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		Design Agent	1	1	N.W. Kirch [signature] 7/14/97 R2-11
2	1	Cog. Eng. J. Jo [signature] 6/26/97	1	1	J.G. Kristofzski [signature] 7/14/97
2	1	Cog. Mgr. K.M. Hall [signature] 7/14/97			
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		Safety			
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Tank Characterization Report for Single-Shell Tank 241-BY-111

Jaiduk Jo
Lockheed Martin Hanford Corp., Richland, WA 99352
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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-111. This report supports the requirements of the Tri-Party Agreement Milestone M-44-10.

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Tank Characterization Report for Single-Shell Tank 241-BY-111

J. Jo
Lockheed Martin Hanford Corporation

R. T. Winward
Meier Associates

Ryan Cromar
Numatec Hanford Corporation

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

Project Hanford Management Contractor for the
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LIST OF TERMS

ANOVA	analysis of variance
AT	alpha total
Btu/hr	British thermal units per hour
BYSltCk	BY saltcake
CAS	chemical abstract service
Ci	curies
Ci/L	curies per liter
cm	centimeter
c/s	centimeters per second
CW	coating waste
CWP	PUREX cladding waste
CWP2	cladding waste PUREX (1961 - 1972)
DQO	data quality objective
DSC	differential scanning calorimetry
EB	evaporator bottoms
EB-ITS	evaporator bottoms from in-tank solidification
EPA	U.S. Environmental Protection Agency
EVAP	evaporator feed
ft	feet
g	gram
g/cc	grams per cubic centimeter
g/mL	grams per milliliter
HDW	Hanford Defined Waste
HHF	hydrostatic head fluid
HTCE	Historical Tank Content Estimate
IC	ion chromatography
ICP	inductively coupled plasma
in.	inches
ITS	In-Tank Solidification
J/g	joules per gram
kCi	kilograms per curies
kg	kilogram
kg/L	kilogram per liter
kgal	kilogallon
kL	kiloliter
kW	kilowatt
L	liter
LANL	Los Alamos National Laboratory
LEL	lower explosive limit
LFL	lower flammability limit
LL	lower limit
LOW	liquid observation well

LIST OF TERMS (Continued)

m	meter
M	moles per liter
mg	milligram
mm	millimeter
mole/L	mole per liter
MW	metal waste
n/a	not applicable
NR	not reported
OWW	organic solvent wash waste from PUREX plant
PHMC	Project Hanford Management Contractor
PNNL	Pacific Northwest National Laboratory
ppm	parts per million
ppmv	parts per million by volume
PUREX	plutonium-uranium extraction plant
QC	quality control
REML	restricted maximum likelihood estimation
RPD	relative percent difference
RSD	relative standard deviation
SACS	Surveillance Analysis Computer System
SL	sludge
SMM	Supernatant Mixing Model
SpG	specific gravity
SU	supernatant
TBP	tributyl phosphate
TBP-F	tributyl phosphate-ferrocyanide
TCP	tank characterization plan
TCR	tank characterization report
TIC	total inorganic carbon
TGA	thermogravimetric analysis
TLM	Tank Layer Model
TOC	total organic carbon
TSAP	tank sampling and analysis plan
TWRS	Tank Waste Remediation System
UL	upper limit
UR	uranium recovery
W	watts
WSTRS	Waste Status and Transaction Record Summary
wt%	weight percent
°C	degrees Celsius
°F	degrees Fahrenheit

LIST OF TERMS (Continued)

μCi/g	microcuries per gram
μCi/mL	microcuries per milliliter
μeq/g	microequivalents per gram
μg/g	micrograms per gram
μg/mL	micrograms per milliliter

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1.0 INTRODUCTION

One of the major functions of the Tank Waste Remediation System (TWRS) is to characterize wastes in support of waste management and disposal activities at the Hanford Site. Analytical data from sampling and analysis, along with other available information about a tank, are compiled and maintained in a tank characterization report (TCR). This report and its appendices serve as the TCR for single-shell tank 241-BY-111.

The objectives of this report are: 1) to use characterization data in response to technical issues associated with tank 241-BY-111 waste; and 2) to provide a standard characterization of this waste in terms of a best-basis inventory estimate. The response to technical issues is summarized in Section 2.0, and the best-basis inventory estimate is presented in Section 3.0. Recommendations regarding safety status and additional sampling needs are provided in Section 4.0. Supporting data and information are contained in the appendices. This report also supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1996) milestone M-44-10.

1.1 SCOPE

Characterization information presented in this report originated from sample analyses and known historical sources. While only the results of recent sample events will be used to fulfill the requirements of the data quality objectives (DQOs), other information can be used to support (or question) conclusions derived from these results. Historical information for tank 241-BY-111, provided in Appendix A, included surveillance information, records pertaining to waste transfers and tank operations, and expected tank contents derived from a process knowledge model.

The recent sampling events listed in Table 1-1, as well as sample data obtained before 1989, are summarized in Appendix B along with the sampling results. The results of the 1996 sampling events, also reported in the laboratory data package (Nuzum 1997), satisfied the data requirements specified in the tank characterization plan (TCP) for this tank (Winkelman 1996). The statistical analysis and numerical manipulation of data used in issue resolution are reported in Appendix C. Appendix D contains the evaluation to establish the best basis for the inventory estimate and the statistical analysis performed for this evaluation.
A bibliography that resulted from an in-depth literature search of known information sources applicable to tank 241-BY-111 and its respective waste types is contained in Appendix E. The reports listed in Appendix E may be found in the Tank Characterization and Safety Resource Center.

Table 1-1. Summary of Recent Sampling.

Sample/Date	Phase	Location	Segmentation	% Recovery
Vapor sample (3/25/93)	Gas	Not known	n/a	n/a
Vapor sample (5/94 & 11/16/94)	Gas	Riser 15	n/a	n/a
Vapor flammability screening (8/13/96 - 8/20/96)	Gas	Tank headspace, riser 6, 6 m (20 ft) below top of riser	n/a	n/a
Push mode (8/13/96 to 9/3/96)	Solid	Risers 15 and 12A	Half segments when possible	Approximately 30%. Bottom 38 in. not sampled for both cores.

Notes:

n/a = not applicable

Dates are provided in mm/dd/yy format.

1.2 TANK BACKGROUND

The 241-BY Tank Farm was constructed from 1948 to 1949 in the 200 East Area. The tank farm contains twelve 100 series tanks. These tanks have a capacity of 2870 kL (758 kgal) and a diameter of 23 m (75 ft). Built according to the second generation design, the 241-BY Tank Farm was designed for nonboiling waste with a maximum fluid temperature of 104 °C (220 °F) (Leach & Stahl 1997). An overflow line 75 mm (3 in.) in diameter connects tank 241-BY-111 as the second in a cascaded series of three tanks ending with tank 241-BY-112 (Brevick et al. 1996). Each tank in the cascade series is set one foot lower in elevation than the preceding tank.

Tank 241-BY-111 first received metal waste from B Plant in the fourth quarter of 1951. The tank continued to receive metal waste (MW) through the first quarter of 1952. Waste began cascading from tank 241-BY-111 to tank 241-BY-112 during the first quarter of 1952. During the fourth quarter of 1952, the tank received uranium recovery waste (UR) and again cascaded supernatant to tank 241-BY-112 (Agnew et al. 1997a).

The tank received waste water during the second quarter of 1954 and supernatant was sent to tank 241-BX-106. Waste was sluiced from the tank in the first, second, and third quarters of 1955 and sent for uranium recovery. Sludge was received from tank 241-BY-112 during this time. During the first and second quarters of 1955, the tank received more waste water. In 1956, the tank received metal waste from B Plant and supernatant from tank 241-BY-107. Supernatant was also sent to crib B-016. Tank 241-BY-111 received supernatant from tanks 241-C-105 and 241-C-111 during the second quarter of 1957.

Supernatant was sent from tank 241-BY-111 to tank 241-BY-103 during the latter half of 1965 and the first quarters of 1966 and 1968, to tank 241-BY-112 during the third quarter of 1966, and to tank 241-BY-108 during the second quarter of 1968. Supernatant was received from tank 241-C-102 during the second and third quarters of 1966. Tank 241-BY-111 received plutonium-uranium extraction facility (PUREX) cladding waste (CWP) during the fourth quarter of 1967.

Tank 241-BY-111 exchanged evaporator bottoms waste and supernatant from the In-Tank Solidification (ITS) process with tank 241-BY-112 from the second quarter of 1968 to the first quarter of 1976. During this time, tank 241-BY-111 occasionally received supernatant from tank 241-BY-109.

