaluated on a dry weight basis to make a decision about tank safety. The dry weight value is calculated from the wet weight value by dividing the reported exothermic value for a subsegment by the solid fraction of the subsegment (that is, one minus the fractional percent water value for that subsegment).

Drainable liquid sample duplicate S95T003418 (1AR drainable liquid) and sample S95T003399 (segment 3 solids) exhibited dry exotherms with enthalpy changes of -1,465 J/g and -806 J/g, respectively, thereby exceeding the safety screening criteria. However, high variability was found in samples and sample duplicates. This may be attributed in part to sample heterogeneity and analytical error. The reactive system screening tool analysis was performed to further assess the two samples with high exotherms. The results showed no self-heating or gas generating response for these samples (Bechtold 1996).

The DSC responses were observed infrequently at higher temperatures (above 330 °C) as well (see Transitions 3 and 4 in Table 4-4). These responses were caused by one or more factors. Generally, the results were modestly exothermic; therefore, results could represent additional reactions or a carryover of a reaction that started at a lower temperature and was masked by a concurrent endotherm. However, for DSC results of this type and magnitude (< 50 J/g instrument drift), a more likely cause was a shift in the instrument baseline at higher temperatures. In these cases, the DSC may have indicated a response where none occurred, and observations could be artifacts of the analytical method. Endotherms were not observed at higher temperatures.

4.3.3 Density

Density measurements for solids and specific gravity measurements for liquids were performed on all samples (see Table A-49). The REML mean density for the samples taken was 1.86 g/mL, with a range of 1.85 to 1.98 g/mL. Because of the limited sample amounts collected, bulk density measurements could not be obtained for segment 1AR, segment 2, and a duplicate for segment 3. The REML mean specific gravity for drainable liquids was 1.4 g/mL. All liquid-specific gravities were within 0.02-g/mL range.

4.4 ANALYSIS FOR HYDROSTATIC HEAD FLUID CONTAMINATION

During sampling, drill string wash water was used to clean the drill string after each core was removed. Lithium bromide was added to the wash water as a tracer, and its presence in core samples indicated contamination by the wash water. This check, through analyses for lithium and bromide, was prescribed by the SAP (Sasaki 1995). The SAP established notification limits of 100 $\mu\text{g/g}$ for lithium and 1,200 $\mu\text{g/g}$ for bromide.

Appendix B contains tables with lithium and bromide analytical results. None of the samples analyzed had lithium or bromide results that exceeded the notification limits. As a result, it is concluded that none of the samples analyzed were significantly contaminated by the hydrostatic head fluid.

4.5 HEADSPACE VAPOR SAMPLING

The safety screening DQO has established a notification limit of 25 percent of the lower flammability limit (LFL) for headspace vapors. Prior to removing core samples, tank vapors were field tested using a combustible gas meter and an organic vapor meter. Lower flammability limits of 0.0 percent were observed in risers 12A and 12B, with 30 to 40 ppm ammonia. The oxygen concentration was 20.9 percent. This result satisfied the safety screening requirement of < 25 percent of the LFL. Table 4-3 provides data from Huckaby and Bratzel (1995) about headspace composition. Vapor flammability calculations from the data in Huckaby and Bratzel (1995) indicate a concentration of less than one percent of the LFL (see Table 4-4).

Table 4-3. Selected Vapor Space Characterization Data.

Analyte	Concentration (ppmv)
Inorganic	
Ammonia	43
Hydrogen	47.9
Carbon dioxide	94
Carbon monoxide	0.38
Nitric oxide	0.10
Nitrogen dioxide	< 0.02
Nitrous oxide	49.5
Organic	
Methane	3.8
Ethanimine	0.081
Propanone (acetone)	0.25
1-Butanol	0.70
n-dodecane	0.0081
n-tridecane	0.010
Other Analytes	
	Concentration (mg/m³)
Water vapor	14.9
Total non-methane organic carbon	12.7

Table 4-4. Vapor Flammability Results from 1994 Vapor Sampling and Analysis Event.

Analyte	LFL	Concentration	Concentration as percent of LFL
Hydrogen	40,000 ppm	47.9 ppm	0.12 %
TNMOC	46,000 mg/m ³	12.7 mg/m ³	0.03 %
Ammonia	150,000 ppm	43 ppm	0.03 %
Total			0.18 %

Notes:

- LFL = lower flammability limit
 TNMOC = total non-methane organic carbon

This page intentionally left blank.

5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

Section 5.0 evaluates the overall quality and consistency of the available results for tank 241-BY-105. These results are assessed and compared against historical information and program requirements.

5.1 ASSESSMENT OF SAMPLING AND ANALYTICAL RESULTS

The subsection below evaluates sampling and analysis factors that may impact data use or interpretation. These factors are used to assess the overall data quality and consistency and to identify limitations in data use.

5.1.1 Field Observations

The safety screening DQO requirement (Dukelow et al. 1995) that at least two widely spaced risers be sampled was not fulfilled because of difficulties in obtaining samples by the push core method and stopping of all rotary drilling because of flammability safety issues. Only a portion of riser 12A, core 108 was sampled before the job was stopped. Additional samples are required to fully characterize this tank and to meet safety, historical, and ferrocyanide DQOs as set forth in the sample analysis plan; therefore, interpretation is very limited. Sample recovery was irregular and inadequate for the riser sampled. Hydrostatic head fluid intrusions were negligible for the samples taken.

5.1.2 Quality Control Assessment

The quality control assessment included an evaluation of the four quality control checks (blanks, duplicates, spikes, and standards) performed in conjunction with the chemical analyses. A general evaluation and summary of some key safety and characterization areas are provided in this section. Additional detail is provided in Sasaki (1996a and 1996b). DOE (1995) provides general laboratory guidance on quality control. The SAP (Sasaki 1995) establishes specific accuracy and precision criteria for the four quality control checks. Samples with one or more quality control results outside of the criteria are identified in Sasaki (1996a and 1996b) and Appendix A.

The precision is estimated by the relative percent difference (RPD), defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times 100. Variability in the analytical results may be caused by the very small samples (10 to 20 mg in DSC and TGA and approximately 1g in IC and ICP) used in these analyses, which imposes the need for a high degree of homogeneity in the sample to achieve reproducible results. The requisite degree of homogeneity may not have been achievable with the procedures and equipment in place at the time of analysis. Difficulties in producing

a highly homogeneous subsample are probably responsible for most of the RPD values exceeding 20 percent. Reruns were not performed except for the DSC and gravimetric samples specified in Appendix A because the results that were out of specification were substantially below any established threshold criteria.

Preparation blanks are used to identify any sample contamination introduced in the laboratory during the process of sample breakdown, digestion, and dilution. The blank results indicated contamination was not a problem.

Quality control results are provided in Appendix A. Although some samples did have precision quality control results outside the SAP boundaries, the vast majority of the quality control results were within the boundaries specified in the SAP (Sasaki 1995). However, an evaluation of quality control discrepancies has been made, and no impact to the validity or use of the data has been found.

5.1.3 Data Consistency Checks

Comparing different analytical methods helps in assessing data consistency and quality. Data consistency checks included comparing phosphorus and sulfur as analyzed by ICP with phosphate and sulfate as analyzed by IC, and calculating a mass and charge balance to assess data consistency.

5.1.3.1 Comparison of Results from Different Analytical Methods. The following data consistency checks compare the results from IC and ICP analytical methods for sulfate and phosphate. Close agreement between the two methods strengthens the credibility of both results. Discrepancies between the two methods suggest that further examination of the data or the assumptions regarding the data is necessary. Table 5-1 presents the phosphate and sulfate comparisons. All segment analytical mean results were taken from Table 4-2; composite analytical results are in Appendix A.

The analytical phosphorus mean result in the saltcake, as determined by ICP analyses, was 1,010 $\mu\text{g/g}$ which converts to 3,090 $\mu\text{g/g}$ of phosphate (assuming that all the phosphorus is present as phosphate). This result is much lower than the IC phosphate mean result of 4,890 $\mu\text{g/g}$. Typically, there are insoluble phosphates in the waste matrices, and the IC method does not detect them. The ICP method usually does detect them. However, because of biases in the analytical method or sample preparation procedure, discrepancies can occur. The ratio of IC to ICP results usually indicates the solubility of the phosphate. In this case, it was 158 percent which is not a reasonable value. The RPD between these two phosphate estimates was an unreasonable 45.1 percent. Because of this discrepancy, the ion chromatography results were used for the mass and charge balance, and phosphate solubility was considered 100 percent.

Table 5-1. Comparison of Phosphate/Phosphorous and Sulfate/Sulfur Concentrations by Different Methods.

Saltcake		
ICP:A	IC	Solubility
PO ₄ ³⁻ (μg/g)	PO ₄ ³⁻ (μg/g)	(IC/ICP)
3,090	4,870	158 percent (100 percent)
SO ₄ ²⁻ (μg/g)	SO ₄ ²⁻ (μg/g)	(IC/ICP)
9,420	10,600	112.5 percent (100 percent)

Notes:

- ICP:A = Inductively coupled plasma - acid prepared sample result
- IC = Ion chromatography result

The ICP sulfur value of 3,140 μg/g converts to 9,420 μg/g of sulfate (assuming all the sulfur is present as sulfate). This compares favorably with the IC sulfate result of 10,600 μg/g. The ratio of IC to ICP results usually indicates the solubility of the sulfate. In this case, it was 112.5 percent. The RPD between the two sulfate estimates was 11.8 percent, suggesting that almost all of the sulfur/sulfate in the saltcake was soluble. In this case, the ion chromatography results provided better internal consistency and were used in the mass balance, and sulfate solubility was considered 100 percent.

5.1.3.3 Mass and Charge Balance. The principal objective in performing a mass and charge balance is to determine whether measurements are consistent. In calculating the balances, only analytes, which were detected at a concentration of 1,000 μg/g or greater, were considered (see Table 4-2).

Except for sodium, the cations listed in Table 5-2 were assumed to be in their most common oxide/hydroxide form. The concentrations of the assumed species were calculated stoichiometrically. Because precipitates are neutral species, all positive charge was attributed to sodium. Acetate species were assumed for the total organic carbon analysis. The other anionic analytes listed in Table 5-3 were assumed to be present as mostly sodium salts and were expected to balance the positive charge exhibited by the cations. Sulfur was present as the sulfate ion, was assumed to be completely water soluble, and appeared only in the anion mass and charge calculations (see Section 5.1.3.1). The IC phosphate value was included in the anion mass and charge data. The concentrations of the cationic species, the anionic species, and the percent water were ultimately used to calculate the mass balance. The uncertainty estimates (RSDs) associated with each analyte, and the uncertainty estimates for the cation and anion totals also are shown in the tables.

Table 5-2. Cation Mass and Charge Data.

Analyte	Concentration (µg/g)	RSD (Mean) (percent)	Assumed Species	Concentration of Assumed Species (µg/g)	Charge (µeq/g)
Aluminum	18,400	19.9	Al(OH) ₃	53,000	0
Sodium	198,000	2.69	Na ⁺	198,000	8,609
Total				251,000	8,609

Table 5-3. Anion Mass and Charge Data.

Analyte	Concentration (µg/g)	RSD (Mean) (percent)	Charge (µeq/g)
Acetate (TOC)	16,300	36.0	-275
Fluoride	4,100	29.6	-216
Nitrate	491,000	15.8	-7,919
Nitrite	9,410	14.4	-205
Oxalate	11,300	41.9	-128
Phosphate	4,890	46.8	-154
Sulfate	10,600	36.2	-221
Totals	548,000		-9,118

The mass balance was calculated from the formula below. The factor 0.0001 is the conversion factor from µg/g to weight percent.

$$\begin{aligned} \text{Mass balance} &= \% \text{ water} + 0.0001 \times \{\text{total analyte concentration}\} \\ &= \% \text{ water} + 0.0001 \times \{\text{Al(OH)}_3 + \text{Na}^+ + \text{C}_2\text{H}_3\text{O}_2^- + \text{F}^- + \text{NO}_3^- + \text{NO}_2^- + (\text{COO})_2^{-2} + \\ &\text{PO}_4^{-3} + \text{SO}_4^{-2}\} \end{aligned}$$

The total analyte concentrations calculated from the above equation was 799,000 µg/g. The mean weight percent water obtained from thermogravimetric analysis was 16.1 percent (see Table 4-2). The mass balance resulting from adding the percent water to the total analyte concentration is 96 percent (see Table 5-4). Using propagation of error techniques, the RSD of the mass balance is approximately nine percent.

Table 5-4. Mass Balance Totals.

	Concentrations ($\mu\text{g/g}$)	Charge ($\mu\text{eq/g}$)
Total from Table 5-3 (cations)	251,000	8,609
Total from Table 5-4 (anions)	548,000	-9,118
Water percent	16.1	0
Grand Total	960,000	-509

The following equations demonstrate the derivation of total cations and total anions; the charge balance is the ratio of these two values.

$$\text{Total cations (microequivalents)} = \text{Na}^+/23.0 = 8,609 \text{ microequivalents}$$

$$\begin{aligned} \text{Total anions (microequivalents)} &= \text{C}_2\text{H}_3\text{O}_2^-/59.0 + \text{F}^-/19.0 + \text{NO}_3^-/62.0 + \text{NO}_2^-/46.0 + \\ &(\text{COO})_2^{2-}/44.0 + \text{PO}_4^{3-}/31.7 + \text{SO}_4^{2-}/48.1 = \\ &-9,118 \text{ microequivalents} \end{aligned}$$

The charge balance was 94 percent. It was obtained by dividing the sum of the positive charge by the sum of the negative charge and taking the absolute value. The net negative charge was 509 microequivalents. Using propagation of error techniques, the RSD for total cations is approximately three percent and for total anions is approximately 14 percent. The RSD for the charge balance is also approximately 14 percent. Perfect agreement is 1,000,000 $\mu\text{g/g}$ for the mass balance and 1.00 for the charge balance with no net charge remaining.

In summary, these calculations yield a reasonable mass balance and charge balance (96 percent for mass balance and 94 percent for charge balance). The principal components of the samples obtained appear to be sodium nitrate and water.

5.2 COMPARISON OF 1995 CORE SAMPLE and GRAB SAMPLE RESULTS

Table 5-5 compares drainable liquid results for the September 1995 core sample event with grab sample results obtained in March 1995. The RPD between the two samples is below 50 percent except for nitrite and fluoride (54 percent) and aluminum (122 percent).