Waste was sent from tank 241-BY-111 to tank 241-A-102 during the second and third quarters of 1977; during the fourth quarter of 1977, waste was sent from tank 241-A-102 back to tank 241-BY-111. A small amount of supernatant was sent to tank 241-BX-105 in 1978. Interstitial liquor was salt-well pumped to tank 241-AW-102 in the third quarter of 1982.

As of January 31, 1997, tank 241-BY-111 contained an estimated 1740 kL (459 kgal) of waste classified as non-complexed (Hanlon 1997). Liquid waste volumes are estimated using a photographic evaluation. The solid waste volumes are estimated using a manual tape. The solid waste volume was last updated on April 28, 1982.

Tank 241-BY-111 is removed from service, as are all single-shell tanks. The tank was removed from the Ferrocyanide Watch List in September 1996 (Kinzer 1996). This tank is categorized as sound with interim stabilization and intrusion prevention completed (Hanlon 1997). The tank is passively ventilated. All monitoring systems were in compliance with documented standards as of January 31, 1997 (Hanlon 1997). Table 1-2 summarizes the description of tank 241-BY-111.

Table 1-2. Description of Tank 241-BY-111.

TANK DESCRIPTION	
Type	Single-Shell
Constructed	1948-1949
In-service	1951
Diameter	22.9 m (75.0 ft)
Operating depth	7.0 m (23 ft)
Capacity	2,870 kL (758 kgal)
Bottom shape	Dish
Ventilation	Passive
TANK STATUS	
Waste classification	Non-complexed
Total waste volume[1]	1,740 kL (459 kgal)
Supernatant volume	0 kL (0 kgal)
Saltcake volume	1,660 kL (438 kgal)
Sludge volume	79 kL (21 kgal)
Drainable interstitial liquid volume	0 kL (0 kgal)
Waste surface level (July 3, 1996)	413 cm (163 in.)
Temperature (November 1974 to December 1996)	14 °C (57 °F) to 44 °C (111 °F)
Integrity	Sound
Watch List	None
SAMPLING DATE	
Vapor sample	March 25, 1993
Vapor sample	May 1994 and November 16, 1994
Vapor flammability screening	August 13, 1996 - August 20, 1996
Push mode core sample	August 13, 1996 - September 3, 1996
SERVICE STATUS	
Declared inactive	1977
Interim stabilization	1985
Intrusion prevention	1991

Note:

[1]Waste volume is estimated from surface level measurements.

2.0 RESPONSE TO TECHNICAL ISSUES

Three technical issues have been identified for tank 241-BY-111 (Brown et al. 1996). They are:

- **Safety screening**: Does the waste pose or contribute to any recognized potential safety problems?

- **Hazardous vapor screening**: Does a potential exist for worker hazards associated with the toxicity of constituents in tank fugitive vapr emissions?

- **Organic solvent**: Does an organic solvent pool exist that may cause a fire or ignition of organic solvents in entrained waste solids?

The TCP (Winkelman 1996) provides the types of sampling and analysis used to address the above issues. Data from the recent analysis of two core samples and tank vapor space flammability measurements, as well as available historical information, provided the means to respond to these issues. These responses are detailed in the following sections. See Appendix B for sample and analysis data for tank 241-BY-111.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-BY-111 for potential safety problems is documented in *Tank Safety Screening Data Quality Objective*, Rev. 2 (Dukelow et al. 1995). These potential safety problems are exothermic conditions in the waste; flammable gases in the waste and/or tank headspace; and criticality conditions in the waste. Each of these conditions is addressed separately below. Because tank 241-BY-111 is not a Watch List tank, the safety screening DQO was the only safety-related DQO associated with the data analysis effort.

2.1.1 Exothermic Conditions (Energetics)

The first requirement outlined in the safety screening DQO (Dukelow et al. 1995) is to ensure that there is not enough fuel in tank 241-BY-111 to cause a safety hazard. Because of this requirement, energetics in the tank 241-BY-111 waste were evaluated. The safety screening DQO required the waste sample profile be tested for energetics every 24 cm (9.5 in.) to determine if the energetics exceed the safety threshold limit. The threshold limit for energetics is 480 J/g on a dry weight basis.

Results obtained using differential scanning calorimetry indicated that exotherms were well below notification limits of 480 J/g on a dry weight (Nuzum 1997). The highest result for solid sample was 312 J/g. Furthermore, the upper limit of the one-sided 95 percent confidence interval for the differential scanning calorimetry (DSC) results was below notification limit. The highest upper limit of the one-sided 95 percent confidence interval was 381 J/g. These results suggest there is no energetic concern for the sampled waste. However, two bottom segments were not obtained and could not be analyzed for exotherms.

2.1.2 Flammable Gas

The vapor phase measurements, taken in the tank headspace before and during the August 1996 core sampling, exhibited a small amount of flammable gas (0.3 percent of the lower flammability limit). Data from these vapor phase measurements are presented in Appendix B.

Vapor sample, taken on November 16, 1994, also confirmed that there was a small amount of hydrogen gas (0.2 percent of the lower flammability limit) present in the vapor space (Huckaby and Bratzel 1995).

2.1.3 Criticality

The safety threshold limit is 1 g ^{239}Pu per liter of waste. Assuming that all alpha is from ^{239}Pu, with maximum density of 1.88 g/mL for solid, the safety threshold limit is equivalent to 32.7 μCi/g and 61.5 μCi/mL for drainable liquid. Waste samples were tested for total alpha activity for lower half segments. Concentrations in all samples were well below these limits. The highest value for total alpha was 0.39 μCi/g. Additionally, as required by the DQO, the upper limit of the one-sided 95 percent confidence interval for these results was less than 32.7 μCi/g. The highest upper limit of the one-sided 95 percent confidence interval was 2.02 μCi/g. The method used to calculate confidence limits is contained in Appendix C.

2.2 HAZARDOUS VAPOR SAFETY SCREENING

The data required to support vapor screening are documented in *Data Quality Objective for Tank Hazardous Vapor Safety Screening* (Osborne and Buckley 1995). The vapor screening DQO addresses two issues: 1) does the vapor headspace exceed 25 percent of the lower flammability limit (LFL)? If so, what are the principal fuel components, and 2) does the potential exist for worker hazards associated with the toxicity of constituents in any fugitive vapor emissions from these tanks?

2.2.1 Flammable Gas

This is the same requirement as the safety screening flammability requirement. As noted previously, flammable gas was very low in the tank headspace (0.2 to 0.3 percent of the LFL).

2.2.2 Toxicity

The vapor screening DQO requires the analysis of ammonia, carbon dioxide (CO_2), carbon monoxide (CO), nitric oxide (NO), nitrous oxide (N_2O), and nitrogen dioxide (NO_2) from a sample. The vapor screening DQO specifies a threshold limit for each of these compounds. Data from the May and November of 1994 vapor sampling event (Huckaby and Bratzel 1995) were used to address the issue of toxicity (see Appendix B). All of the analytes were within the threshold limits, except ammonia. The toxicity issue has been closed for all tanks (Hewitt 1996).

2.3 ORGANIC SOLVENTS

The data required to support the organic solvent screening issue were documented in the 93-5 implementation plan. A new DQO is currently being developed to address the organic solvent issue. In the interim, tanks are to be sampled for total non-methane hydrocarbon to determine if an organic extractant pool greater than 1 m^2 (10.8 ft^2) exists (Cash 1996). The purpose of this assessment is to ensure that the organic solvent pool is sufficiently small to ensure that an organic solvent pool fire or ignition of organic solvents cannot occur. The size of the organic extract and pool was 0.26 m^2 (2.8 ft^2) (Huckaby et al. 1997). Therefore, the organic solvent pool is sufficiently small to ensure that fire or ignition cannot occur.

2.4 OTHER TECHNICAL ISSUES

A factor in assessing tank safety is the heat generation and temperature of the waste. Heat is generated in the tanks from radioactive decay. An estimate of the tank heat load based on the results from the 1996 sample event was not possible because radionuclide analyses were not required. However, the heat load estimate based on the tank process history was 2,560 W (8,750 Btu/hr) (Agnew et al. 1997b). The heat load estimate based on the tank headspace temperature was 1,500 W (5,200 Btu/hr) (Kummerer 1995). Both of these estimates are quite low and are well below the limit of 11,700 W (40,000 Btu/hr) that separates high- and low-heat-load tanks (Smith 1986).

2.5 SUMMARY

The results from all analyses performed to address potential safety issues showed no primary analyte exceeding safety decision threshold limits. However, the last 38 to 57 in. of the tank were not sampled due to the sampling difficulties. The analyses results are summarized in Table 2-1.