5.3 TANK WASTE PROFILE

One objective of the 1995 sampling event was to obtain a vertical profile of the waste from two or more widely-spaced risers (Sasaki 1995). Only one partial vertical profile was obtained from riser 5. As a result discussion in this section is limited to a comparison of results for the top 3 segments of core 108. Historical estimates of tank contents and tank profile information are available in Agnew et al. (1996) and summarized in Section 3.0 of this report. According to the TLM, the waste in the tank is composed of three layers: a heel of MW waste with PFeCN2 waste on the bottom third of the tank, and BY saltcake in the upper two-thirds. Portland cement is expected to be mixed in with the BY saltcake. Sample analyses to this point appear to be consistent with Agnew et al. (1996) for the top portion of the tank. However, elevated calcium concentrations were not observed in any sample as would be expected if Portland cement was present. The hard layer encountered when attempting to obtain segment 3 may be Portland cement. It is about the right depth in the tank as expected from the 1966 transfer date. Additional core samples are required to verify this to describe the tank profile in greater detail.

Table 5-5. Comparison of 1995 core sample and grab sample results.¹

Analyte	Sept, 1995 Drainable Liquid	March 1995 Grab Sample	RPD
Percent water	50.2	55.7	10.4
Specific gravity	1.43	1.23	15.0
Aluminum (µg/mL)	25,400	6,128	122
Iron (µg/mL)	< detection limit	nm	nm
Sodium (µg/mL)	203,000	183,500	9.36
Sulfate (µg/mL)	1,680	nm	nm
Phosphate (µg/mL)	894	nm	nm
Nitrate (µg/mL)	220,000	298,000	30.1
Nitrite (µg/mL)	44,900	26,600	54.2
Fluoride (µg/mL)	534	805	40.5
Chloride (µg/mL)	3,660	2,100	54.2
TOC (µg/mL)	2,090	1,665	22.6

Notes:

nm = not measured

¹Esch (1995) Sasaki (1996a)

5.4 COMPARISON OF ANALYTICAL AND TRANSFER DATA

Although additional samples were not taken or analyzed for the historical DQO, some comparisons can be made with the data obtained. The key fingerprint analytes identified in the historical DQO (Simpson and McCain 1995) for tank BY-105 include the following: sodium, aluminum, nitrate, sulfate, and percent water. Tank BY-105 was selected for historical evaluation because it was expected to contain a thick saltcake layer and a thick ferrocyanide waste layer (Agnew et al. 1996). The first step in the evaluation was to compare the analytical results with DQO-defined concentration levels for the "fingerprint" analytes. This comparison ensures that a predicted waste type is in the tank at the predicted location within the waste matrix. If the analytical results are ≥ 10 percent of the DQO levels (ratio of 0.1), the waste type and layer identification are further investigated (Simpson and McCain 1995). BY saltcake was predicted to comprise the top two-thirds of the tank waste (Agnew et al. 1995a). Therefore, a comparison was made between the mean results for each top three sampled segments from core 108 and fingerprint analyte concentrations for saltcake (see Table 5-6).

Table 5-6. Comparison of BY Saltcake Fingerprint Analytes with Analytical Results.

Fingerprint Analyte	Mean Analytical Results	Historical DQO Concentration Level ¹
Sodium	198,000 $\mu\text{g/g}$	> 165,000 $\mu\text{g/g}$
Aluminum	18,400 $\mu\text{g/g}$	18,600 $\mu\text{g/g}$
Nitrate	491,000 $\mu\text{g/g}$	> 266,000 $\mu\text{g/g}$
Sulfate	10,600 $\mu\text{g/g}$	33,700 $\mu\text{g/g}$
Percent water	16.1 %	35.9 %

Note:

¹Simpson and McCain (1995)

All of the mean analytical results for the fingerprint analytes were at concentrations greater than 10 percent of the historical DQO concentration level for those analytes. Consequently, this waste type appears to fit the description of BY saltcake. However, because the samples did not meet the DQO requirement for completeness, additional comparisons were not done.

5.5 SAFETY EVALUATION

Data criteria identified in the safety screening DQO (Dukelow et al. 1995) were used to assess the waste safety and to check for unidentified safety issues. The DQO requires samples from two widely spaced risers. This requirement was not met because sampling was terminated early: the waste was too hard to push through and rotary drilling was halted by

potential flammability concerns. The three primary analyses required by the safety screening DQO included the following: DSC to evaluate energetics, TGA to measure weight percent water, and a determination of total alpha activity. For each required analysis, the DQO notification limit was established which, if exceeded, could warrant further investigation to ensure tank safety. A final requirement of the safety screening DQO was to determine the flammability of tank headspace vapors. These measurements were taken prior to removing core samples. Tank flammable vapors were measured at 0.2 percent of the LFL, well below the safety screening limit of 25 percent (Dukelow et al. 1995). To compare tank 241-BY-105 observations and relevant vapor thresholds, see Table 4-4.

The safety screening DQO limit for criticality is 33.1 $\mu\text{Ci/g}$. It was assessed from the total alpha activity. All results obtained were well below this limit; the largest single result was 0.31 $\mu\text{Ci/g}$ with the upper limit to a one-sided 95 percent confidence interval on the mean being 0.43 $\mu\text{Ci/g}$.

The safety screening DQO has established a notification limit of -480 J/g (dry weight basis) for the DSC analysis. Two samples exceeded this limit with dry weight exotherms of -1,465 J/g for sample S95T003418 (drainable liquid, segment 1AR) and -806 J/g for sample S95T003399 (solid, segment 3). The upper limits of the 95 percent confidence intervals for these samples were -1,895 J/g and -1,053 J/g, respectively.

The total organic carbon content notification limit was set at 30,000 $\mu\text{g/g}$. A mean TOC concentration of 3,870 $\mu\text{g C/g}$ (dry) was found in the saltcake. No sample exceeded the notification limit. No sample with a separable organic layer was observed.

To investigate the relationship between the DSC results and the TOC and cyanide concentrations, the DSC dry weight results for those subsegments, which had exothermic reactions greater than the -480 J/g threshold limit, are compared with the corresponding dry weight TOC and cyanide results and their energy equivalents in Table 5-7. The TOC data were converted to their energy equivalents using the following equation. The 632 J/g value represents the energy equivalent of 5 weight percent TOC, based on a sodium acetate average energetics standard. Drainable liquid values were converted from $\mu\text{g/mL}$ to $\mu\text{g/g}$ by dividing by the average specific gravity (1.4 g/mL). The TOC analytical results were converted from $\mu\text{g/g}$ to weight percent by dividing by 10,000.

$$\text{Energy Equivalent} = \text{wt\% TOC (dry weight)} \frac{(632 \text{ J/g})}{5}$$

Table 5-7. Comparison of DSC Analytical Results Exceeding the Threshold Limit with TOC and Cyanide Results.

Segment: Subsegment	Analyte	Mean Analytical Result ¹	Energy Equivalent	Sum	Mean DSC Analytical Result
		µg/g	J/g	J/g	J/g
Core 108					
1AR: DL	TOC	1,755	-22.2	-34.0	-1,465
	CN ⁻	9.7	-11.8		
3: Solid	TOC	1,564	-19.7	-33.6	-806
	CN ⁻	11.4	-13.9		

Notes:

¹Dry weight basis.

The cyanide fuel content was assumed to exist as the species $Na_2NiFe(CN)_6$ (Meacham et al. 1995). The necessary conversion of the cyanide analytical result (dry weight) to the weight percent of the assumed species was accomplished by the following equation:

$$Na_2NiFe(CN)_6 \text{ wt}\% = \left[\frac{X \mu\text{g CN}}{g} \right] * \left[\frac{1 \mu\text{mol CN}}{26 \mu\text{g CN}} \right] * \left[\frac{1 \mu\text{mol } Na_2NiFe(CN)_6}{6 \mu\text{mol CN}} \right] * \left[\frac{316.5 \mu\text{g } Na_2NiFe(CN)_6}{1 \mu\text{mol } Na_2NiFe(CN)_6} \right] * \left[\frac{1}{1 \times 10^{SUP6} \text{ mug}} \right] * 100 \text{ wt}\% Na_2NiFe(CN)_6$$

The resulting weight percent was then inserted into the energy equivalent ferrocyanide concentration equation given in Meacham et al. (1995), which was manipulated algebraically to give the following energy equivalent in J/g:

$$(\text{weight}\% Na_2NiFe(CN)_6) * \left[\frac{6,000 \text{ J/g } Na_2NiFe(CN)_6}{100 \text{ weight}\%} \right] = X \text{ J/g waste}$$

For a given subsegment, the energy equivalent values for cyanide and TOC were added in column 5 of Table 5-7; the mean DSC analytical result is in column 6. The sum of the two energy equivalents were well below the DSC results. Assuming that all of the TOC is present as sodium acetate may have biased the comparison slightly, but it would probably not

account for the differences observed. Although some exothermic activity was observed, the fuel content estimates based on the TOC and cyanide results observed indicate that excessive fuel sources are not present, and the exotherms are not a safety problem.

Another factor in assessing tank waste safety is heat generation and waste temperature. Heat is generated in the tanks by radioactive decay. The estimated tank head load of 2.46 kW (8,400 Btu/hr) (Agnew et al. 1996) and 2.55 kW (8,700 Btu/hr) (Kummerer 1995) were well below the 11.7 kW limit that separates high-heat and low-heat load tanks (Bergmann 1991). The heat load could not be calculated from the 1995 analytical data because radionuclide analyses were not performed. However, the low levels of alpha activity in the tank and the continuous trend of decreasing tank temperatures since 1993 indicate that exothermic reactions are unlikely.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The waste in tank 241-BY-105 was sampled and analyzed during August to October of 1995 for the purposes of safety screening in accordance with the requirements listed in the following documents: *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995), the *Data Requirements for the Ferrocyanide Safety Issue Developed through the Data Quality Objectives Process* (Meacham et al. 1994), *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue* (Turner et al. 1995), *Test Plan for Samples From Hanford Waste Tanks 241-BY-103, BY-104, BY-105, BY-108, BY-110, TY-103, U-105, U-107, U-108, and U-109* (Meacham 1995), *Historical Model Evaluation Data Requirements* (Simpson and McCain 1995), and *Strategy for Sampling Hanford Site Tank Wastes for Development of Disposal Technology* (Kupfer et al. 1995). Grab Sampling was completed in March 1995 to satisfy the requirements of *Data Quality and Objectives for the Waste Compatibility Program* (Fowler 1995).

However, as a result of sampling difficulties, samples were obtained from only part of one core. As a result the only DQO that was fully met was the compatibility DQO, which was met by the March 1995 grab sampling event. The September core analyses were conducted for the safety screening and TOC DQOs. The IC and ICP analyses were obtained to assess hydrostatic head fluid intrusion. The IC/ICP values were used for mass balance calculations and to compare gateway historical estimates of tank waste composition.

Analytical results showed that the waste contains some compounds capable of exothermic reactions. Two samples demonstrated exotherms with enthalpy changes in excess of the -480 J/g safety screening limit. One sample had a water content of 7.2 percent. However, TOC and cyanide comparisons with DSC results indicated that this was not a safety concern. The ICP analyses showed that the only metals found at concentrations of one weight percent or greater were aluminum and sodium. Anions detected at concentrations than one weight percent included nitrate, sulfate, and oxalate.

Total alpha activity was approximately 0.1 percent of the safety screening limit. Total organic carbon and cyanide concentrations, required by Meacham et al. (1994), were well below their respective notification limits.

The estimated tank heat load of between 2.46 to 2.55 kW (8,390 to 8,700 Btu/hr) was well below the 11.7 kW (40,000 Btu/hr) limit that separates high-heat and low-heat load tanks. The highest LFL measured from the tank headspace was less than 1 percent, which is significantly lower than the 25 percent limit (Dukelow et al. 1995).

The available analytical data suggests that the BY saltcake in this tank is principally sodium nitrate. The measurements appear to be consistent, meaning that no additional assumptions about the composition of these samples were necessary to complete the mass and charge

balance performed. The samples from this core sample event pass the gateway analysis for historical assessment. However, the current data set does not support further analysis as described in the historical DQO.

In summary, the limited analytical results from the 1995 rotary core sampling indicate that the top portion of tank 241-BY-105 is safe when compared to the safety screening data quality objectives (Sasaki 1996b). Although some exothermic activity was observed, the fuel content estimates based on the TOC and cyanide results that excessive fuel sources are not present and this is not a safety concern. The tank heat load estimate given by Agnew et al. (1996) and head space flammability measurements were both well below established limits. However, additional rotary core samples of the full tank profile are required to more conclusively assess tank safety and meet the requirements of the applicable DQOs.