Table 2-1. Summary of Technical Issues.

Issue	Sub-issue	Result
Safety screening	Energetics	All exothermic reactions below 480 J/g. Highest 95% confidence interval upper limit = 381 J/g.
	Flammable gas	Vapor measurement reported 0.3% of lower flammability limit (Combustible gas meter).
	Criticality	All analyses well below 32.7 μCi/g total alpha. Highest 95% confidence interval for upper limit = 2.02 μCi/g.
Hazardous vapor	Flammability	See safety screening - flammable gas
	Toxicity	All analytes were within the threshold limits, except ammonia.
Organic solvent	Solvent pool size	Size of organic pool - 0.26 m^2 (2.8 ft^2)

3.0 BEST-BASIS STANDARD INVENTORY ESTIMATE

Information about the chemical and/or physical properties of tank wastes is used to perform safety analyses, engineering evaluations, and risk assessments associated with waste management activities, as well as to address regulatory issues. Waste management activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes, and processing the wastes into a form that is suitable for long-term storage.

Chemical inventory information generally is derived using two approaches: 1) component inventories are estimated using the results of sample analyses; and 2) component inventories are predicted using a model based on process knowledge and historical information. The most recent model was developed by Los Alamos National Laboratory (LANL) (Agnew et al. 1997b). The information derived from these two different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available chemical information for tank 241-BY-111 was performed, including the following:

- Data from two partial 1996 push-mode core samples (Appendix B)
- An inventory estimate generated by the Hanford defined waste (HDW) model (Agnew et al. 1997b)
- Evaluation of the BY Saltcake (BYSltCk) data from other BY Tank Farm tanks. Two engineering assessments were performed. One compared this tank to other BY Farm tanks without ITS heaters. The second engineering assessment compared this tank to the two ITS evaporator tanks (241-BY-102 and 241-BY-112). Tank 241-BY-111 is more like the two tanks with the ITS heaters.

Results from this evaluation, detailed in Appendix D, support using the sampling data as the basis for the best estimate inventory for tank 241-BY-111 for the following reasons:

- The sample-based inventory analytical concentrations for tank 241-BY-111 compared favorably to those of other BY tanks, specifically the evaporator tanks for the ITS.
- No methodology is available to fully predict BYSltCk from process flowsheet or historical records.
- Waste transfer records are not complete and not always accurate.

For those few analytes for which no values could be calculated from the sample-based inventory, the engineering evaluation data or the HDW model values were used. These values are less reliable than the values for which sample data are available.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-111. When the sample-based inventory had a high less-than value or was not measured, the engineering assessment-based values were used (if applicable). Some high less than values are reported because all three tanks used in the second engineering assessment had high less than values. Results for radionuclides were not available for the sample-based inventory. The best basis radionuclide values were either engineering assessment values based on the heat load of tank 241-BY-111 from Kummerer (1995) or HDW values. The HDW model was used only where no other data were available. The best-basis inventory for tank 241-BY-111 is presented in Tables 3-1 and 3-2.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-111. (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	68,300	S	---
Bi	307	M	---
Ca	840	E	---
Cl	2,990	S	---
TIC as CO_3	266,000	S	---
Cr	5,630	S	---
F	26,300	S	---
Fe	16,300	S	---
Hg	11.9	M	No sample basis
K	4,650	E	Average concentration from other tanks in BY Farm, these tanks are less representative of tank 241-BY-111, but have data.
La	0.47	M	---
Mn	<672	S	---
Na	660,000	S	---
Ni	13,100	E	This could be high by a factor of up to ten as Ni was not measured in the tank and the other non heater tanks are much lower.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-111. (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
NO_2	38,800	S	---
NO_3	418,000	S	---
OH_{Total}	172,000	C	Calculated from charge balance
Pb	223	E	---
PO_4	54,500	S	---
Si	94,200	S	This value very high but seems to be representative of several layers.
SO_4	93,900	S	---
Sr	173	M	---
TOC	16,700	S	---
U_{TOTAL}	<26,400	S	Average concentration from other BY tanks <27,100
Zr	24	E	Model reports 5.08

Notes:
[1]S = Sample-based, M = HDW model-based, E = Engineering assessment-based, and C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_3, NO_2, PO_4, SO_4, and SiO_3

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994. (2 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	214	M	
^{14}C	55.9	M	
^{59}Ni	5.95	M	
^{60}Co	52.1	M	
^{63}Ni	591	M	
^{79}Se	4.68	M	
^{90}Sr	151,000	E	HDW estimate was 209,000
^{90}Y	151,000	E	Based on ^{90}Sr
^{93}Zr	22.6	M	
^{93m}Nb	16.3	M	
^{99}Tc	310	M	
^{106}Ru	0.0104	M	
^{113m}Cd	120	M	
^{125}Sb	234	M	
^{126}Sn	7.00	M	
^{129}I	0.601	M	
^{134}Cs	2.54	M	
^{137}Cs	171,000	E	HDW estimate was 247,000
^{137m}Ba	162,000	E	Based on ^{137}Cs
^{151}Sm	16,200	M	
^{152}Eu	7.34	M	
^{154}Eu	880	M	
^{155}Eu	445	M	
^{226}Ra	2.38E-04	M	
^{227}Ac	0.00321	M	
^{228}Ra	2.79	M	
^{229}Th	0.0643	M	
^{231}Pa	0.0164	M	
^{232}Th	0.103	M	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994. (2 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}U	15.5	M	
^{233}U	59.5	M	
^{234}U	17.7	M	
^{235}U	0.764	M	
^{236}U	0.227	M	
^{237}Np	1.04	M	
^{238}Pu	4.15	M	
^{238}U	22.5	M	
^{239}Pu	149	M	
^{240}Pu	25.5	M	
^{241}Am	72.9	M	
^{241}Pu	299	M	
^{242}Cm	9.64E-04	M	
^{242}Pu	0.00144	M	
^{243}Am	0.00252	M	
^{243}Cm	1.96E-05	M	
^{244}Cm	3.34E-04	M	

Notes:

[1]S = Sample-based, M = HDW model-based, and E = Engineering assessment-based.

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4.0 RECOMMENDATIONS

All analytical results for the safety screening DQO were well within the safety notification limits. However, the sampling and analysis activities performed for tank 241-BY-111 have not met all requirements for the applicable DQO document. Only partial cores were obtained from the sampling event in 1996 (safety screening DQO requires two full cores). Using partial core, a characterization best-basis inventory was developed for the tank contents.

Table 4-1 summarizes the Project Hanford Management Contractor (PHMC) TWRS Program review status and acceptance of the sampling and analysis results reported in this TCR. All DQO issues required to be addressed by sampling and analysis are listed in column one of Table 4-1. The second column indicates whether the requirements of the DQO were met by the sampling and analysis activities performed. The third column indicates concurrence and acceptance by the program in TWRS that is responsible for the DQO that the sampling and analysis activities performed adequately meet the needs of the DQO. Because the waste at the bottom of the tank was not sampled (see Section B3.1), the safety screening DQO has been only partially completed. The upper part of the waste was sampled and analyzed in accordance with the safety screening DQO and accepted by the responsible TWRS program.

Table 4-1. Acceptance of Tank 241-BY-111 Sampling and Analysis.

Issue	Sampling and Analysis Performed	TWRS[1] Program Acceptance
Safety screening DQO	Partial	Partial
Hazardous vapor screening DQO	Yes	Yes
Organic solvent	Yes	Yes

Note:

[1]PHMC TWRS Program Office

Table 4-2 summarizes the status of PHMC TWRS Program review and acceptance of the evaluations and other characterization information contained in this report. The evaluations specifically outlined in this report are to determine whether the tank is safe, conditionally safe, or unsafe. Column one lists the different evaluations performed in this report. Columns two and three are in the same format as Table 4-1. The manner in which concurrence and acceptance are summarized is also the same as that in Table 4-1. The safety categorization of the tank is listed as "partial" in Table 4-2 because the full depth of the waste was not sampled. However, none of the analyses performed on the core samples indicate any safety problems.

Resampling of tank 241-BY-111 using rotary-mode core sampling is recommended in order to provide the two full depth profiles required by the safety screening DQO. Further evaluation could be performed in lieu of the rotary-mode core sampling. This could be accomplished by sampling and analyzing tanks with similar waste.

One final comment regarding the safety screening DQO needs to be made. The one-sided confidence intervals that were used to determine whether or not ^{239}Pu and DSC were below the DQO stated threshold limit were performed on each individual sample as required by the DQO.

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-BY-111.

Issue	Evaluation Performed	TWRS Program Acceptance
Safety categorization (tank is safe)	Partial	Partial
Hazardous vapor screening DQO	Yes	Yes
Organic solvent	Yes	Yes

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APPENDIX A

HISTORICAL TANK INFORMATION

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APPENDIX A

HISTORICAL TANK INFORMATION

Appendix A describes tank 241-BY-111 based on historical information. For this report, historical information includes any information about the fill history, waste types, surveillance, or modeling data about the tank. This information is necessary for providing a balanced assessment of the sampling and analytical results.

This appendix contains the following information:

- **Section A1.0**: Current status of the tank, including the current waste levels, as well as the stabilization and isolation status of the tank.
- **Section A2.0**: Information about the design of the tank.
- **Section A3.0**: Process knowledge of the tank, that is, the waste transfer history and the estimated contents of the tank based on modeling data.
- **Section A4.0**: Surveillance data for tank 241-BY-111, including surface-level readings, temperatures, and a description of the waste surface based on photographs.
- **Section A5.0**: References for Appendix A.

Historical sampling results (results from samples obtained before 1989) are included in Appendix B.

A1.0 CURRENT TANK STATUS

As of July 3, 1996, tank 241-BY-111 contained an estimated 1740 kL (459 kgal) of waste classified as non-complexed (Hanlon 1997). The solid waste volumes are estimated using a manual tape. The solid waste volume was last updated on April 28, 1982. The amounts of various waste phases in the tank are presented in Table A1-1.

Tank 241-BY-111 is removed from service, as are all single-shell tanks. The tank was removed from the Ferrocyanide Watch List in September 1996 (Kinzer 1996). This tank is categorized as sound with interim stabilization and intrusion prevention completed (Hanlon 1997). The tank is passively ventilated. All monitoring systems were in compliance with documented standards as of January 31, 1997 (Hanlon 1997).

Table A1-1. Tank Contents Status Summary (Hanlon 1997).

Waste Type	kL (kgal)
Total waste	1,740 (459)
Supernatant liquid	0 (0)
Sludge	79 (21)
Saltcake	1,660 (438)
Drainable interstitial liquid	0 (0)
Drainable liquid remaining	0 (0)
Pumpable liquid remaining	0 (0)

A2.0 TANK DESIGN AND BACKGROUND

The 241-BY Tank Farm was constructed from 1948 to 1949 in the 200 East Area. The tank farm contains twelve 100 series tanks. These tanks have a capacity of 2870 kL (758 kgal) and a diameter of 23 m (75 ft). Built according to the second generation design, the 241-BY Tank Farm was designed for nonboiling waste with a maximum fluid temperature of 104 °C (220 °F) (Leach & Stahl 1993). An overflow line, 75 mm (3 in.) in diameter, connects tank 241-BY-111 as the second in a cascaded series of three tanks ending with tank 241-BY-112 (Hanlon 1997). Each tank in the cascade series is set one foot lower in elevation from the preceding tank.

The tank has a dished bottom with a 1.2-m (4-ft) radius knuckle. Tank 241-BY-111 was designed with a primary mild steel liner (ASTM A283 Grade C) and a concrete dome with various risers. The tank is set on a reinforced concrete foundation. A three-ply asphalt waterproofing was applied over the foundation and steel tank. Two coats of primer were sprayed on all exposed interior tank surfaces. The tank ceiling dome was covered with three applications of magnesium zinc fluorosilicate wash. Lead flashing was used to protect the joint where the steel liner meets the concrete dome. Asbestos gaskets were used to seal the risers in the tank dome. The tank was waterproofed on the sides and top with tar and welded wire reinforced gunite (Rutherford 1948).

Tank 241-BY-111 has 19 risers according to the drawings and engineering change notices. The risers range in diameter from 10 cm (4 in.) to 1.1 m (42 in.). Table A2-1 shows numbers, diameters, and descriptions of the risers and the nozzles. A plan view that depicts the riser configuration is shown as Figure A2-1. Riser 4 (10 cm [4 in.] in diameter), riser 12A (30 cm [12 in.] in diameter), and riser 15 (15 cm [6 in.] in diameter) are available for sampling (Lipnicki 1997). A tank cross-section showing the approximate waste level along with a schematic of the tank equipment is in Figure A2-2.

Figure A2-1. Riser Configuration for Tank 241-BY-111.

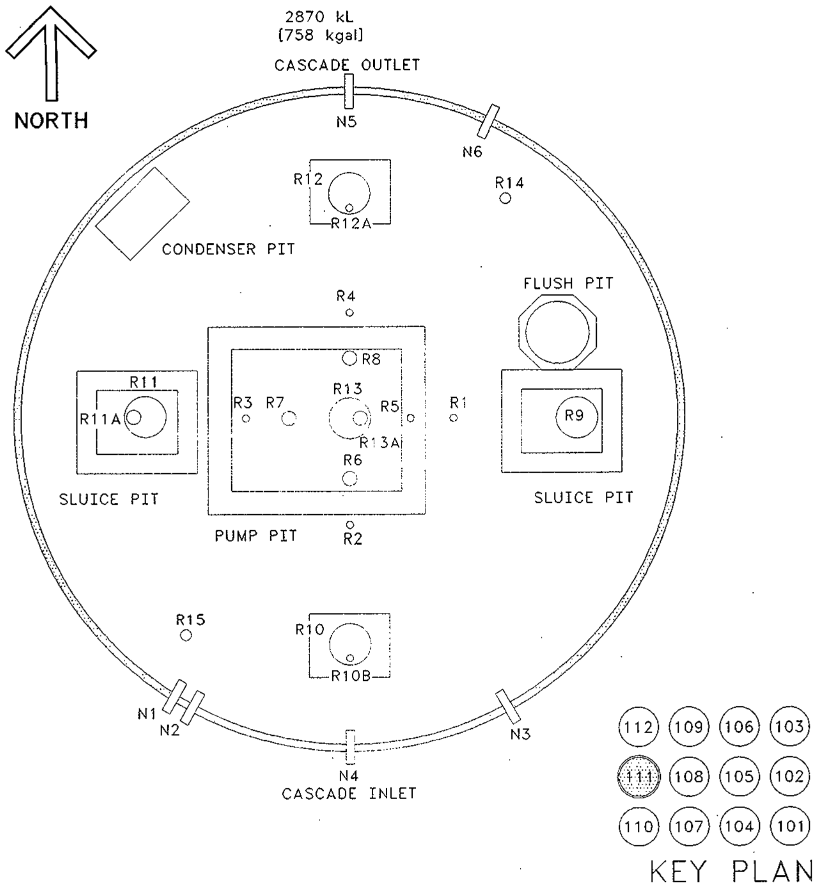


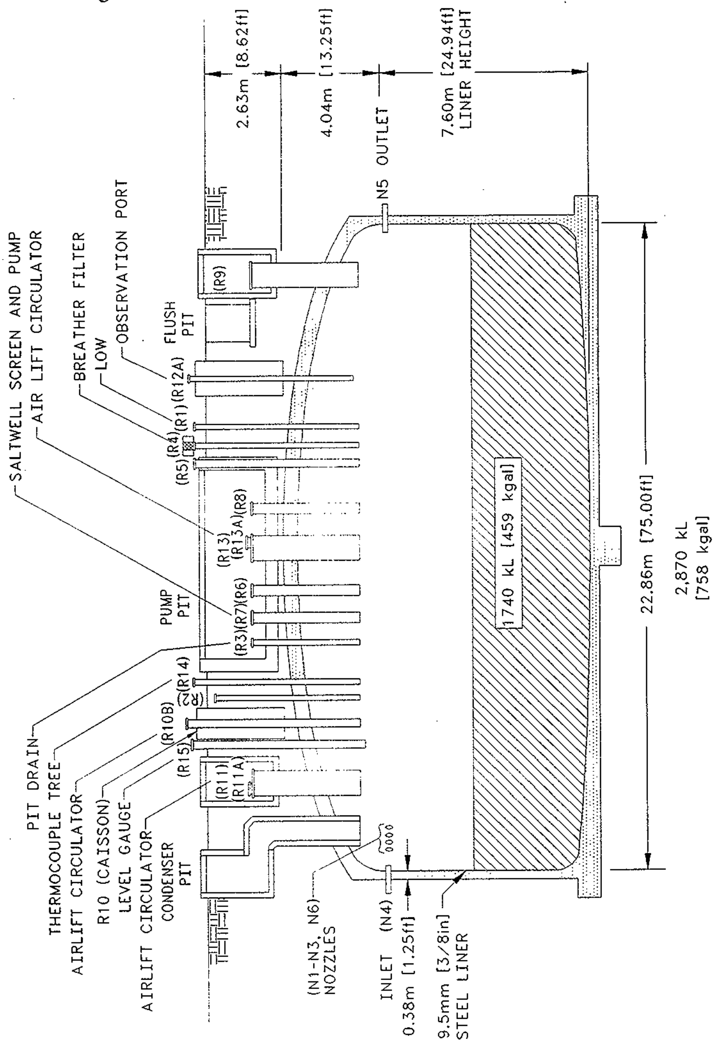
Table A2-1. Tank 241-BY-111 Risers.[1,2,3,4]