7.0 REFERENCES

- Adams, M. K., 1996, *Tank Characterization Project Data Management Plan*, WHC-SD-WM-MP-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1996, *Hanford Tank Chemical and Radionuclide Inventories, HDW Model Rev. 3*, LA-UR-96-858, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.
- Agnew, S. F., P. Baca, R. Corbin, K. Jurgensen, and B. Young, 1995a, *Tank Layer Model for Northeast, Southwest, and Northwest Quadrants*, LAUR-94-4269, Rev. 1, Los Alamos National Laboratory, Los Alamos, New Mexico.
- Agnew, S. F., P. Baca, R. Corbin, T. Duran, and K. Jurgensen, 1995b, *Waste Status and Transaction Record Summary for the Northeast Quadrant*, WHC-SD-WM-TI-615, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
- Alstad, A. T., 1993, *Riser Configuration Document for Single-Shell Waste Tanks*, WHC-SD-RE-TI-053, Rev. 9, Westinghouse Hanford Company, Richland, Washington.
- Bechtold, D. B., 1996 "RSST Adiabatic Calorimetry Results of BY-105 Samples," (Internal Memo 75764-PC596-079, to L. M. Sasaki, August 5, 1996), Westinghouse Hanford Company, Richland, Washington.
- Bechtold, D. B., 1992, *Laboratory Test Plan for Adiabatic Calorimetry of Single-Shell and Double-Shell Tank Wastes*, WHC-SD-WM-TP-104, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Bergmann, L. M., 1991, *Single-Shell Tank Isolation Safety Analysis Report*, WHC-SD-WM-SAR-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
- Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1995, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Area*, WHC-SD-WM-ER-349, Rev. 0-A, Westinghouse Hanford Company, Richland, Washington.
- Brevick, C. H., L. A. Gaddis, and A. C. Walsh, 1994, *Supporting Document for the Northeast Quadrant Historical Tank Contents Estimate Report for BY-Tank Farm*, WHC-SD-WM-ER-312, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- DeLorenzo, D. J., A. T. DiCenso, D. B. Hiller, K. W. Johnson, J. H. Rutherford, B. C. Simpson, and D. J. Smith, 1994, *Tank Characterization Reference Guide*, WHC-SD-WM-TI-648, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004 Rev. 2, Westinghouse Hanford Company, Richland, Washington.
- DOE, 1995, *Hanford Analytical Services Quality Assurance Plan*, DOE/RL-94-55, Rev. 2, U.S. Department of Energy, Richland, Washington.
- Ecology, EPA, and DOE, 1996, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.
- Esch, R. A., 1995, "Results for 241-BY-105 Grab Samples," (Internal Memo 8E480-95-020, to J. M. Jones, April, 6 1995), Westinghouse Hanford Company, Richland, Washington.
- Farley, W. G., 1991, *Safety Assessment for Gas Sampling All Ferrocyanide Tanks*, WHC-SD-WM-SAD-009 Rev. 2, Westinghouse Hanford Company, Richland, Washington.
- Fowler, K. D., 1995, *Data Quality Objectives for Tank Farms Waste Compatibility Program*, WHC-SD-WM-DQO-001, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Grigsby, J. M., D. B. Bechtold, G. L. Borsheim, M. D. Crippen, D. R. Dickinson, G. L. Fox, D. W. Jeppson, M. Kummerer, J. M. McLaren, J. D. McCormack, A. Padilla, B. C. Simpson, D. D. Stepnewski, 1992, *Ferrocyanide Waste Tank Hazard Assessment--Interim Report*, WHC-SD-WM-RPT-032, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Hanlon, B. M., 1996, *Waste Tank Summary Report for Month Ending February 29, 1996*, WHC-EP-0182-95, Westinghouse Hanford Company, Richland, Washington.
- Hartley, S. A., K. M. Remund, B. C. Simpson, R. D. Cromar, and C. M. Amderson, 1995, *Statistical Supplement to the Tank Characterization Reference Guide*, WHC-SD-WM-TI-648, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Hodgson, K. M., 1995, "Portland Cement in Tank 241-BY-105, (Internal memo 71330-95-004 to N. W. Kirch, March 29, 1995), Westinghouse Hanford Company, Richland, Washington.
-
-

- Huckaby, J. L. and D. R. Bratzel, 1995, *Tank 241-BY-105 Headspace Gas and Vapor Characterization Results for Samples Collected in May 1994 and July 1994*, WHC-SD-WM-ER-419, Rev. 2A, Westinghouse Hanford Company, Richland, Washington.
- Huckaby, J. L., H. Babad, and D. R. Bratzel, 1995, *Headspace Gas and Vapor Characterization Summary for the 43 Vapor Program Suspect Tanks*, WHC-SD-WM-ER-514 Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Huckaby, J. L., 1994, *Vapor Sampling System (VSS) and In Situ Sampling (ISS) Method Comparison*, WHC-SD-WM-RPT-101 Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Huckaby, J. L., and M. S. Story, 1994, *Vapor Characterization of Tank 241-C-103*, WHC-EP-0780 Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Kristofzski, J. G., 1995, "Directions for Opportunistic Analyses," (Letter 75310-95-103 to J. H. Baldwin, September 13), Westinghouse Hanford Company, Richland, Washington.
- Kummerer, M. 1994, *Topical Report on Heat Removal Characteristics of Waste Storage Tanks*, WHC-SD-WM-SARR-010, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Kupfer, M. J., W. W. Schulz, and J. T. Slankas, 1995, *Strategy for Sampling Hanford Site Tank Wastes for Development of Disposal Technology*, WHC-SD-WM-TA-154, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Leach, C. E., and S. M. Stahl, 1993, *Hanford Site Tank Farm Facilities Interim Safety Basis*, WHC-SD-WM-ISB-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Lipnicki, J., 1996, *Waste Tank Risers Available for Sampling*, WHC-SD-WM-TI-710, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
- Meacham, J. E., 1995, *Test Plan for Samples From Hanford Waste Tanks 241-BY-103, BY-104, BY-105, BY-106, BY-108, BY-110, TY-103, U-105, U-107, U-108, and U-109*, WHC-SD-WM-TP-378, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Meacham, J. E., C. M. Anderson, H. Babad, J. W. Buck, R. J. Cash, G. T. Dukelow, B. A. Pulsipher, J. J. Toth, and P. J. Turner, 1994, *Data Requirements for the Ferrocyanide Safety Issue Developed through the Data Quality Objectives Process*, WHC-SD-WM-DQO-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Osborne, J. W., J. L. Huckaby, E. R. Hewitt, C. M. Anderson, D. D. Mahlum, B. A. Pulsipher, J. Y. Young, 1994, *Data Quality Objectives for Generic In-Tank Health and Safety Vapor Issue Resolution*, Westinghouse Hanford Company, Richland, Washington.
- Osborne, J. W., and J. L. Huckaby, 1994, *Program Plan for the Resolution of Tank Vapor Issues*, WHC-EP-0562 Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Rodenhizer, D. G., 1987, *Hanford Waste Tank Sluicing History*, WHC-SD-WM-TI-302, Westinghouse Hanford Company, Richland, Washington.
- Sasaki, L. M., 1995, *Tank 241-BY-105 Rotary Core Sampling and Analysis Plan*, WHC-SD-WM-TSAP-046 Rev. 0-A, Westinghouse Hanford Company, Richland, Washington.
- Sasaki, L. M., 1996a, *Final Report for Tank 241-BY-105 Rotary and Push Mode Samples, Core 108*, WHC-SD-WM-DP-162 Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Sasaki, L. M., 1996b, *45 Day Safety Screening Results for Tank 241-BY-105 Rotary and Push Mode Samples, Core 108*, WHC-SD-WM-DP-162, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Schreiber, R. D., 1995, *Tank 241-BY-105 Tank Characterization Plan*, WHC-SD-WM-TP-218, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Simpson, B. C., and D. J. McCain, 1995, *Historical Model Evaluation Data Requirements*, WHC-SD-WM-DQO-018, Rev. 0-A, Westinghouse Hanford Company, Richland, Washington.
- Swaney, S. L., 1993 "Waste Level Discrepancies Between Manual Level Readings and Current Waste Inventory for Single-Shell Tanks," (Internal memo 7C242-93-038 to G. T. Frater, December 10, 1993, Westinghouse Hanford Company, Richland, Washington.

- Tran, T. T., 1993, *Thermocouple Status Single-Shell and Double-Shell Waste Tanks*, WHC-SD-WM-TI-533, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Turner, D. A., H. Babad, L. L. Buckley, and J. E. Meacham, 1995, *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue*, WHC-SD-WM-DQO-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
- Winkelman, W. D., 1996, *Technical Basis and Spreadsheet Documentation for Correcting Waste Tank Core Samples for Water Intrusion Based on a LiBr Tracer*, WHC-SD-WM-CSWD-081, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995a, *Operating Specification for Watch List Tanks*, OSD-T-151-00030, Rev/Mod. B-9, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1995b, *Tank Waste Remediation System Fiscal Year 1996 Multi-Year Program Plan, W.B.S. 1.1*, WHC-SP-1101, Rev. 1a, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1992, *Fire Protection Engineering Surveys Instructions*, WHC-IP-0030, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1988, *Piping and Waste Isolation Drawing, 241-BY-105*, H-2-73247, Rev. 5, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1987, *Piping Thermocouple Tree Drawing*, H-2-90342, Rev. 2, sheet 2, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1976, *105-BY Tank Arrangement, As-Built Drawing*, H-2-37105, Rev. 0, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

This page intentionally left blank.

APPENDIX A
ANALYTICAL RESULTS FROM 1995 CORE SAMPLING

This page intentionally left blank.

A.0 ANALYTICAL RESULTS FROM 1995 CORE SAMPLING

A.1 INTRODUCTION

Appendix A reports the chemical, radiochemical, and physical characteristics of tank 241-BY-105 in terms of the specific concentrations of metals, ions, radionuclides, and physical properties.

Each data table in the appendix lists the following: laboratory sample identification, sample origin (core/segment/subsegment), an original and duplicate result for each sample, a sample mean, a mean result for the tank, an RSD (mean), and a projected tank inventory for the particular analyte using the weighted mean and the appropriate conversion factors. Projected tank inventory is not applicable to the percent water, DSC, or density data. The data are listed in standard notation for values greater than 0.001 and less than 100,000. Values outside these limits are listed in scientific notation.

Tables are numbered A-1 through A-49. A description of the units and symbols used in the analyte tables and the references used in compiling the analytical data are found in the List of Terms and Section 7.0, respectively. See Section 3.0 for a description of the sampling event and information on sampling rationale and locations.

A.2 ANALYTE TABLE DESCRIPTION

The "Sample Number" column lists the laboratory sample for which the analyte was measured.

The "Core:Segment" column specifies the core and segment from which each sample was derived.

The "Subsegment" column specifies "Whole" or "DL," depending on whether the sample analyzed was a whole (solid) segment or drainable liquid from a segment.

The "Result" and "Duplicate" columns are self-explanatory. The "Sample Mean" column lists the average of the result and duplicate values. If the result and duplicate values were both detected, or one of the two values is detected and the other nondetected, then the mean is expressed as the detected value. If the result and duplicate values were both nondetected, then the mean is expressed as a nondetected number. The result and duplicate values and the result/duplicate means are reported in the tables exactly as found in the original laboratory data package.

The overall (or analyte concentration) means for the waste in tank 241-BY-105 were calculated using restricted maximum likelihood estimates (REML). Overall means were an average of the three segment means.

All values, including those below the detection level (indicated by the less-than symbol, "<"), were used in calculating the overall means. If 50 percent or more of all individual sample primary and duplicate results were detected, then the overall mean was expressed as a detected value. If less than 50 percent of all individual results were detected, then the overall mean was expressed as a nondetected value.

The RSD (mean) was computed for applicable analytes using standard ANOVA statistical techniques. Relative standard deviations (of the mean) were calculated for all analytes with "detected" means.

Projected inventories were not calculated for the solids portion of the waste because the samples were only obtained from the top 3 segments of the waste. Projected inventories were not calculated for the drainable liquid samples because the tank contains no supernatant (Hanlon 1996).

The four quality control parameters assessed on the tank 241-BY-105 samples were standard recoveries, spike recoveries, duplicate analyses (RPDs), and blanks. These were summarized in Section 5.1.2. More specific information is provided in the following appendix tables. Sample and duplicate pairs in which any of the quality control (QC) parameters were outside their specified limits are superscripted in the "Sample Mean" column as follows:

- QC:a -- indicates that the standard recovery was below the QC range.
- QC:b -- indicates that the standard recovery was above the QC range.
- QC:c -- indicates that the spike recovery was below the QC range.
- QC:d -- indicates that the spike recovery was above the QC range.
- QC:e -- indicates that the RPD was greater than the QC limit range.
- QC:f -- indicates blank contamination.

Table A-1. Tank 241-BY-105 Analytical Results: Aluminum.

Sample Number	Core Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	20,400	22,900	21,600 ^{cc,ee}	18,400	19.9	n/a
S95T003502	108:1A	Whole	29,200	25,200	27,200 ^{cc,ee}			
S95T003507	108:1AR	Whole	16,600	23,400	20,000 ^{cc,ee}			
S95T003503	108:1B	Whole	18,900	17,800	18,400			
S95T003506	108:1R	Whole	16,000	22,900	19,400 ^{cc,de}			
S95T003504	108:2	Whole	5,670	5,750	5,710			
S95T003509	108:2AR	Whole	47,700	44,400	46,000			
S95T003508	108:2R	Whole	36,200	36,200	36,200			
S95T003505	108:3	Whole	4,090	4,960	4,520 ^{cc,ee}			
Liquids								
S95T003394	108:1	DL	13,800	14,300	14,000 ^{cc,d}	25,400	34.4	n/a
S95T003396	108:1A	DL	14,500	13,900	14,200			
S95T003418	108:1AR	DL	22,300	22,000	22,200			
S95T003422	108:2AR	DL	34,700	33,300	34,000			

Table A-2. Tank 241-BY-105 Analytical Results: Antimony.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 25.90	< 23.5	< 24.7	< 24.1	n/a	n/a
S95T003502	108:1A	Whole	< 23.10	< 23.3	< 23.2			
S95T003507	108:1AR	Whole	< 28.00	< 27.1	< 27.6			
S95T003503	108:1B	Whole	< 22.00	< 21.4	< 21.7			
S95T003506	108:1R	Whole	< 21.50	< 21.2	< 21.4			
S95T003504	108:2	Whole	< 26.60	< 28.2	< 27.4			
S95T003509	108:2AR	Whole	< 21.90	< 20.8	< 21.4			
S95T003508	108:2R	Whole	< 27.30	< 28.3	< 27.8			
S95T003505	108:3	Whole	< 22.50	< 23.2	< 22.9			
Liquids								
S95T003394	108:1	DL	< 24.10	< 24.1	< 24.1	< 24.1	n/a	n/a
S95T003396	108:1A	DL	< 24.10	< 24.1	< 24.1			
S95T003418	108:1AR	DL	< 24.10	< 24.1	< 24.1			
S95T003422	108:2AR	DL	< 24.10	< 24.1	< 24.1			

Table A-3. Tank 241-BY-105 Analytical Results: Arsenic.