Number	Diameter (inches)	Description and Comments
1	4	B-436 Liquid Observation Well (LOW)
2	4	Not Usable, Below Grade
3	4	Pit Drain, Weather Covered
4[5]	4	Breather Filter, G1 Housing
5	12	Cover plate
6	12	Not Usable, Weather Covered
7	12	Salt Well Pump and Screen
8	12	Not Usable, Weather Covered
9	42	Transfer Pump, Weather Covered
10	42	Adapter Plate (Caisson)
10B	12	Airlift Circulator, Blind Flange [Bench Marked Change Engineering Order-36924 December 11, 1986]
11	42	Cover Plate, Weather Covered
11A[6]	12	Airlift Circulator
12	42	Adapter Plate
12A[5]	12	Observation Port [Vapor Assembly on a 12 to 4 Adapter Engineering Change Notice-614494L November 3, 1994]
13	42	Cover Plate, Weather Covered
13A[6]	12	Airlift Circulator
14	6	Thermocouple Tree
15	6	Level Gauge
N1	3	Spare
N2	3	Spare
N3	3	Spare Inlet
N4	3	Inlet
N5	3	Outlet
N6	3	Inlet Line V304, from Diversion Box

Notes:

[1]Alstad 1993
[2]Tran 1993
[3]Vitro 1986
[4]ARCHO 1976
[5]Denotes risers tentatively available for sampling (Lipnicki 1997)
[6]Risers do not appear in any drawings or Engineering Change Notices, but appear in Lipnicki (1997). The risers were confirmed in photographs, dated October 31, 1986, 8606972-012CN and -004CN.2.

Figure A2-2. Tank 241-BY-111 Cross Section and Schematic.



A3.0 PROCESS KNOWLEDGE

The sections below: 1) provide information about the history of the major waste transfers that involved tank 241-BY-111, 2) describe the process wastes that were transferred, and 3) give an estimate of the tank's current contents based on the waste transfer history.

A3.1 WASTE TRANSFER HISTORY

Table A3-1 summarizes the waste transfer history of tank 241-BY-111 (Agnew et al. 1997a). Tank 241-BY-111 first received MW from B Plant in the fourth quarter of 1951. The tank continued to receive MW through the first quarter of 1952. Waste began cascading from tank 241-BY-111 to tank 241-BY-112 during the first quarter of 1952. During the fourth quarter of 1952, the tank received UR waste and again cascaded supernatant to tank 241-BY-112.

The tank received waste water during the second quarter of 1954, and supernatant was sent to tank 241-BX-106. During the fourth quarter of 1954, much of the waste was sent for uranium recovery. Sludge was received from tank 241-BY-112 during the first quarter of 1954. Waste was sluiced from the tank in the first, second, and third quarters of 1955 and sent for uranium recovery. During the first and second quarters of 1955, the tank received more waste water. The tank received metal waste from B Plant and supernatant was received from tank 241-BY-107 in the second quarter of 1956. Supernatant was sent to crib B-016 during the third quarter of 1956. Tank 241-BY-111 received supernatant from tanks 241-C-105 and 241-C-111 during the second quarter of 1957.

Supernatant was sent from tank 241-BY-111 to tank 241-BY-103 during the latter half of 1965 and the first quarters of 1966 and 1968. During the third quarter of 1966, supernatant was sent to tank 241-BY-112; during the second quarter of 1968, supernatant was sent to tank 241-BY-108. Supernatant was received from tank 241-C-102 during the second and third quarters of 1966. Tank 241-BY-111 received PUREX CWP during the fourth quarter of 1967.

Tank 241-BY-111 exchanged evaporator bottoms waste and supernatant from the ITS process with tank 241-BY-112 from the second quarter of 1968 to the first quarter of 1976. During this time, tank 241-BY-111 occasionally received supernatant from tank 241-BY-109.

Waste was sent from tank 241-BY-111 to tank 241-A-102 during the second and third quarters of 1977; during the fourth quarter of 1977, tank 241-BY-111 received waste from tank 241-A-102. A small amount of supernatant was sent to tank 241-BX-105 in 1978. Interstitial liquor was salt-well pumped to tank 241-AW-102 in the third quarter of 1982.

Table A3-1. Tank 241-BY-111 Major Waste Transfers.[1,2] (2 sheets)

Transfer Source	Transfer Destination	Waste Type	Time	Estimated Waste Volume	
				kL	Kgal
B Plant		MW	1951-1952	3,650	964
	241-BY-112	SU	1952	-988	-261
U Plant		UR (TBP)	1952	210	55
		Water	1954	1,930	509
	241-BX-106	SU	1954	-1,930	-509
	U Plant	SL	1954-1955	-5,163	-1,364
		Water	1955	818	216
241-BY-112		SL	1955	1,480	390
B-Plant		MW	1956	98	26
241-BY-107		SU	1956	2,040	539
	Crib B-016	SU	1956	-1,940	-513
241-C-105, 241-C-111		SU	1957	2,510	663
	241-BY-103	SU	1965, 1966, 1968	-5,397	-1,426
241-C-102		SU	1966	2,750	726
	241-BY-112	SU	1966	-53	-14
PUREX		CWP2	1967	49	13
	241-BY-108	SU	1968	-1,440	-379
241-BY-112		EB	1968-1976	4,453	1,203
	241-BY-112	SU	1968-1976	-19,080	-5,041
241-BY-109		SU	1969, 1970	18,360	4,851

Table A3-1. Tank 241-BY-111 Major Waste Transfers.[1,2] (2 sheets)

Transfer Source	Transfer Destination	Waste Type	Time	Estimated Waste Volume	
				kL	Kgal
	241-A-102	SU	1977	-606	-160
241-A-102		SU	1977	397	105
	241-BX-105	SU	1978	-8	-2
	241-AW-102	EVAP	1982	-617	-163

Notes:

MW = metal waste from $BiPO_4$
UR = Uranium Recovery Operation in 222-U, 1952-1957. Created TBP (primary waste) and FeCN (scavenging wastes)
SU = supernatant liquid
SL = sludge
CWP2 = cladding waste PUREX (1961 - 1972)
EB = evaporator bottoms
EVAP = evaporator feed
TBP = Tributyl Phosphate

[1]Agnew et al. 1997a
[2]Because only major waste transfers are listed, the sum of the transfers will not equal the current volume of waste in the tank.

A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS

The historical transfer data used for this estimate are from the following sources:

- The *Waste Status and Transaction Record Summary: WSTRS, Rev. A*, (Agnew et al. 1997a) is a tank-by-tank quarterly summary spreadsheet of waste transactions.

- The *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4* (Agnew et al. 1997b) contains the HDW list, the supernatant mixing model (SMM), the tank layer model (TLM), and the historical tank content estimate (HTCE).

- The HDW list is comprised of approximately 50 waste types defined by concentration for major analyses/compounds for sludge and supernatant layers.

- The TLM defines the sludge and saltcake layers in each tank using waste composition and waste transfer information.

- The SMM is a subroutine within the HDW model that calculates the volume and composition of certain supernatant blends and concentrates.

Using these records, the TLM defines the sludge and saltcake layers in each tank. The SMM uses information from the Waste Status and Transaction Record Summary (WSTRS), the TLM, and the HDW list to describe the supernatants and concentrates in each tank. Together the WSTRS, TLM, SMM, and HDW list determine the inventory estimate for each tank. These model predictions are considered estimates that require further evaluation using analytical data.

Based on the TLM and SMM, tank 241-BY-111 contains a top layer of 1640 kL (433 kgal) BYSltCk above a bottom layer of 100 kL (26 kgal) of MW. Figure A3-1 shows a graph representing the estimated waste type and volume for each waste layer.

The MW (bottom waste layer) should contain, from highest concentration above one weight percent, the following major constituents: uranium, hydroxide, sodium, carbonate, and phosphate. Constituents contained in this layer above a tenth of a weight percent are sulfate, iron, nitrate, and calcium. The BYSltCk layer should contain, from highest concentration above one weight percent, the following constituents: nitrate, sodium, hydroxide, nitrite, aluminum, carbonate, and sulfate. Constituents contained in this layer above a tenth of a weight percent are phosphate, uranium, dibutyl phosphate, citrate, chloride, calcium, chromium, silicate, acetate, and butanol. Radiological activity will be found in this layer due to the quantity of cesium present. Table A3-2 shows an estimate of the expected waste constituents and their concentrations.

Figure A3-1. Tank Layer Model.

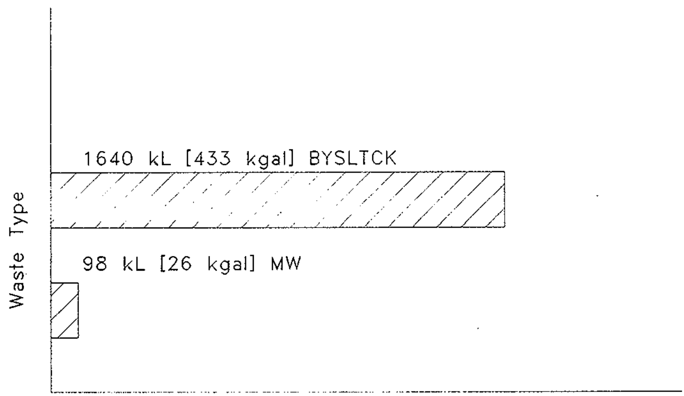


Table A3-2. Historical Tank Inventory Estimate.[1,2] (2 sheets)

Single-Shell Tank 241-BY-111			
Total Inventory Estimate			
Physical Properties			
Total waste	2.84E+06 (kg)(459 kgal)		
Heat load	2.56 (kW)(8.75E+03 Btu/hr)		
Bulk density	1.63 (g/cc)		
Water wt%	36.9		
TOC wt% C (wet)	0.420		
Chemical Constituents	**mole/L**	**ppm**	**kg[3]**
Na^+	12.6	1.78E+05	5.05E+05
Al^{3+}	1.99	3.29E+04	9.34E+04
Fe^{3+} (total Fe)	2.74E-02	935	2.65E+03
Cr^{3+}	5.19E-02	1.65E+03	4.69E+03
Bi^{3+}	8.46E-04	108	307
La^{3+}	1.93E-06	0.164	0.466
Hg^{2+}	3.42E-05	4.20	11.9
Zr (as $ZrO(OH)_2$)	3.20E-05	1.79	5.08
Pb^{2+}	5.35E-03	679	1.93E+03
Ni^{2+}	1.28E-02	460	1.30E+03
Sr^{2+}	0	0	0
Mn^{4+}	3.06E-03	103	292
Ca^{2+}	7.35E-02	1.80E+03	5.12E+03
K^+	3.76E-02	900	2.55E+03
OH^{+-}	9.83	1.02E+05	2.90E+05
NO_3^-	6.18	2.34E+05	6.65E+05
NO_2^-	1.58	4.44E+04	1.26E+05
CO_3^{2-}	0.583	2.14E+04	6.08E+04
PO_4^{3-}	8.74E-02	5.08E+03	1.44E+04
SO_4^{2-}	0.187	1.10E+04	3.12E+04
Si (as SiO_3^{2-})	7.24E-02	1.24E+03	3.53E+03
F^-	5.25E-02	611	1.73E+03
Cl^-	0.124	2.69E+03	7.65E+03
$C_6H_5O_7^{3-}$	2.26E-02	2.61E+03	7.41E+03

Table A3-2. Historical Tank Inventory Estimate.[1,2] (2 sheets)

Single-Shell Tank 241-BY-111			
Total Inventory Estimate			
Chemical Constituents (Cont'd)	mole/L	ppm	kg[3]
EDTA $^{4-}$	5.06E-03	893	2.53E+03
HEDTA $^{3-}$	6.83E-04	115	325
glycolate $^{-}$	1.59E-02	729	2.07E+03
acetate $^{-}$	3.01E-02	1.09E+03	3.09E+03
oxalate $^{2-}$	2.53E-06	0.136	0.387
DBP	2.40E-02	3.08E+03	8.75E+03
butanol	2.40E-02	1.09E+03	3.08E+03
$Fe(CN)_6^{4-}$	0	0	0
NH_3	1.27E-02	132	375
Radiological Constituents			
Pu		0.168 (μCi/g)	1.94 (kg)
U	0.125 (*M*)	1.82E+04 (μg/g)	5.15 E+04 (kg)
Cs^{137}	0.142 (Ci/L)	86.9 (μCi/g)	2.47 E+05 (Ci)
Sr^{90}	0.12 (Ci/L)	73.5 (μCi/g)	2.09 E+05 (Ci)

Notes:
TOC = total organic carbon

[1]Agnew et al. 1997b
[2]These predictions have not been validated and should be used with caution.
[3]Differences exist among the inventories in this column and the inventories calculated from the two sets of concentrations.

A4.0 SURVEILLANCE DATA

Tank 241-BY-111 surveillance includes surface level measurements (liquid and solid) and temperature monitoring inside the tank (waste and vapor space). The data provide the basis for determining tank integrity.

Liquid level measurements may indicate if there is a major leak from a tank. Solid surface level measurements provide an indication of physical changes and consistency of the solid layers.

A4.1 SURFACE LEVEL READINGS

The waste surface level for tank 241-BY-111 is measured by a manual tape located in riser 15. On July 3, 1996, the waste surface level was 4.13 m (163 in.), as measured by the manual tape. A graphical representation of the volume measurements is presented as a level history graph in Figure A4-1.

A4.2 DRY WELL READINGS

Tank 241-BY-111 has 4 dry wells. Dry wells 22-11-01 (active before 1990, current readings >200 c/s) and 22-11-09 (active before 1990, current readings <200 c/s) have readings greater than the 50 c/s background radiation. A large increase in dry well reading may indicate a leak from the tank.

A4.3 INTERNAL TANK TEMPERATURES

Tank 241-BY-111 contains one thermocouple tree located in riser 14. The liquid observation well (LOW) in riser 1 was also used to record temperature data. The Surveillance Analysis Computer System (SACS) has data from the LOW and the thermocouple tree located in riser 14, with 6 thermocouples to monitor the waste temperature. No elevation information is given for the temperature data taken in the LOW. Temperature data from the LOW were recorded from November 1989 through December 1996 and were obtained from the SACS. The average temperature of the data is 30.2 °C (86.3 °F) with a minimum of 23 °C (73.4 °F) and a maximum of 31.7 °C (89.1 °F). The elevations of the thermocouples on the thermocouple tree in riser 14 are available. Temperature data were recorded from November 1974 through December 1996 also in SACS. The average temperature of the SACS data is 25.5 °C (77.9 °F), the minimum is 14 °C (57 °F), and the maximum is 43.9 °C (111 °F). The average temperature of the SACS data over the last year (December 1995 through December 1996) was 24.7 °C (76.5 °F), the minimum was 17.9 °C (64.2 °F), and the maximum was 30.5 °C (86.9 °F). A graph of the weekly high temperatures can be found in Figure A4-2. Plots of the individual thermocouple readings can be found in the BY Tank Farm Supporting Document for the HTCE (Brevick et al. 1996b).

A4.4 TANK 241-BY-111 PHOTOGRAPHS

The October 1986 photographic montage of tank 241-BY-111's interior shows a dry rough surface of saltcake (Brevick et al. 1996a). Various pieces of equipment and risers are identifiable. The waste level has not changed since the photographs were taken; therefore, this photographic montage should accurately represent the current appearance of the tank's waste.

Figure A4-1. Tank 241-BY-111 Level History.