Sample Number	Core Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 43.20	< 39.1	< 41.2	< 40.0	n/a	n/a
S95T003502	108:1A	Whole	< 38.50	< 38.9	< 38.7			
S95T003507	108:1AR	Whole	< 46.70	< 45.1	< 45.9			
S95T003503	108:1B	Whole	< 36.60	< 35.6	< 36.1			
S95T003506	108:1R	Whole	< 35.90	< 35.3	< 35.6			
S95T003504	108:2	Whole	< 44.30	< 46.9	< 45.6			
S95T003509	108:2AR	Whole	< 36.50	< 34.7	< 35.6			
S95T003508	108:2R	Whole	< 45.60	< 47.2	< 46.4			
S95T003505	108:3	Whole	< 37.30	< 38.7	< 38.0			
Liquids								
S95T003394	108:1	DL	< 40.10	< 40.1	< 40.1	< 40.1	n/a	n/a
S95T003396	108:1A	DL	< 40.10	< 40.1	< 40.1			
S95T003418	108:1AR	DL	< 40.10	< 40.1	< 40.1			
S95T003422	108:2AR	DL	< 40.10	< 40.1	< 40.1			

Table A-4. Tank 241-BY-105 Analytical Results: Barium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 21.60	< 19.6	< 20.6	< 20.0	n/a	n/a
S95T003502	108:1A	Whole	< 19.20	< 19.4	< 19.3			
S95T003507	108:1AR	Whole	< 23.30	< 22.6	< 23.0			
S95T003503	108:1B	Whole	< 18.30	< 17.8	< 18.1			
S95T003506	108:1R	Whole	< 17.90	< 17.6	< 17.8			
S95T003504	108:2	Whole	< 22.10	< 23.5	< 22.8			
S95T003509	108:2AR	Whole	< 18.30	< 17.3	< 17.8			
S95T003508	108:2R	Whole	< 22.80	< 23.6	< 23.2			
S95T003505	108:3	Whole	< 18.60	< 19.4	< 19.0			
Liquids								
S95T003394	108:1	DL	< 20.00	< 20.0	< 20.0	< 20.0	n/a	n/a
S95T003396	108:1A	DL	< 20.00	< 20.0	< 20.0			
S95T003418	108:1AR	DL	< 20.00	< 20.0	< 20.0			
S95T003422	108:2AR	DL	< 20.00	< 20.0	< 20.0			

Table A-5. Tank 241-BY-105 Analytical Results: Beryllium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 2.160	< 1.96	< 2.06	< 2.00	n/a	n/a
S95T003502	108:1A	Whole	< 1.920	< 1.94	< 1.93			
S95T003507	108:1AR	Whole	< 2.330	< 2.26	< 2.30			
S95T003503	108:1B	Whole	< 1.830	< 1.78	< 1.81			
S95T003506	108:1R	Whole	< 1.790	< 1.76	< 1.78			
S95T003504	108:2	Whole	< 2.210	< 2.35	< 2.28			
S95T003509	108:2AR	Whole	< 1.830	< 1.73	< 1.78			
S95T003508	108:2R	Whole	< 2.280	< 2.36	< 2.32			
S95T003505	108:3	Whole	< 1.860	< 1.94	< 1.90			
Liquids								
S95T003394	108:1	DL	< 2.000	< 2.00	< 2.00	< 2.00	n/a	n/a
S95T003396	108:1A	DL	< 2.000	< 2.00	< 2.00			
S95T003418	108:1AR	DL	< 2.000	< 2.00	< 2.00			
S95T003422	108:2AR	DL	< 2.000	< 2.00	< 2.00			

Table A-6. Tank 241-BY-105 Analytical Results: Bismuth.

Sample Number	Core Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	47.60	63.10	55.35 ^{0C:c}	55.6	17.8	n/a
S95T003502	108:1A	Whole	103	43.80	73.40 ^{0C:c}			
S95T003507	108:1AR	Whole	< 46.70	220.0	133			
S95T003503	108:1B	Whole	37.20	< 35.6	36.4			
S95T003506	108:1R	Whole	< 35.90	48.00	42.0 ^{0C:c}			
S95T003504	108:2	Whole	< 44.30	128.0	86.2			
S95T003509	108:2AR	Whole	< 36.50	39.70	38.1			
S95T003508	108:2R	Whole	< 45.60	< 47.2	< 46.4			
S95T003505	108:3	Whole	< 37.30	46.20	41.8			
Liquids								
S95T003394	108:1	DL	< 40.10	< 40.1	< 40.1	< 40.1	n/a	n/a
S95T003396	108:1A	DL	< 40.10	< 40.1	< 40.1			
S95T003418	108:1AR	DL	< 40.10	< 40.1	< 40.1			
S95T003422	108:2AR	DL	< 40.10	< 40.1	< 40.1			

Table A-7. Tank 241-BY-105 Analytical Results; Boron.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 21.60	< 19.6	< 20.6	< 21.5	n/a	n/a
S95T003502	108:1A	Whole	32.90	< 19.4	26.2			
S95T003507	108:1AR	Whole	25.40	23.40	24.40			
S95T003503	108:1B	Whole	< 18.30	20.50	< 19.4			
S95T003506	108:1R	Whole	< 17.90	< 17.6	< 17.8			
S95T003504	108:2	Whole	< 22.10	< 23.5	< 22.8			
S95T003509	108:2AR	Whole	< 18.30	< 17.3	< 17.8			
S95T003508	108:2R	Whole	35.80	25.20	30.50 ^{c,c}			
S95T003505	108:3	Whole	< 18.60	< 19.4	< 19.0			
Liquids								
S95T003394	108:1	DL	22.70	25.30	24.00	23.1	11.1	n/a
S95T003396	108:1A	DL	32.50	29.10	30.80			
S95T003418	108:1AR	DL	22.70	23.30	23.00			
S95T003422	108:2AR	DL	20.4	< 20.0	20.2			

Table A-8. Tank 241-BY-105 Analytical Results: Cadmium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	5.450	6.620	6.035	6.54	25.3	n/a
S95T003502	108:1A	Whole	9.650	8.840	9.245			
S95T003507	108:1AR	Whole	5.490	7.420	6.455 ^{QC:c}			
S95T003503	108:1B	Whole	8.560	8.420	8.490			
S95T003506	108:1R	Whole	5.310	6.940	6.125 ^{QC:c}			
S95T003504	108:2	Whole	5.610	6.280	5.945			
S95T003509	108:2AR	Whole	11.70	10.90	11.30			
S95T003508	108:2R	Whole	11.10	11.70	11.40			
S95T003505	108:3	Whole	< 1.860	3.750	2.81			
Liquids								
S95T003394	108:1	DL	< 2.000	< 2.00	< 2.00	< 2.00	n/a	n/a
S95T003396	108:1A	DL	< 2.000	< 2.00	< 2.00			
S95T003418	108:1AR	DL	< 2.000	< 2.00	< 2.00			
S95T003422	108:2AR	DL	< 2.000	< 2.00	< 2.00			

Table A-9. Tank 241-BY-105 Analytical Results: Calcium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	201	252.0	226.5 ^{OC:e}	216	10.0	n/a
S95T003502	108:1A	Whole	235	254.0	244.5			
S95T003507	108:1AR	Whole	203	254.0	228.5 ^{OC:e}			
S95T003503	108:1B	Whole	313	232.0	272.5 ^{OC:e}			
S95T003506	108:1R	Whole	187	206.0	196.5			
S95T003504	108:2	Whole	200	232.0	216.0 ^{OC:e}			
S95T003509	108:2AR	Whole	264	256.0	260.0			
S95T003508	108:2R	Whole	255	290.0	272.5 ^{OC:e}			
S95T003505	108:3	Whole	136	195.0	165.5 ^{OC:e}			
Liquids								
S95T003394	108:1	DL	< 40.10	< 40.1	< 40.1 ^{OC:d}	< 40.1	n/a	n/a
S95T003396	108:1A	DL	< 40.10	< 40.1	< 40.1			
S95T003418	108:1AR	DL	< 40.10	< 40.1	< 40.1			
S95T003422	108:2AR	DL	< 40.10	< 40.1	< 40.1			

Table A-10. Tank 241-BY-105 Analytical Results: Cerium.

Sample Number	Core: Segment	Sub-segment	Result $\mu\text{g/g}$	Duplicate $\mu\text{g/g}$	Sample Mean $\mu\text{g/g}$	Overall Mean $\mu\text{g/g}$	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 43.20	< 39.1	< 41.2	< 40.0	n/a	n/a
S95T003502	108:1A	Whole	< 38.50	< 38.9	< 38.7			
S95T003507	108:1AR	Whole	< 46.70	< 45.1	< 45.9			
S95T003503	108:1B	Whole	< 36.60	< 35.6	< 36.1			
S95T003506	108:1R	Whole	< 35.90	< 35.3	< 35.6			
S95T003504	108:2	Whole	< 44.30	< 46.9	< 45.6			
S95T003509	108:2AR	Whole	< 36.50	< 34.7	< 35.6			
S95T003508	108:2R	Whole	< 45.60	< 47.2	< 46.4			
S95T003505	108:3	Whole	< 37.30	< 38.7	< 38.0			
Liquids								
S95T003394	108:1	DL	< 40.10	< 40.1	< 40.1	< 40.1	n/a	n/a
S95T003396	108:1A	DL	< 40.10	< 40.1	< 40.1			
S95T003418	108:1AR	DL	< 40.10	< 40.1	< 40.1			
S95T003422	108:2AR	DL	< 40.10	< 40.1	< 40.1			

Table A-1.1. Tank 241-BY-105 Analytical Results: Chromium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	240	266.0	253.0	321	12.4	n/a
S95T003502	108:1A	Whole	259	248.0	253.5			
S95T003507	108:1AR	Whole	258	395.0	326.5 ^{QC,c}			
S95T003503	108:1B	Whole	300	296.0	298.0			
S95T003506	108:1R	Whole	297	352.0	324.5			
S95T003504	108:2	Whole	361	382.0	371.5			
S95T003509	108:2AR	Whole	374	448.0	411.0			
S95T003508	108:2R	Whole	403	433.0	418.0			
S95T003505	108:3	Whole	162	383.0	272.5 ^{QC,c}			
Liquids								
S95T003394	108:1	DL	1,220	1,270	1,240	1,320	5.3	n/a
S95T003396	108:1A	DL	1,290	1,230	1,260			
S95T003418	108:1AR	DL	1,260	1,230	1,240			
S95T003422	108:2AR	DL	1,420	1,360	1,390			

Table A-12. Tank 241-BY-105 Analytical Results: Cobalt.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 8.650	< 7.83	< 8.24	8.75	6.7	n/a
S95T003502	108:1A	Whole	9.530	9.260	9.395			
S95T003507	108:1AR	Whole	< 9.340	< 9.03	< 9.19			
S95T003503	108:1B	Whole	9.540	9.360	9.450			
S95T003506	108:1R	Whole	< 7.170	7.970	7.57			
S95T003504	108:2	Whole	< 8.850	< 9.39	< 9.12			
S95T003509	108:2AR	Whole	10.20	9.760	9.980			
S95T003508	108:2R	Whole	9.120	12.00	10.56 ^{GC-C}			
S95T003505	108:3	Whole	< 7.450	< 7.75	< 7.60			
Liquids								
S95T003394	108:1	DL	< 8.020	< 8.02	< 8.02	< 8.02	n/a	n/a
S95T003396	108:1A	DL	< 8.020	< 8.02	< 8.02	< 8.02		
S95T003418	108:1AR	DL	< 8.020	< 8.02	< 8.02	< 8.02		
S95T003422	108:2AR	DL	< 8.020	< 8.02	< 8.02	< 8.02		

Table A-13. Tank 241-BY-105 Analytical Results: Copper.

Sample Number	Core Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	5.170	4.100	4.635 ^{OCe}	7.57	31.1	n/a
S95T003502	108:1A	Whole	56.60	4.780	30.69 ^{OCe}			
S95T003507	108:1AR	Whole	5.500	< 4.51	5.01			
S95T003503	108:1B	Whole	5.820	< 3.56	4.69			
S95T003506	108:1R	Whole	9.340	12.10	10.72 ^{OCe}			
S95T003504	108:2	Whole	< 4.430	< 4.69	< 4.56			
S95T003509	108:2AR	Whole	11.20	8.250	9.725 ^{OCe}			
S95T003508	108:2R	Whole	9.100	8.870	8.985			
S95T003505	108:3	Whole	< 3.730	< 3.87	< 3.80			
Liquids								
S95T003394	108:1	DL	< 4.010	< 4.01	< 4.01	< 4.01	n/a	n/a
S95T003396	108:1A	DL	< 4.010	< 4.01	< 4.01			
S95T003418	108:1AR	DL	< 4.010	< 4.01	< 4.01			
S95T003422	108:2AR	DL	< 4.010	< 4.01	< 4.01			

Table A-14. Tank 241-BY-105 Analytical Results: Iron.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	357	354.0	355.5 ^{00c,e}	476	21.0	n/a
S95T003502	108:1A	Whole	539	675.0	607.0 ^{00c,e}			
S95T003507	108:1AR	Whole	248	369.0	308.5 ^{00c,e}			
S95T003503	108:1B	Whole	531	521.0	526.0			
S95T003506	108:1R	Whole	473	555.0	514.0 ^{00c,e}			
S95T003504	108:2	Whole	316	495.0	405.5 ^{00c,e}			
S95T003509	108:2AR	Whole	493	478.0	485.5			
S95T003508	108:2R	Whole	1,010	1,550	1,280 ^{00c,e}			
S95T003505	108:3	Whole	117	370.0	243.5 ^{00c,e}			
Liquids								
S95T003394	108:1	DL	< 20.00	< 20.0	< 20.0	< 20.0	n/a	n/a
S95T003396	108:1A	DL	< 20.00	< 20.0	< 20.0			
S95T003418	108:1AR	DL	< 20.00	< 20.0	< 20.0			
S95T003422	108:2AR	DL	< 20.00	< 20.0	< 20.0			

Table A-15. Tank 241-BY-105 Analytical Results: Lanthanum.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 21.60	< 19.6	< 20.6	< 20.8	n/a	n/a
S95T003502	108:1A	Whole	< 19.20	< 19.4	< 19.3			
S95T003507	108:1AR	Whole	< 23.30	43.90	33.6			
S95T003503	108:1B	Whole	< 18.30	< 17.8	< 18.1			
S95T003506	108:1R	Whole	< 17.90	< 17.6	< 17.8			
S95T003504	108:2	Whole	< 22.10	24.90	23.5			
S95T003509	108:2AR	Whole	< 18.30	< 17.3	< 17.8			
S95T003508	108:2R	Whole	< 22.80	< 23.6	< 23.2			
S95T003505	108:3	Whole	< 18.60	< 19.4	< 19.0			
Liquids								
S95T003394	108:1	DL	< 20.00	< 20.0	< 20.0	< 20.0	n/a	n/a
S95T003396	108:1A	DL	< 20.00	< 20.0	< 20.0			
S95T003418	108:1AR	DL	< 20.00	< 20.0	< 20.0			
S95T003422	108:2AR	DL	< 20.00	< 20.0	< 20.0			

Table A-16. Tank 241-BY-105 Analytical Results: Lead.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	49.30	53.10	51.20	50.3	10.7	n/a
S95T003502	108:1A	Whole	54.40	54.70	54.55			
S95T003507	108:1AR	Whole	< 46.70	< 45.1	< 45.9			
S95T003503	108:1B	Whole	51.00	56.50	53.75			
S95T003506	108:1R	Whole	41.70	54.80	48.25 ^{QC:2}			
S95T003504	108:2	Whole	< 44.30	< 46.9	< 45.6			
S95T003509	108:2AR	Whole	61.60	59.30	60.45			
S95T003508	108:2R	Whole	72.00	87.20	79.60			
S95T003505	108:3	Whole	< 37.30	39.50	38.4			
Liquids								
S95T003394	108:1	DL	68.00	73.90	70.95	80.7	10.2	n/a
S95T003396	108:1A	DL	68.90	66.30	67.60			
S95T003418	108:1AR	DL	79.60	78.30	78.95			
S95T003422	108:2AR	DL	91.80	85.90	88.85			

Table A-17. Tank 241-BY-105 Analytical Results: Magnesium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 43.20	< 39.1	< 41.2	< 40.0	n/a	n/a
S95T003502	108:1A	Whole	< 38.50	< 38.9	< 38.7			
S95T003507	108:1AR	Whole	< 46.70	< 45.1	< 45.9			
S95T003503	108:1B	Whole	< 36.60	< 35.6	< 36.1			
S95T003506	108:1R	Whole	< 35.90	< 35.3	< 35.6			
S95T003504	108:2	Whole	< 44.30	< 46.9	< 45.6			
S95T003509	108:2AR	Whole	< 36.50	< 34.7	< 35.6			
S95T003508	108:2R	Whole	< 45.60	< 47.2	< 46.4			
S95T003505	108:3	Whole	< 37.30	< 38.7	< 38.0			
Liquids								
S95T003394	108:1	DL	< 40.10	< 40.1	< 40.1	< 40.1	n/a	n/a
S95T003396	108:1A	DL	< 40.10	< 40.1	< 40.1			
S95T003418	108:1AR	DL	< 40.10	< 40.1	< 40.1			
S95T003422	108:2AR	DL	< 40.10	< 40.1	< 40.1			

Table A-18. Tank 241-BY-105 Analytical Results: Manganese.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	20.20	22.50	21.35	54.8	30.3	n/a
S95T003502	108:1A	Whole	32.20	31.70	31.95			
S95T003507	108:1AR	Whole	17.30	25.10	21.20 ^{QC}			
S95T003503	108:1B	Whole	34.40	35.00	34.70			
S95T003506	108:1R	Whole	19.10	25.40	22.25 ^{QC}			
S95T003504	108:2	Whole	84.90	89.60	87.25			
S95T003509	108:2AR	Whole	34.10	35.10	34.60			
S95T003508	108:2R	Whole	42.20	48.80	45.50			
S95T003505	108:3	Whole	26.80	138.0	82.40 ^{QC}			
Liquids								
S95T003394	108:1	DL	< 4.010	< 4.01	< 4.01	< 4.01	n/a	n/a
S95T003396	108:1A	DL	< 4.010	< 4.01	< 4.01			
S95T003418	108:1AR	DL	< 4.010	< 4.01	< 4.01			
S95T003422	108:2AR	DL	< 4.010	< 4.01	< 4.01			

Table A-19. Tank 241-BY-105 Analytical Results: Molybdenum.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 21.60	< 19.6	< 20.6	< 20.0	n/a	n/a
S95T003502	108:1A	Whole	< 19.20	< 19.4	< 19.3			
S95T003507	108:1AR	Whole	< 23.30	< 22.6	< 23.0			
S95T003503	108:1B	Whole	< 18.30	< 17.8	< 18.1			
S95T003506	108:1R	Whole	< 17.90	< 17.6	< 17.8			
S95T003504	108:2	Whole	< 22.10	< 23.5	< 22.8			
S95T003509	108:2AR	Whole	< 18.30	< 17.3	< 17.8			
S95T003508	108:2R	Whole	< 22.80	< 23.6	< 23.2			
S95T003505	108:3	Whole	< 18.60	< 19.4	< 19.0			
Liquids								
S95T003394	108:1	DL	25.10	26.80	25.95	28.9	7.8	n/a
S95T003396	108:1A	DL	27.50	25.00	26.25			
S95T003418	108:1AR	DL	27.70	27.80	27.75			
S95T003422	108:2AR	DL	32.00	30.30	31.15			

Table A-20. Tank 241-BY-105 Analytical Results: Neodymium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 43.20	< 39.1	< 41.2	< 40.0	n/a	n/a
S95T003502	108:1A	Whole	< 38.50	< 38.9	< 38.7			
S95T003507	108:1AR	Whole	< 46.70	< 45.1	< 45.9			
S95T003503	108:1B	Whole	< 36.60	< 35.6	< 36.1			
S95T003506	108:1R	Whole	< 35.90	< 35.3	< 35.6			
S95T003504	108:2	Whole	< 44.30	< 46.9	< 45.6			
S95T003509	108:2AR	Whole	< 36.50	< 34.7	< 35.6			
S95T003508	108:2R	Whole	< 45.60	< 47.2	< 46.4			
S95T003505	108:3	Whole	< 37.30	< 38.7	< 38.0			
Liquids								
S95T003394	108:1	DL	< 40.10	< 40.1	< 40.1	< 40.1	n/a	n/a
S95T003396	108:1A	DL	< 40.10	< 40.1	< 40.1			
S95T003418	108:1AR	DL	< 40.10	< 40.1	< 40.1			
S95T003422	108:2AR	DL	< 40.10	< 40.1	< 40.1			

Table A-21. Tank 241-BY-105 Analytical Results: Nickel.

Sample Number	Core Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	56.40	62.20	59.30 ^{OC:e}	75.9	10.2	n/a
S95T003502	108:1A	Whole	106	99.80	102.9			
S95T003507	108:1AR	Whole	54.80	79.20	67.00 ^{OC:e}			
S95T003503	108:1B	Whole	113	115.0	114.0			
S95T003506	108:1R	Whole	58.90	76.00	67.45 ^{OC:e,e}			
S95T003504	108:2	Whole	69.50	75.30	72.40			
S95T003509	108:2AR	Whole	106	103.0	104.5			
S95T003508	108:2R	Whole	109	122.0	115.5 ^{OC:e}			
S95T003505	108:3	Whole	21.10	75.30	48.20 ^{OC:e}			
Liquids								
S95T003394	108:1	DL	< 8.020	< 8.02	< 8.02	< 8.02	n/a	n/a
S95T003396	108:1A	DL	< 8.020	< 8.02	< 8.02	< 8.02		
S95T003418	108:1AR	DL	< 8.020	< 8.02	< 8.02	< 8.02		
S95T003422	108:2AR	DL	< 8.020	< 8.02	< 8.02	< 8.02		

Table A-22. Tank 241-BY-105 Analytical Results: Phosphorus.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	1,210	1,430	1,320 ^{QC:CC}	1,010	17.7	n/a
S95T003502	108:1A	Whole	2,040	2,200	2,120			
S95T003507	108:1AR	Whole	1,830	871.0	1,350 ^{QC:CC}			
S95T003503	108:1B	Whole	1,140	1,150	1,140			
S95T003506	108:1R	Whole	1,510	746.0	1,130 ^{QC:CC}			
S95T003504	108:2	Whole	242	394.0	318.0 ^{QC:CC}			
S95T003509	108:2AR	Whole	1,850	1,880	1,860			
S95T003508	108:2R	Whole	1,980	1,980	1,980			
S95T003505	108:3	Whole	276	163.0	219.5 ^{QC:CC}			
Liquids								
S95T003394	108:1	DL	474	488.0	481.0	478	0.9	n/a
S95T003396	108:1A	DL	488	469.0	478.5			
S95T003418	108:1AR	DL	483	467.0	475.0			
S95T003422	108:2AR	DL	495	459.0	477.0			

Table A-23. Tank 241-BY-105 Analytical Results: Potassium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	646	652.0	649.0	712	10.7	n/a
S95T003502	108:1A	Whole	466	592.0	529.0 ^{cc}			
S95T003507	108:1AR	Whole	763	1,060	911.5 ^{cc}			
S95T003503	108:1B	Whole	568	657.0	612.5			
S95T003506	108:1R	Whole	760	777.0	768.5			
S95T003504	108:2	Whole	881	929.0	905.0			
S95T003509	108:2AR	Whole	764	986.0	875.0 ^{cc}			
S95T003508	108:2R	Whole	808	842.0	825.0			
S95T003505	108:3	Whole	569	578.0	573.5			
Liquids								
S95T003394	108:1	DL	3,270	3,420	3,340	3,790	9.9	n/a
S95T003396	108:1A	DL	3,500	3,200	3,350			
S95T003418	108:1AR	DL	3,540	3,540	3,540 ^{cc}			
S95T003422	108:2AR	DL	4,240	4,080	4,160 ^{cc}			

Table A-24. Tank 241-BY-105 Analytical Results: Samarium.

Sample Number	Core Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 43.20	< 39.1	< 41.2	< 40.0	n/a	n/a
S95T003502	108:1A	Whole	< 38.50	< 38.9	< 38.7			
S95T003507	108:1AR	Whole	< 46.70	< 45.1	< 45.9			
S95T003503	108:1B	Whole	< 36.60	< 35.6	< 36.1			
S95T003506	108:1R	Whole	< 35.90	< 35.3	< 35.6			
S95T003504	108:2	Whole	< 44.30	< 46.9	< 45.6			
S95T003509	108:2AR	Whole	< 36.50	< 34.7	< 35.6			
S95T003508	108:2R	Whole	< 45.60	< 47.2	< 46.4			
S95T003505	108:3	Whole	< 37.30	< 38.7	< 38.0			
Liquids								
S95T003394	108:1	DL	< 40.10	< 40.1	< 40.1	< 40.1	n/a	n/a
S95T003396	108:1A	DL	< 40.10	< 40.1	< 40.1			
S95T003418	108:1AR	DL	< 40.10	< 40.1	< 40.1			
S95T003422	108:2AR	DL	< 40.10	< 40.1	< 40.1			

Table A-25. Tank 241-BY-105 Analytical Results: Selenium.

Sample Number	Core: Segment	Sub-segment	Result	Duplicate	Sample Mean	Overall Mean		RSD (Mean)		Projected Inventory
						µg/g	µg/g	µg/g	%	
Solids										
S95T003501	108:1	Whole	< 43.20	< 39.1	< 41.2	< 40.0	n/a	n/a	n/a	n/a
S95T003502	108:1A	Whole	< 38.50	< 38.9	< 38.7					
S95T003507	108:1AR	Whole	< 46.70	< 45.1	< 45.9					
S95T003503	108:1B	Whole	< 36.60	< 35.6	< 36.1					
S95T003506	108:1R	Whole	< 35.90	< 35.3	< 35.6					
S95T003504	108:2	Whole	< 44.30	< 46.9	< 45.6					
S95T003509	108:2AR	Whole	< 36.50	< 34.7	< 35.6					
S95T003508	108:2R	Whole	< 45.60	< 47.2	< 46.4					
S95T003505	108:3	Whole	< 37.30	< 38.7	< 38.0					
Liquids										
S95T003394	108:1	DL	< 40.10	< 40.1	< 40.1	< 40.1	n/a	n/a	n/a	n/a
S95T003396	108:1A	DL	< 40.10	< 40.1	< 40.1					
S95T003418	108:1AR	DL	< 40.10	< 40.1	< 40.1					
S95T003422	108:2AR	DL	< 40.10	< 40.1	< 40.1					

Table A-26. Tank 241-BY-105 Analytical Results: Silicon.

Sample Number	Core Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	201	249.0	225.0 ^{cc,b,c,e}	180	12.4	n/a
S95T003502	108:1A	Whole	322	316.0	319.0 ^{cc,b}			
S95T003507	108:1AR	Whole	167	233.0	200.0 ^{cc,b,e}			
S95T003503	108:1B	Whole	216	262.0	239.0 ^{cc,b}			
S95T003506	108:1R	Whole	120	246.0	183.0 ^{cc,b,e}			
S95T003504	108:2	Whole	132	221.0	176.5 ^{cc,b,e}			
S95T003509	108:2AR	Whole	140	156.0	148.0 ^{cc,b}			
S95T003508	108:2R	Whole	374	298.0	336.0 ^{cc,b,e}			
S95T003505	108:3	Whole	74.90	98.70	86.80 ^{cc,b,e}			
Liquids								
S95T003394	108:1	DL	149	152.0	150.5	144	23.6	n/a
S95T003396	108:1A	DL	306	239.0	272.5 ^{cc,e}			
S95T003418	108:1AR	DL	144	139.0	141.5			
S95T003422	108:2AR	DL	97.80	103.0	100.4			

Table A-27. Tank 241-BX-105 Analytical Results: Silver.