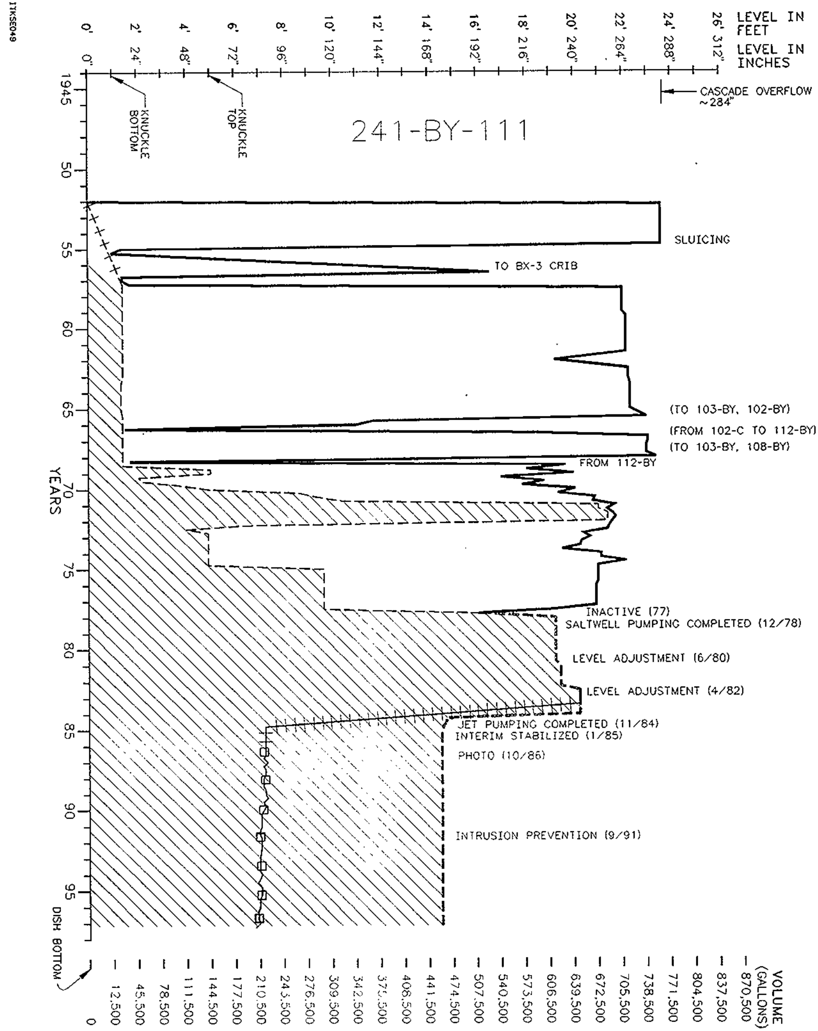
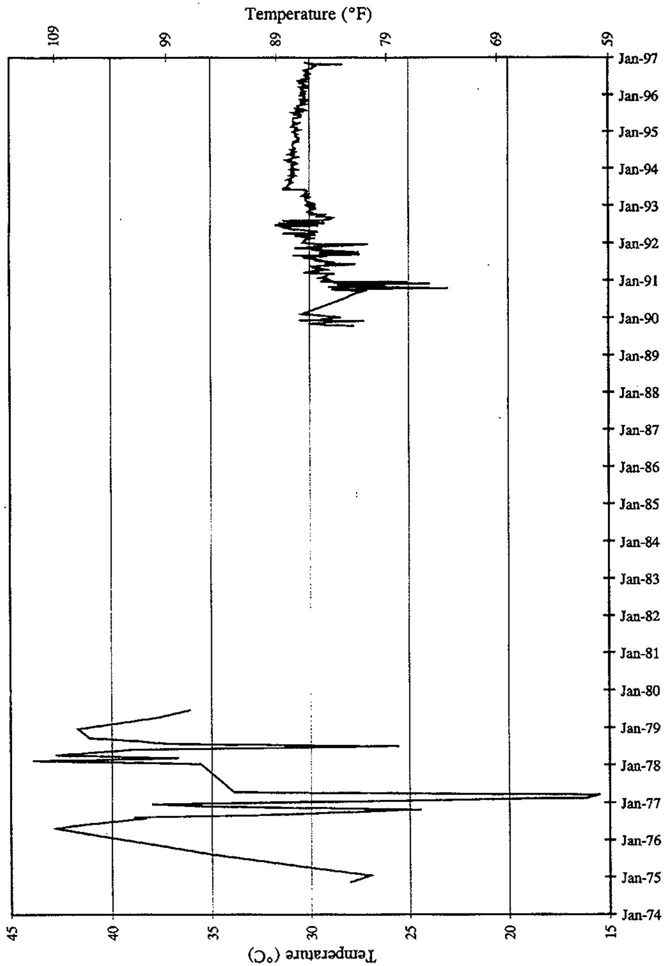


Figure A4-2. Tank 241-BY-111 Weekly High Temperature Plot.



A5.0 APPENDIX A REFERENCES

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APPENDIX B

SAMPLING OF TANK 241-BY-111

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APPENDIX B

SAMPLING OF TANK 241-BY-111

Appendix B provides sampling and analysis information for each known sampling event for tank 241-BY-111 and provides an assessment of the auger sample results.

- **Section B1.0**: Tank Sampling Overview
- **Section B2.0**: Analytical Results
- **Section B3.0**: Assessment of Characterization Results
- **Section B4.0**: References for Appendix B.

Future sampling of tank 241-BY-111 will be appended to the above list.

B1.0 TANK SAMPLING OVERVIEW

This section describes the June 1996 sampling and analysis events for tank 241-BY-111. Core samples were taken to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995), *Data Quality Objective for Tank Hazardous Vapor Safety Screening* (Osborne and Buckley 1995) and the organic solvent screening issue (Cash 1996). The sampling and analyses were performed in accordance with the *Tank 241-BY-111 Rotary Mode Core Sampling and Analysis Plan* (Kruger 1996).

Two push mode core segments were removed between August and September 1996 to satisfy requirements for *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995). The sampling and analyses were performed in accordance with the *Tank 241-BY-111 Rotary Mode Core Sampling and Analysis Plan* (Kruger 1997).

Vapor samples were used in March 1993 and November 1994 to satisfy the *Data Quality Objective for Tank Hazardous Vapor Safety Screening* (Osborne and Buckley 1995) and the organic solvent screening issue (Cash 1996).

Sampling and analytical requirements from the safety screening and vapor screening DQOs are summarized in Table B1-1.

Table B1-1. Integrated Data Quality Objective Requirements for Tank 241-BY-111.[1]

Sampling event	Applicable DQOs	Sampling Requirements	Analytical Requirements
Vapor sampling	Organic Solvent Screening 93-5 Vapor Issue (Cash 1996) -Health and Safety Vapor DQO (Osborne and Buckley 1995)	Steel canisters, Triple Sorbent Traps, Sorbent Trap Systems	Flammable Gas Organic Vapors Permanent Gases
Push Mode Core Sampling	-Safety Screening DQO	Core samples from 2 risers separated radially to the maximum extent possible Combustible gas measurement	Flammability, Energetics, Moisture, Total alpha activity, Density

B1.1 1996 CORE SAMPLING EVENT

B1.1.1 Sampling and Handling

Push mode core segments were removed from risers 15 and 12A between August 13, 1996, and September 3, 1996. Segments were received and extruded at 222-S Laboratory. Analyses were performed in accordance with *Tank 241-BY-111 Rotary Mode Core Sampling and Analysis Plan* (Kruger 1996).

Two cores with nine segments each were expected from this tank. Sampling problems prevented the acquisition of complete cores. For the first core, six core segments were removed from tank 241-BY-111 riser 15 (Core 168) between August 13, 1996, and August 21, 1996. All segments were received by 222-S Laboratory between September 10, 1996 and September 20, 1996. Several attempts were made to obtain segments 5 and 6. Segments 5, 5A, 6, 6A, and 6B contained 3 inches or less of sample. Segment 6B did not have enough sample to retain.

For the second core, Core 171 (Riser 12A), segment 1 through 7 were removed between August 29, 1996 and September 3, 1996. All segments were received by 222-S Laboratory between September 26, 1996 and October 3, 1996. Segments 1 through 5 contained 3 inches or less of sample. Segment 2 did not have any sample present.

In addition to segment samples, a field blank and a lithium bromide blank were sent to the 222-S Laboratory for analysis.

The core samples were shipped to the 222-S Laboratory for subsampling and analysis. Samples were assigned LABCORE numbers and were subjected to visual inspection for color, clarity, and solids content. The radiation dose rate on contact was also measured. All drainable liquid samples were collected in one single jar and analyzed. Some of the solid samples were divided into subsegments. The material was homogenized and subsampled for laboratory analyses and archiving. Tables B1-2a and B1-2b gives the subsampling scheme and sample description for core 168 and 171, respectively.

Table B1-2a. Sample Receipt and Extrusion Information for Tank 241-BY-111, Core 168.