Sample Number	Core Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	13.10	14.10	13.60	17.4	8.6	n/a
S95T003502	108:1A	Whole	14.30	14.40	14.35			
S95T003507	108:1AR	Whole	14.30	15.50	14.90			
S95T003503	108:1B	Whole	14.60	15.80	15.20			
S95T003506	108:1R	Whole	14.90	16.80	15.85			
S95T003504	108:2	Whole	20.60	22.20	21.40			
S95T003509	108:2AR	Whole	13.00	14.10	13.55			
S95T003508	108:2R	Whole	14.90	15.50	15.20			
S95T003505	108:3	Whole	13.50	27.70	20.60 ^{OCe}			
Liquids								
S95T003394	108:1	DL	< 4.010	< 4.01	< 4.01 ^{OCe}	< 4.01	n/a	n/a
S95T003396	108:1A	DL	< 4.010	< 4.01	< 4.01 ^{OCe}	< 4.01		
S95T003418	108:1AR	DL	< 4.010	< 4.01	< 4.01 ^{OCe}	< 4.01		
S95T003422	108:2AR	DL	< 4.010	< 4.01	< 4.01 ^{OCe}	< 4.01		

Table A-28. Tank 241-BY-105 Analytical Results: Sodium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	1.89E+05	1.85E+05	1.87E+05 ^{c,d}	1.98E+05	2.7	n/a
S95T003502	108:1A	Whole	1.84E+05	1.84E+05	1.84E+05			
S95T003507	108:1AR	Whole	1.83E+05	1.92E+05	1.88E+05			
S95T003503	108:1B	Whole	1.92E+05	1.98E+05	1.95E+05			
S95T003506	108:1R	Whole	1.97E+05	2.19E+05	2.08E+05 ^{c,d,e}			
S95T003504	108:2	Whole	2.13E+05	2.36E+05	2.24E+05 ^{c,e}			
S95T003509	108:2AR	Whole	1.64E+05	1.79E+05	1.72E+05			
S95T003508	108:2R	Whole	1.81E+05	1.97E+05	1.89E+05			
S95T003505	108:3	Whole	1.82E+05	2.29E+05	2.06E+05 ^{c,e}			
Liquids								
S95T003394	108:1	DL	1.94E+05	1.98E+05	1.96E+05	2.03E+05	2.5	n/a
S95T003396	108:1A	DL	2.04E+05	1.96E+05	2.00E+05			
S95T003418	108:1AR	DL	1.99E+05	1.97E+05	1.98E+05			
S95T003422	108:2AR	DL	2.12E+05	2.04E+05	2.08E+05			

Table A-29. Tank 241-BY-105 Analytical Results: Strontium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	74.60	81.10	77.85	88.3	13.2	n/a
S95T003502	108:1A	Whole	127	127.0	127.0			
S95T003507	108:1AR	Whole	59.40	85.70	72.55 ^{QC}			
S95T003503	108:1B	Whole	137	137.0	137.0			
S95T003506	108:1R	Whole	73.00	100.0	86.50 ^{QC}			
S95T003504	108:2	Whole	28.00	30.30	29.15			
S95T003509	108:2AR	Whole	127	118.0	122.5			
S95T003508	108:2R	Whole	133	147.0	140.0			
S95T003505	108:3	Whole	31.20	104.0	67.60 ^{QC}			
Liquids								
S95T003394	108:1	DL	< 4.010	< 4.01	< 4.01	< 4.01	n/a	n/a
S95T003396	108:1A	DL	< 4.010	< 4.01	< 4.01			
S95T003418	108:1AR	DL	< 4.010	< 4.01	< 4.01			
S95T003422	108:2AR	DL	< 4.010	< 4.01	< 4.01			

Table A-30. Tank 241-BY-105 Analytical Results: Sulfur.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	2,670	3,010	2,840	3,140	30.6	n/a
S95T003502	108:1A	Whole	5,080	5,140	5,110			
S95T003507	108:1AR	Whole	1,930	2,860	2,400 ^{OC:e}			
S95T003503	108:1B	Whole	3,150	3,370	3,260			
S95T003506	108:1R	Whole	3,600	4,570	4,080 ^{OC:d,e}			
S95T003504	108:2	Whole	4,510	4,930	4,720			
S95T003509	108:2AR	Whole	4,470	4,620	4,540			
S95T003508	108:2R	Whole	5,170	4,790	4,980			
S95T003505	108:3	Whole	442	1,840	1,140 ^{OC:c}			
Liquids								
S95T003394	108:1	DL	647	676.0	661.5	675	1.1	n/a
S95T003396	108:1A	DL	697	661.0	679.0			
S95T003418	108:1AR	DL	702	690.0	696.0			
S95T003422	108:2AR	DL	689	655.0	672.0			

Table A-31. Tank 241-BY-105 Analytical Results: Thallium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 86.50	< 78.3	< 82.4	< 80.0	n/a	n/a
S95T003502	108:1A	Whole	< 76.90	< 77.7	< 77.3			
S95T003507	108:1AR	Whole	< 93.40	< 90.3	< 91.9			
S95T003503	108:1B	Whole	< 73.20	< 71.2	< 72.2			
S95T003506	108:1R	Whole	< 71.70	< 70.6	< 71.2			
S95T003504	108:2	Whole	< 88.50	< 93.9	< 91.2			
S95T003509	108:2AR	Whole	< 73.00	< 69.3	< 71.2			
S95T003508	108:2R	Whole	< 91.20	< 94.5	< 92.9			
S95T003505	108:3	Whole	< 74.50	< 77.5	< 76.0			
Liquids								
S95T003394	108:1	DL	< 80.20	< 80.2	< 80.2	< 80.2	n/a	n/a
S95T003396	108:1A	DL	< 80.20	< 80.2	< 80.2			
S95T003418	108:1AR	DL	< 80.20	< 80.2	< 80.2			
S95T003422	108:2AR	DL	< 80.20	< 80.2	< 80.2			

Table A-32. Tank 241-BY-105 Analytical Results: Titanium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 4.320	< 3.91	< 4.12	< 4.00	n/a	n/a
S95T003502	108:1A	Whole	< 3.850	< 3.89	< 3.87			
S95T003507	108:1AR	Whole	< 4.670	< 4.51	< 4.59			
S95T003503	108:1B	Whole	< 3.660	< 3.56	< 3.61			
S95T003506	108:1R	Whole	< 3.590	< 3.53	< 3.56			
S95T003504	108:2	Whole	< 4.430	< 4.69	< 4.56			
S95T003509	108:2AR	Whole	< 3.650	< 3.47	< 3.56			
S95T003508	108:2R	Whole	< 4.560	< 4.72	< 4.64			
S95T003505	108:3	Whole	< 3.730	< 3.87	< 3.80			
Liquids								
S95T003394	108:1	DL	< 4.010	< 4.01	< 4.01	< 4.01	n/a	n/a
S95T003396	108:1A	DL	< 4.010	< 4.01	< 4.01			
S95T003418	108:1AR	DL	< 4.010	< 4.01	< 4.01			
S95T003422	108:2AR	DL	< 4.010	< 4.01	< 4.01			

Table A-33. Tank 241-BY-105 Analytical Results: Uranium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 216	213.0	215	261	8.6	n/a
S95T003502	108:1A	Whole	334	328.0	331.0			
S95T003507	108:1AR	Whole	< 233	233.0	233			
S95T003503	108:1B	Whole	405	425.0	415.0			
S95T003506	108:1R	Whole	< 179	246.0	213			
S95T003504	108:2	Whole	224	< 235	230			
S95T003509	108:2AR	Whole	291	278.0	284.5			
S95T003508	108:2R	Whole	300	359.0	329.5			
S95T003505	108:3	Whole	< 186	251.0	219			
Liquids								
S95T003394	108:1	DL	< 200	< 200	< 200	< 200	n/a	n/a
S95T003396	108:1A	DL	< 200	< 200	< 200			
S95T003418	108:1AR	DL	< 200	< 200	< 200			
S95T003422	108:2AR	DL	< 200	< 200	< 200			

Table A-34. Tank 241-BY-105 Analytical Results: Vanadium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	< 21.60	< 19.6	< 20.6	< 20.0	n/a	n/a
S95T003502	108:1A	Whole	< 19.20	< 19.4	< 19.3			
S95T003507	108:1AR	Whole	< 23.30	< 22.6	< 23.0			
S95T003503	108:1B	Whole	< 18.30	< 17.8	< 18.1			
S95T003506	108:1R	Whole	< 17.90	< 17.6	< 17.8			
S95T003504	108:2	Whole	< 22.10	< 23.5	< 22.8			
S95T003509	108:2AR	Whole	< 18.30	< 17.3	< 17.8			
S95T003508	108:2R	Whole	< 22.80	< 23.6	< 23.2			
S95T003505	108:3	Whole	< 18.60	< 19.4	< 19.0			
Liquids								
S95T003394	108:1	DL	< 20.00	< 20.0	< 20.0	< 20.0	n/a	n/a
S95T003396	108:1A	DL	< 20.00	< 20.0	< 20.0			
S95T003418	108:1AR	DL	< 20.00	< 20.0	< 20.0			
S95T003422	108:2AR	DL	< 20.00	< 20.0	< 20.0			

Table A-35. Tank 241-BY-105 Analytical Results: Zinc.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003501	108:1	Whole	25.20	28.20	26.70	36.8	22.6	n/a
S95T003502	108:1A	Whole	43.40	39.30	41.35			
S95T003507	108:1AR	Whole	39.40	51.90	45.65 ^{QC:z}			
S95T003503	108:1B	Whole	34.00	30.60	32.30			
S95T003506	108:1R	Whole	46.10	57.90	52.00 ^{QC:z}			
S95T003504	108:2	Whole	29.70	19.20	24.45 ^{QC:z}			
S95T003509	108:2AR	Whole	81.90	62.00	71.95 ^{QC:z}			
S95T003508	108:2R	Whole	65.80	78.30	72.05			
S95T003505	108:3	Whole	12.80	16.60	14.70 ^{QC:z}			
Liquids								
S95T003394	108:1	DL	26.60	31.80	29.20	63.5	37.2	n/a
S95T003396	108:1A	DL	98.50	107.0	102.8			
S95T003418	108:1AR	DL	151	150.0	150.5			
S95T003422	108:2AR	DL	33.40	32.20	32.80			

Table A-36. Tank 241-BY-105 Analytical Results: Zirconium.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean)		Projected Inventory kg
							µg/mL	%	
Solids									
S95T003501	108:1	Whole	< 4.320	4.090	4.21	5.23	8.3		n/a
S95T003502	108:1A	Whole	6.610	6.410	6.510				
S95T003507	108:1AR	Whole	< 4.670	< 4.51	< 4.59				
S95T003503	108:1B	Whole	7.650	8.480	8.065				
S95T003506	108:1R	Whole	< 3.590	4.380	3.99				
S95T003504	108:2	Whole	4.580	< 4.69	4.64				
S95T003509	108:2AR	Whole	6.470	5.670	6.070				
S95T003508	108:2R	Whole	5.160	7.030	6.095 ^{QC:c}				
S95T003505	108:3	Whole	< 3.730	5.510	4.62				
Liquids									
S95T003394	108:1	DL	< 4.010	< 4.01	< 4.01	< 4.01	n/a		n/a
S95T003396	108:1A	DL	< 4.010	< 4.01	< 4.01				
S95T003418	108:1AR	DL	< 4.010	< 4.01	< 4.01				
S95T003422	108:2AR	DL	< 4.010	< 4.01	< 4.01				

Table A-37. Tank 241-BY-105 Analytical Results: Chloride.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003510	108:1	Whole	530	791.0	660.8 ^{cc:de}	897	30.7	n/a
S95T003511	108:1A	Whole	428	392.0	410.1			
S95T003516	108:1AR	Whole	891	1,060	975.4			
S95T003512	108:1B	Whole	840	504.0	672.0 ^{cc:e}			
S95T003515	108:1R	Whole	617	717.0	667.1			
S95T003513	108:2	Whole	1,240	848.0	1,040 ^{cc:e}			
S95T003518	108:2AR	Whole	2,910	1,100	2,010 ^{cc:e}			
S95T003517	108:2R	Whole	1,330	1,270	1,300			
S95T003514	108:3	Whole	551	580.0	565.4			
Liquids								
S95T003394	108:1	DL	3,080	3,210	3,140	3,660	8.4	n/a
S95T003396	108:1A	DL	3,060	3,410	3,240			
S95T003418	108:1AR	DL	3,280	4,070	3,680 ^{cc:e}			
S95T003422	108:2AR	DL	3,940	3,990	3,960			

Table A-38. Tank 241-BY-105 Analytical Results: Flouride.

Sample Number	Core Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003510	108:1	Whole	5,420	5,630	5,520	4,100	29.6	n/a
S95T003511	108:1A	Whole	9,490	9,970	9,730			
S95T003516	108:1AR	Whole	3,490	4,170	3,830			
S95T003512	108:1B	Whole	4,510	3,930	4,220			
S95T003515	108:1R	Whole	6,810	7,240	7,020			
S95T003513	108:2	Whole	3,680	3,770	3,730			
S95T003518	108:2AR	Whole	4,390	6,730	5,560 ^{o:c}			
S95T003517	108:2R	Whole	7,690	8,850	8,270			
S95T003514	108:3	Whole	391	356.0	373.6			
Liquids								
S95T003394	108:1	DL	602	648.0	624.9	534	13.5	n/a
S95T003396	108:1A	DL	632	630.0	630.9			
S95T003418	108:1AR	DL	513	615.0	564.0			
S95T003422	108:2AR	DL	466	457.0	461.4			

Table A-39. Tank 241-BY-105 Analytical Results: Nitrate.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003510	108:1	Whole	5.21E+05	5.47E+05	5.34E+05 ^{c,d}	4.91E+05	15.8	n/a
S95T003511	108:1A	Whole	5.28E+05	5.10E+05	5.19E+05			
S95T003516	108:1AR	Whole	5.16E+05	4.72E+05	4.94E+05			
S95T003512	108:1B	Whole	4.29E+05	5.39E+05	4.84E+05 ^{c,d,e}			
S95T003515	108:1R	Whole	4.78E+05	4.62E+05	4.70E+05			
S95T003513	108:2	Whole	2.78E+05	3.11E+05	2.95E+05 ^{c,e}			
S95T003518	108:2AR	Whole	4.14E+05	3.70E+05	3.92E+05 ^{c,e}			
S95T003517	108:2R	Whole	3.57E+05	3.78E+05	3.67E+05			
S95T003514	108:3	Whole	6.20E+05	6.20E+05	6.20E+05			
Liquids								
S95T003394	108:1	DL	2.44E+05	2.49E+05	2.46E+05 ^{c,d}	2.20E+05	8.8	n/a
S95T003396	108:1A	DL	2.46E+05	2.52E+05	2.49E+05			
S95T003418	108:1AR	DL	2.14E+05	2.29E+05	2.22E+05 ^{c,d}			
S95T003422	108:2AR	DL	1.98E+05	2.02E+05	2.00E+05			

Table A-40. Tank 241-BY-105 Analytical Results: Nitrite.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003510	108:1	Whole	11,000	10,500	10,700	9,410	14.4	n/a
S95T003511	108:1A	Whole	7,880	7,740	7,810			
S95T003516	108:1AR	Whole	10,600	12,500	11,600			
S95T003512	108:1B	Whole	7,750	6,500	7,120			
S95T003515	108:1R	Whole	8,560	9,260	8,910			
S95T003513	108:2	Whole	9,890	10,500	10,200			
S95T003518	108:2AR	Whole	12,900	13,200	13,100			
S95T003517	108:2R	Whole	13,200	12,900	13,000			
S95T003514	108:3	Whole	6,960	6,840	6,900			
Liquids								
S95T003394	108:1	DL	40,200	41,500	40,900	44,900	9.7	n/a
S95T003396	108:1A	DL	39,500	40,900	40,200			
S95T003418	108:1AR	DL	38,600	42,300	40,500 ^{c,d}			
S95T003422	108:2AR	DL	48,400	49,900	49,200			

Table A-41. Tank 241-BY-105 Analytical Results: Oxalate.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg	
									µg/mL
Solids									
S95T003510	108:1	Whole	15,400	15,700	15,600	11,300	41.9	n/a	
S95T003511	108:1A	Whole	25,500	26,800	26,100				
S95T003516	108:1AR	Whole	17,500	19,900	18,700				
S95T003512	108:1B	Whole	25,600	21,300	23,400				
S95T003515	108:1R	Whole	13,900	14,100	14,000				
S95T003513	108:2	Whole	12,400	12,600	12,500				
S95T003518	108:2AR	Whole	7,910	9,790	8,850 ^{0.2e}				
S95T003517	108:2R	Whole	17,000	17,900	17,400				
S95T003514	108:3	Whole	1,400	1,270	1,340				
Liquids									
S95T003394	108:1	DL	587	554.0	570.7	1,060	50.2	n/a	
S95T003396	108:1A	DL	564	< 541	553				
S95T003418	108:1AR	DL	< 541	< 541	< 541				
S95T003422	108:2AR	DL	2600	< 541	1,570				

Table A-42. Tank 241-BY-105 Analytical Results: Phosphate.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003510	108:1	Whole	5,250	5,480	5,370	4,890	46.8	n/a
S95T003511	108:1A	Whole	5,060	5,530	5,290			
S95T003516	108:1AR	Whole	2,440	3,300	2,870 ^{OC:ε}			
S95T003512	108:1B	Whole	3,550	2,250	2,900 ^{OC:ε}			
S95T003515	108:1R	Whole	3,410	3,650	3,530			
S95T003513	108:2	Whole	959	< 491	725			
S95T003518	108:2AR	Whole	6,360	26,800	16,600 ^{OC:ε}			
S95T003517	108:2R	Whole	13,400	13,200	13,300			
S95T003514	108:3	Whole	< 460	< 474	< 467			
Liquids								
S95T003394	108:1	DL	995	777.0	886.0 ^{OC:ε}	894	4.9	n/a
S95T003396	108:1A	DL	888	< 618	753			
S95T003418	108:1AR	DL	919	924.0	921.5			
S95T003422	108:2AR	DL	915	953.0	933.8			

Table A-43. Tank 241-BY-105 Analytical Results: Sulfate.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003510	108:1	Whole	12,300	11,800	12,000	10,600	36.2	n/a
S95T003511	108:1A	Whole	21,100	21,700	21,400			
S95T003516	108:1AR	Whole	8,640	9,800	9,220 ^{SCC}			
S95T003512	108:1B	Whole	9,390	8,540	8,970			
S95T003515	108:1R	Whole	13,500	13,500	13,500			
S95T003513	108:2	Whole	17,000	17,600	17,300			
S95T003518	108:2AR	Whole	14,900	15,400	15,200			
S95T003517	108:2R	Whole	18,000	18,200	18,100			
S95T003514	108:3	Whole	1,850	2,030	1,940			
Liquids								
S95T003394	108:1	DL	1,900	1,850	1,880	1,680	3.4	n/a
S95T003396	108:1A	DL	1,630	1,800	1,710			
S95T003418	108:1AR	DL	1,620	1,670	1,650			
S95T003422	108:2AR	DL	1,580	1,650	1,620			

Table A-44. Tank 241-BY-105 Analytical Results: Total Alpha.

Sample Number	Core: Segment	Sub-segment	Result μCi/g	Duplicate μCi/g	Sample Mean μCi/g	Overall Mean μCi/g	RSD (Mean) %	Projected Inventory Ci
Solids								
S95T003400	108:1	Whole	0.0112	0.00984	0.0105	0.0168	15.3	n/a
S95T003401	108:1A	Whole	0.0205	0.0161	0.0183 ^{QC-e}			
S95T003424	108:1AR	Whole	0.0158	0.0132	0.0145			
S95T003402	108:1B	Whole	0.0252	0.0301	0.0277			
S95T003423	108:1R	Whole	0.0109	< 0.00882	0.00986			
S95T003403	108:2	Whole	0.0294	0.0330	0.0312 ^{QC-e}			
S95T003426	108:2AR	Whole	< 0.00514	0.0145	0.00982			
S95T003425	108:2R	Whole	0.0204	0.00666	0.0135 ^{QC-e}			
S95T003404	108:3	Whole	0.0129	0.0194	0.0162 ^{QC-e}			
Liquids								
S95T003394	108:1	DL	< 0.00371	0.00411	0.00391	< 0.00407	n/a	n/a
S95T003396	108:1A	DL	0.00611	0.00451	0.00531 ^{QC-e}			
S95T003418	108:1AR	DL	< 0.00327	< 0.00261	< 0.00294 ^{QC-b}			
S95T003422	108:2AR	DL	< 0.00327	< 0.00491	< 0.00409 ^{QC-b}			

Table A-45. Tank 241-BY-105 Analytical Results: TOC.

Sample Number	Core: Segment	Sub-segment	Result µg C/g	Duplicate µg C/g	Sample Mean µg C/g	Overall Mean µg C/g	RSD (Mean) %	Projected Inventory kg C
Solids								
S95T003393	108:1	Whole	3,460	3,470	3,460	3,250	36.0	n/a
S95T003395	108:1A	Whole	6,970	6,800	6,880			
S95T003419	108:1AR	Whole	5,400	5,710	5,560			
S95T003397	108:1B	Whole	7,600	6,340	6,970			
S95T003417	108:1R	Whole	4,030	4,100	4,060			
S95T003398	108:2	Whole	4,030	4,120	4,080			
S95T003421	108:2AR	Whole	1,990	2,370	2,180			
S95T003420	108:2R	Whole	5,160	4,500	4,830			
S95T003399	108:3	Whole	650	687.0	668.5			
Liquids								
S95T003394	108:1	DL	1,930	1,920	1,920	2,090	7.3	n/a
S95T003396	108:1A	DL	1,990	1,950	1,970			
S95T003418	108:1AR	DL	1,780	2,060	1,920			
S95T003422	108:2AR	DL	2,270	2,220	2,240			

Table A-46. Tank 241-BY-105 Analytical Results: Cyanide.

Sample Number	Core: Segment	Sub-segment	Result µg/g	Duplicate µg/g	Sample Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
Solids								
S95T003399	108:3	Whole	3,920	5,860	4,890 ^{0.5±}	4.89	14.5	n/a
Liquids								
S95T003418	108:1AR	DL	10.10	11.30	10.70 ^{0.5±}	10.7	5.6	n/a

Table A-47. Tank 241-BY-105 Analytical Results: Weight Percent Water. (2 sheets)

Sample Number	Core Segment	Sub-segment	Run	Transition 1		Transition 2		Total	Sample Mean	Overall Mean	RSD (Mean)
				% H ₂ O	Temp. Range (°C)	% H ₂ O	Temp. Range (°C)				
S95T003393	108:1	Whole	1 ¹	18.37	35 - 115	10.63	115 - 205	29.00	25.33 ^{OC:c}	16.1	25.9
			2 ¹	7.32	35 - 110	12.56	110 - 190	19.88			
			3 ²	27.11	35 - 240	---	---	27.11			
S95T003395 ¹	108:1A	Whole	1	4.26	55 - 120	5.21	120 - 210	9.470	9.280		
			2	4.74	35 - 110	4.35	110 - 195	9.090			
S95T003419 ¹	108:1AR	Whole	1	7.61	35 - 125	13.45	125 - 220	21.06	21.95		
			2	8.79	35 - 120	14.04	120 - 220	22.83			
S95T003397	108:1B	Whole	1 ¹	17.99	35 - 120	10.59	120 - 195	28.58	26.96 ^{OC:c}		
			2 ¹	11.05	35 - 120	7.02	120 - 205	18.07			
			3 ²	34.23	35 - 230	---	---	34.23			
S95T003417 ¹	108:1R	Whole	1	17.69	35 - 145	---	---	17.69	24.03 ^{OC:c}		
			2	39.65	35 - 100	---	---	39.65			
			3	5.54	35 - 115	9.22	115 - 225	14.76			
S95T003398 ¹	108:2	Whole	1	16.46	35 - 170	---	---	16.46	16.78		
			2	17.10	35 - 170	---	---	17.10			
S95T003421 ¹	108:2AR	Whole	1	7.52	35 - 125	11.91	125 - 225	19.43	20.09		
			2	9.27	35 - 135	11.47	135 - 215	20.74			
S95T003420 ¹	108:2R	Whole	1	32.35	35 - 185	---	---	32.35	25.95 ^{OC:c}		
			2	5.27	35 - 115	17.34	115 - 200	22.61			
			3	8.10	35 - 120	14.79	120 - 215	22.89			

Table A-47. Tank 241-BY-105 Analytical Results: Weight Percent Water. (2 sheets)

Sample Number	Core: Segment	Sub-segment	Run	Transition 1		Transition 2		Total	Sample Mean	Overall Mean	RSD (Mean)
				% H ₂ O	Temp. Range (°C)	% H ₂ O	Temp. Range (°C)				
Solids											
S95T003399 ¹	108:3	Whole	1	8.27	35 - 120	---	---	8.270	5.73 ^{2c}		
			2	6.12	35 - 125	---	---	6.120			
			3	2.80	35 - 130	---	---	2.80			
Liquids											
S95T003394 ¹	108:1	DL	1	54.03	30 - 195	---	---	54.03	54.22	50.2	7.8
			2	54.41	35 - 195	---	---	54.41			
S95T003396 ¹	108:1A	DL	1	54.36	35 - 210	---	---	54.36	54.22		
			2	54.07	35 - 205	---	---	54.07			
S95T003418 ²	108:1AR	DL	1	53.58	21 - 226	---	---	53.58	53.84		
			2	54.10	27 - 230	---	---	54.10			
S95T003422 ²	108:2AR	DL	1	41.35	108 - 229	---	---	41.35	46.27 ^{2c}		
			2	37.32	130 - 229	---	---	37.32			
			3	53.29	27 - 246	---	---	53.29			
			4	53.10	33 - 234	---	---	53.10			

Notes:

¹Performed on a Mettler™ instrument

²Performed on a Perkin-Elmer™ instrument

Table A-48. Tank 241-BY-105 Analytical Results: Energetics by DSC. (2 sheets)

Sample Number	Core: Segment	Sub-segment	Run	Sample Weight mg	Transition 1		Transition 2		Transition 3		Transition 4	
					Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)
S95T003393	108:1	Whole			1	110.1	654.0	274.6	20.2	431.1	-27.9	---
					2	136.4	512.8	277.5	82.9	423.7	-26.8	---
S95T003395	108:1A	Whole			1	95.7	291.4	307.5	264.7	---	---	---
					2	104.6	240.8	312.2	230.8	---	---	---
					3	134.9	396.7	304.0	180.9	427.1	-60.0	---
S95T003419	108:1AR	Whole			1	137.8	692.9	277.4	42.1	423.6	-32.6 ^{0C±}	---
					2	134.9	449.8	301.3	86.3	419.9	-21.1 ^{0C±}	---
S95T003397	108:1B	Whole			1	132.8	564.4	306.8	176.6	---	---	---
					2	106.2	665.1	301.5	179.3	---	---	---
					3	138.3	516.5	300.7	88.2	420.0	-33.8	---
S95T003417	108:1R	Whole			1	133.9	439.8	299.3	111.6	423.5	-21.8	---
					2	137.7	458.3	275.0	83.4	419.9	-23.6	---
S95T003398	108:2	Whole			1	115.5	337.3	289.9	52.6	374.5	-15.5 ^{0C±}	---
					2	115.1	251.0	290.1	43.8	416.9	-17.3 ^{0C±}	---
					3	116.1	279.0	301.1	28.7	365.4	-10.5 ^{0C±}	---
S95T003421	108:2AR	Whole			1	111.5	751.2	423.7	-6.4 ^{0C±}	---	---	
					2	127.3	753.3	265.0	15.1	431.7	-2.5 ^{0C±}	---
S95T003420	108:2R	Whole			1	115.6	758.7	303.1	66.2	421.8	-14.7	---
					2	121.3	535.8	272.5	32.5	419.4	-14.6	---

Table A-48. Tank 241-BY-105 Analytical Results: Energetics by DSC. (2 sheets)

Sample Number	Core: Segment	Sub-segment	Run	Sample Weight mg	Transition 1		Transition 2		Transition 3		Transition 4	
					Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)
Solids ¹	108:3	Whole	1	20.181	114.4	344.2	296.1	134.5	417.9	38.9 ^{0°C:c}	---	---
			2	26.631	116.6	253.9	293.0	99.4	436.6	-760.0 ^{0°C:c}	---	---
			3	21.290	---	---	---	---	---	---	---	---
Liquids ¹	108:1	DL	1	13.951	120.2	1226.4	239.7	-120.2	---	---	---	---
			2	17.801	124.4	1089.6	241.6	-105.2	---	---	---	---
	108:1A	DL	1	15.448	120.1	1358.6	---	---	---	---	---	---
			2	14.498	107.7	1223.4	---	---	---	---	---	---
	108:1AR	DL	1	17.920	113.0	570.5	163.6	47.8	219.8	9.3	278.7	20.4 ^{0°C:c}
			2	15.233	125.5	833.0	242.0	-676.2 ^{0°C:c}	---	---	---	---
3			20.000	117.3	728.2	240.1	-87.1 ^{0°C:c}	---	---	---	---	
108:2AR	DL	1	14.150	117.2	809.2	191.8	28.9	243.8	-75.1	---	---	
		2	16.141	120.8	845.4	191.7	16.4	243.7	-70.8	---	---	

Notes:

ΔH = change in enthalpy (negative sign denotes exothermic reaction)

¹All analyses performed on a Mettler™ instrument.

Table A-49. Tank 241-BY-105 Analytical Results: Bulk Density/Specific Gravity.

Sample Number	Core: Segment	Sub-segment	Result g/mL	Duplicate g/mL	Sample Mean g/mL	Overall Mean g/mL	RSD (Mean) %
Solids							
S95T003379	108:1	Whole	1.970	1.900	1.935	1.86	1.6
S95T003381	108:1A	Whole	1.970	1.980	1.975		
S95T003406	108:1AR	Whole	< 0.500	n/a	n/a		
S95T003383	108:1B	Whole	1.870	1.890	1.880		
S95T003405	108:1R	Whole	1.900	1.860	1.880		
S95T003384	108:2	Whole	< 0.500	n/a	n/a		
S95T003409	108:2AR	Whole	1.880	1.810	1.845		
S95T003408	108:2R	Whole	1.840	1.850	1.845		
S95T003385	108:3	Whole	1.830	n/a	n/a		
Liquids							
S95T003394	108:1	DL	1.390	1.390	1.390	1.40	0.3
S95T003396	108:1A	DL	1.400	1.390	1.395		
S95T003418	108:1AR	DL	1.410	1.410	1.410		
S95T003422	108:2AR	DL	1.410	1.400	1.405		

APPENDIX B

**RESULTS OF HYDROSTATIC HEAD FLUID CONTAMINATION CHECK FOR
SINGLE-SHELL TANK 241-BY-105**

This page intentionally left blank.

ION CHECK FOR

SINGLE-SHELL TANK 241-BY-105

B.1 INTRODUCTION AND ANALYTE TABLE DESCRIPTION

Appendix B reports the results of the HHF contamination check for the 1995 core sampling event. Lithium and bromide were measured to detect any contamination of the waste samples by the HHF.

The "Sample Number" column in each of the data tables lists the laboratory sample identification number. Sampling rationale, locations, and a description of the sampling event are discussed in Section 3.0.

The "Core:Segment" column specifies the core and segment from which the sample was derived.

The "Subsegment" column specifies "Whole" or "DL," depending on whether the sample analyzed was a whole (solid) segment or drainable liquid from a segment.

The "Result" and "Duplicate" columns are self-explanatory. The "Sample Mean" column lists the average of the result and duplicate values. If the result and duplicate values were both detected, or one of the two values is detected and the other non-detected, then the mean is expressed as a detected value. If the result and duplicate values were both nondetected, then the mean is expressed as a nondetected. The result and duplicate values, as well as the result/duplicate means, are reported in the tables exactly as found in the original laboratory data package. The means may appear to have been rounded up in some cases and down in others. This is because the analytical results in the tables may have fewer significant figures than originally reported, not because the means were incorrectly calculated.

Projected inventories were not calculated for either of the two analytes because they are not believed to be inherent constituents of the waste.

The four quality control parameters assessed on the tank 241-BY-105 samples were standard recoveries, spike recoveries, duplicate analyses (RPDs), and blanks. These were summarized in Section 5.1.2. More specific information is provided in the following appendix tables. Sample and duplicate pairs in which any of the QC parameters were outside their specified limits are superscripted in the "Sample Mean" column as follows:

- QC:a -- indicates that the standard recovery was below the QC range.
- QC:b -- indicates that the standard recovery was above the QC range.
- QC:c -- indicates that the spike recovery was below the QC range.
- QC:d -- indicates that the spike recovery was above the QC range.
- QC:e -- indicates that the RPD was greater than the QC limit range.
- QC:f -- indicates blank contamination.

Table B-1. Tank 241-BY-105 Hydrostatic Head Fluid Contamination Check: Lithium.

Sample Number	Core: Segment	Sub-segment	Result	Duplicate	Sample Mean
Solids			$\mu\text{g/g}$	$\mu\text{g/g}$	$\mu\text{g/g}$
S95T003501	108:1	Whole	< 4.320	< 3.91	< 4.12
S95T003502	108:1A	Whole	< 3.850	< 3.89	< 3.87
S95T003507	108:1AR	Whole	12.60	18.80	15.70 ^{QC}
S95T003503	108:1B	Whole	< 3.660	< 3.56	< 3.61
S95T003506	108:1R	Whole	69.20	79.50	74.35
S95T003504	108:2	Whole	< 4.430	< 4.69	< 4.56
S95T003509	108:2AR	Whole	9.060	11.40	10.23 ^{QC}
S95T003508	108:2R	Whole	41.40	40.80	41.10
S95T003505	108:3	Whole	< 3.730	< 3.87	< 3.80
Liquids			$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$
S95T003394	108:1	DL	< 4.010	< 4.01	< 4.01
S95T003396	108:1A	DL	< 4.010	< 4.01	< 4.01
S95T003418	108:1AR	DL	< 4.010	< 4.01	< 4.01
S95T003422	108:2AR	DL	< 4.010	< 4.01	< 4.01

Table B-2. Tank 241-BY-105 Hydrostatic Head Fluid Contamination Check: Bromide.

Sample Number	Core: Segment	Sub-segment	Result	Duplicate	Sample Mean
Solids			$\mu\text{g/g}$	$\mu\text{g/g}$	$\mu\text{g/g}$
S95T003510	108:1	Whole	< 2,420	< 2,290	< 2,360
S95T003511	108:1A	Whole	< 1,630	< 1,640	< 1,640
S95T003516	108:1AR	Whole	783	817.0	799.9
S95T003512	108:1B	Whole	< 520	< 508	< 514
S95T003515	108:1R	Whole	1,060	1,120	1,090
S95T003513	108:2	Whole	< 522	< 516	< 519
S95T003518	108:2AR	Whole	< 2,270	< 2,260	< 2,270
S95T003517	108:2R	Whole	< 2,320	3,280	2,800
S95T003514	108:3	Whole	< 484	< 497	< 491
Liquids			$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$
S95T003394	108:1	DL	< 649	< 649	< 649
S95T003396	108:1A	DL	< 649	< 649	< 649
S95T003418	108:1AR	DL	1,110	1,150	1,130
S95T003422	108:2AR	DL	685	673.0	679.1

This page intentionally left blank.

APPENDIX C

MARCH 1995 GRAB SAMPLING RESULTS

This page intentionally left blank.

C.0 MARCH 1995 GRAB SAMPLING RESULTS

Table C-1 presents the historical analytical results from two grab samples collected from tank 241-BY-105 in March 1995. The samples were reported as having no organic layer and having approximately 2% settled solids.

Table C-1. Tank 241-BY-105 March 1995 Grab Sampling Results. (2 sheets)

Sample Number	Analyte	Result	Duplicate	Sample Mean
METALS		µg/mL	µg/mL	µg/mL
S95T000450	Aluminum	6,130	6,140	6,135
S95T000451		6,110	6,130	6,120
S95T000450	Iron	< 20	< 20	< 20
S95T000451		< 20.0	< 20	< 20
S95T000450	Sodium	1.87E+05	1.86E+05	1.865E+05
S95T000451		1.80E+05	1.81E+05	1.805E+05
ANIONS		µg/mL	µg/mL	µg/mL
S95T000450	Chloride	2,080	2,070	2,080
S95T000451		2,080	2,150	2,120
S95T000450	Flouride	802	787	794
S95T000451		801	830	816
S95T000450	Nitrate	2.95E+05	2.90E+05	2.92E+05
S95T000451		3.10E+05	2.98E+05	3.04E+05
S95T000450	Nitrite	26,800	26,400	26,600
S95T000451		26,300	27,000	26,600
S95T000450	Phosphate	< 2,647	< 2,647	< 2,647
S95T000451		< 2,647	< 2,647	< 2,647
S95T000450	Sulfate	< 3,528	< 3,528	< 3,528
S95T000451		< 3,528	< 3,528	< 3,528
S95T000450	Hydroxide	11,600	11,900	11,800
S95T000451		11,700	12,100	11,900
RADIONUCLIDES		µCi/mL	µCi/mL	µCi/mL
S95T000450	Americium-241	< 2.56E-04	< 2.46E-04	< 2.51E-04
S95T000451		< 2.99E-04	< 2.60E-04	< 2.80E-04
S95T000450	Cesium-137	85.2	85.3	85.2
S95T000451		89.7	89.8	89.8
S95T000450	Plutonium-239/240	5.07E-05	4.09E-05	4.58E-05
S95T000451		3.80E-05	< 7.27E-05	5.54E-05

Table C-1. Tank 241-BY-105 March 1995 Grab Sampling Results. (2 sheets)

Sample Number	Analyte	Result	Duplicate	Sample Mean
RADIONUCLIDES (Cont'd)		$\mu\text{Ci/mL}$	$\mu\text{Ci/mL}$	$\mu\text{Ci/mL}$
S95T000450	Strontium-89/90	0.158	0.163	0.161
S95T000451		0.155	0.162	0.159
CARBON		$\mu\text{g C/mL}$	$\mu\text{g C/mL}$	$\mu\text{g C/mL}$
S95T000450	TIC	13,300	13,300	13,300
S95T000451		14,700	15,000	14,800
S95T000450	TOC	1,660	1,580	1,620
S95T000451		1,720	1,700	1,710
PHYSICAL PROPERTIES				
S95T000450	Weight percent water	55.21	55.36	55.28
S95T000451		56.34	55.90	56.12
S95T000450	DSC (J/g)	0	0	0
S95T000451		0	0	0
S95T000450	pH	13.50	13.56	13.53
S95T000451		13.55	13.54	13.54
S95T000450	SpG	1.32	1.33	1.325
S95T000451		1.08	1.20	1.140
S95T000450	Volume % solids	2.00	n/a	n/a
S95T000451		2.1	n/a	n/a
S95T000450	Organic volume present (mL)	0	n/a	n/a
S95T000451		0	n/a	n/a

DISTRIBUTION SHEET

To Distribution	From Data Assessment and Interpretation	Page 3 of 4
		Date 08/14/96
Project Title/Work Order Tank Characterization Report for Single-Shell Tank 241-BY-105. WHC-SD-WM-ER-598, Rev. 0		EDT No. EDT-617521
		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./Appendix Only	EDT/ECN Only
------	------	-----------------------	-----------	-----------------------	--------------

ONSITE

Department of Energy - Richland Operations

J. F. Thompson	S7-54	X			
W. S. Liou	S7-54	X			
N. W. Willis	S7-54	X			

ICF-Kaiser Hanford Company

R. L. Newell	S3-09	X			
--------------	-------	---	--	--	--

Pacific Northwest Laboratory

N. G. Colton	K3-75	X			
* J. R. Gormsen	K7-28				X
S. A. Hartley	K5-12	X			
J. G. Hill	K7-94	X			
G. J. Lumetta	P7-25	X			
A. F. Noonan	K9-81	X			

Westinghouse Hanford Company

H. Babad	S7-14	X			
D. A. Barnes	R1-80	X			
G. R. Bloom	H5-61	X			
W. L. Cowley	A3-37	X			
L. A. Diaz	T6-06	X			
G. L. Dunford	A2-34	X			
* E. J. Eberlein	R2-12				X
D. B. Engelman	R1-49	X			
J. G. Field	R2-12	X			
J. S. Garfield	H5-49	X			
* J. D. Guberski	R1-51				X
D. L. Herting	T6-09	X			
D. C. Hetzer	S6-31	X			
G. Jansen	H6-33	X			
G. D. Johnson	S7-15	X			
T. J. Kelley	S7-21	X			
N. W. Kirch	R2-11	X			
M. J. Kupfer	H5-49	X			
J. E. Meacham	S7-15	X			

* *Dist Done*

DISTRIBUTION SHEET

To Distribution	From Data Assessment and Interpretation	Page 2 of 4
		Date 08/14/96
Project Title/Work Order Tank Characterization Report for Single-Shell Tank 241-BY-105, WHC-SD-WM-ER-598, Rev. 0		EDT No. EDT-617521
		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./Appendix Only	EDT/ECN Only
------	------	-----------------------	-----------	-----------------------	--------------

SAIC
20300 Century Boulevard, Suite 200-B
Germantown, MD 20874

H. Sutter X

555 Quince Orchard Rd., Suite 500
Gaithersburg, MD 20878

P. Szerszen X

Los Alamos Laboratory
CST-14 MS-J586
P. O. Box 1663
Los Alamos, NM 87545

S. F. Agnew (4) X

Los Alamos Technical Associates

T. T. Tran BI-44 X

Ogden Environmental
101 East Wellisian Way
Richland, WA 99352

R. J. Anema X

CH2M Hill
P. O. Box 91500
Bellevue, WA 98009-2050

M. McAfee X

Tank Advisory Panel
102 Windham Road
Oak Ridge, TN 37830

D. O. Campbell X

DISTRIBUTION SHEET

To Distribution	From Data Assessment and Interpretation	Page 1 of 4
		Date 08/14/96
Project Title/Work Order Tank Characterization Report for Single-Shell Tank 241-BY-105. WHC-SD-WM-ER-598, Rev. 0		EDT No. EDT-617521
		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./Appendix Only	EDT/ECN Only
------	------	-----------------------	-----------	-----------------------	--------------

OFFSITE

Sandia National Laboratory
P.O. Box 5800
MS-0744, Dept. 6404
Albuquerque, NM 87815

D. Powers X

Nuclear Consulting Services Inc.
P. O. Box 29151
Columbus, OH 43229-01051

J. L. Kovach X

Chemical Reaction Sub-TAP
P.O. Box 271
Lindsborg, KS 67456

B. C. Hudson X

Tank Characterization Panel
Senior Technical Consultant
Contech
7309 Indian School Road
Albuquerque, NM 87110

J. Arvisu X

U. S. Department of Energy - Headquarters
Office of Environmental Restoration and Waste Management EM-563
12800 Middlebrook Road
Germantown, MD 20874

J. A. Poppitti X

Jacobs Engineering Group X
B5-36

DISTRIBUTION SHEET

To Distribution	From Data Assessment and Interpretation	Page 4 of 4
		Date 08/14/96

Project Title/Work Order Tank Characterization Report for Single-Shell Tank 241-BY-105. WHC-SD-WM-ER-598, Rev. 0	EDT No. EDT-617521
	ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./Appendix Only	EDT/ECN Only
------	------	-----------------------	-----------	-----------------------	--------------

Westinghouse Hanford Company continued

W. C. Miller	R1-56	X
C. T. Narquis	T6-16	X
D. E. Place	H5-27	X
D. A. Reynolds	R2-11	X
L. M. Sasaki (2)	R2-12	X
L. W. Shelton, Jr.	H5-49	X
B. C. Simpson	R2-12	X
G. L. Troyer	T6-50	X
L. R. Webb	T6-06	X
K. A. White	S5-13	X
TFIC (Tank Farm Information Center)	R1-20	X
Central Files	A3-88	X
EDMC	H6-08	X
ERC (Environmental Resource Center)	R1-51	X
OSTI (2)	A3-36	X
TCRC (10)	R2-12	X

NO LONGER