Customer Id	Segment	Date Sampled	Date Received	Date Extruded	Inches Extruded[1]	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
Blank H2O	Blank	8/16/96	9/20/96	9/27/96	0.0	250.2--Drainable	0.0	Drainable liquid was clear and colorless.
LiBr Blank	n/a	8/21/96	9/10/96	n/a	n/a	n/a	n/a	Hydrostatic head fluid blank analyzed for lithium and bromide ions only.
96-483	1	8/13/96	9/10/96	9/18/96	5.5	0.0	28.2--Qtr. Seg. A 63.7--Qtr. Seg. B	Solids were dark brown to white and resembled a dry saltcake.
96-484	2	8/19/96	9/10/96	9/18/96	6.0	0.0	77.7--Lower half	Solids were brown to white and resembled a dry saltcake.
96-485	3	8/19/96	9/10/96	9/18/96	5.5	0.0	87.3--Lower half	Solids were brown and resembled a dry saltcake.
96-486	4	8/19/96	9/20/96	9/30/96	9.0	0.0	119-5--Lower half	Solids were brown and resembled a dry saltcake.
96-487	5	8/19/96	9/20/96	9/30/96	1.0	0.0	11.7--Lower half	Solids were brown and resembled a dry saltcake.
96-487A	5A	8/19/96	9/20/96	9/30/96	3.0	Unmeasurable	77.0--Lower half	Drainable liquid was brown and opaque. Solids were brown to white and resembled a wet saltcake. Separation of solids and liquids was not possible. All of the sample was subsampled as a solid.
96-488	6	8/20/96	9/20/96	9/30/96	0.0	78.7--Drainable 41.4--Liner	0.0	Drainable liquid was yellowish green and opaque. Liner liquid was yellow and cloudy.
96-488A	6A	8/20/96	9/10/96	9/23/96	0.5	92.5--Liner	11.0--Lower half	Solids were gray and resembled a moist saltcake.
96-488B	6B	8/21/96	9/10/96	9/23/96	0.0	0.0	0.0	Less than 3 mL liner liquid. Did not retain.

Notes:

n/a = not applicable

[1]Approximate inches extruded

Dates are provided in mm/dd/yy format.

Table B1-2b. Sample Receipt and Extrusion Information for Tank 241-BY-111, Core 171.

Customer Id	Segment	Date Sampled	Date Received	Date Extruded	Inches Extruded[1]	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
96-497	1	8/29/96	9/26/96	9/30/96	2.0	0.0	58.7--Lower half	Solids were gray and resembled a dry saltcake.
96-498	2	8/29/96	9/26/96	9/30/96	0.0	0.0	0.0	No sample present.
96-499	3	8/29/96	9/26/96	10/2/96	1.5	0.0	14.7--Lower half	Solids were gray and white and resembled a dry saltcake.
96-500	4	8/29/96	9/26/96	10/2/96	3.0	0.0	92.8--Lower half	Solids were brown and resembled a wet saltcake.
96-501	5	8/29/96	9/26/96	10/2/96	3.0	84.3--Drainable	99.7--Lower half	Solids were brown and resembled a wet saltcake. Drainable liquid was greenish brown and opaque.
96-502	6	8/29/96	9/26/96	10/2/96	10.0	146.7--Drainable	95.4--Lower half 110.2--Upper half	Lower half solids were bluish gray and resembled a wet saltcake. Upper half solids were greenish gray and resembled a wet saltcake.
96-503	7	9/3/96	10/3/96	10/10/96	14.0	0.0	226.3--Lower half 134.3--Upper half	Lower half solids were grayish black and resembled a wet saltcake. Upper half solids were gray and resembled a wet saltcake.

Note:

[1]Approximate inches extruded

Dates are provided in mm/dd/yy format.

B1.1.2 Sample Analysis

The analyses performed on the core samples were limited to those required by the safety screening DQO. The analyses required by the safety screening DQO included analyses for thermal properties by DSC, moisture content by TGA, and content of fissile material by total alpha activity analysis. The hydrostatic head fluid (HHF) analysis requires lithium and bromide analysis by ICP and IC.

Differential scanning calorimetry and TGA were performed on 8.665-mg to 45.550-mg samples. Quality control (QC) tests included performing the analyses in duplicate and the use of standards.

Total alpha activity measurements were performed on samples that had been fused in a solution of potassium and then dissolved in acid. The resulting solution was then dried on a counting planchet and counted in an alpha proportional counter. Quality control tests included standards, spikes, blanks, and duplicate analyses.

Ion chromatography was performed on samples that had been prepared by water digestion. Quality control tests included standards, spikes, blanks, and duplicate analyses. The TSAP required that the full suite of IC analytes be measured.

Inductively coupled plasma spectrometry was performed on samples that had been prepared by a fusion procedure, followed by dissolution in acid. Quality control tests included standards, blanks, spikes, and duplicate analyses. The TSAP required that the full suite of ICP elements be analyzed.

All reported analyses were performed in accordance with approved laboratory procedures. A list of the sample numbers and applicable analyses is presented in Table B1-3. The sample preparation procedure numbers and analysis procedure numbers are presented in Table B1-4.

Table B1-3. Tank 241-BY-111 Sample Analysis Summary. (3 sheets)

Riser	Sample Identification	Sample Portion	Sample Number	Analyses
15	Core 168	Whole	S96T004945	ICP, IC
			S96T005153	ICP, IC
			S96T005298	Alpha rad, DSC/TGA, SpG, ICP, IC
			S96T005314	Alpha rad, TIC/TOC, DSC/TGA, SpG, ICP, IC
			S96T005319	ICP, IC
			S97T000007	TIC/TOC
		Lower sample	S96T005147	Bulk density
			S96T005148	TIC/TOC, TGA, DSC
			S96T005150	Alpha, ICP
			S96T005151	IC
			S96T005155	Bulk density
			S96T005157	TIC/TOC, TGA, DSC
			S96T005158	TIC/TOC, TGA, DSC
			S96T005160	Alpha, ICP
			S96T005161	Alpha, ICP
			S96T005162	IC
			S96T005163	IC
			S96T005300	Bulk density
			S96T005301	TIC/TOC, TGA, DSC
			S96T005304	TIC/TOC, TGA, DSC
			S96T005305	Alpha, ICP
			S96T005306	Alpha, ICP
			S96T005307	IC
			S96T005308	IC
			S96T005309	Bulk density
			S96T005310	TIC/TOC, DSC/TGA
			S96T005311	Alpha, ICP
			S96T005312	IC

Table B1-3. Tank 241-BY-111 Sample Analysis Summary. (3 sheets)

Riser	Sample Identification	Sample Portion	Sample Number	Analyses
15 (Cont'd)	Core 168 (Cont'd)	Subsegment B	S96T005165	Bulk density
		Subsegment A top	S96T005166	TIC/TOC, TGA, DSC
		Subsegment B	S96T005167	TIC/TOC, DSC/TGA
		Subsegment A top	S96T005168	ICP
		Subsegment B	S96T005169	Alpha, ICP
		Subsegment A top	S96T005170	IC
		Subsegment B	S96T005171	IC
12A	Core 171	Whole	S96T005346	Alpha rad, TIC/TOC, TGA, SpG, ICP, DSC, IC
			S96T005357	Alpha rad, TIC/TOC, TGA, SpG, ICP, DSC, IC
		Upper sample	S96T005349	TIC/TOC, TGA, DSC
			S96T005352	ICP
			S96T005354	IC
			S96T005383	TIC/TOC, TGA, DSC
			S96T005387	ICP
			S96T005389	IC
		Lower sample	S96T005320	Bulk density
			S96T005321	TIC/TOC, DSC/TGA
			S96T005323	Alpha, ICP
			S96T005324	IC
			S96T005334	Bulk density
			S96T005335	TIC/TOC, TGA, DSC
			S96T005336	TIC/TOC, TGA, DSC
			S96T005337	Alpha, ICP
			S96T005338	Alpha, ICP
			S96T005339	IC
			S96T005340	IC
			S96T005341	Bulk density
			S96T005342	TIC/TOC, TGA, DSC
			S96T005344	IC

Table B1-3. Tank 241-BY-111 Sample Analysis Summary. (3 sheets)

Riser	Sample Identification	Sample Portion	Sample Number	Analyses
12A (Cont'd)	Core 171 (Cont'd)	Lower sample (Cont'd)	S96T005348	Bulk density
			S96T005350	TIC/TOC, TGA, DSC
			S96T005353	Alpha, ICP
			S96T005355	IC
			S96T005382	Bulk density
			S96T005384	TIC/TOC, TGA, DSC
			S96T005388	Alpha, ICP
			S96T005390	IC
			S97T000031	Alpha, ICP

Note:

SpG = specific gravity

Table B1-4. Analytical Procedures.

Analysis	Matrix	Preparation Procedure +	Analysis Procedure
DSC	Solid liquid	n/a	LA-514-113 Rev. C-1 LA-514-114 Rev. D-0
TGA	Solid liquid	n/a	LA-514-114 Rev. D-0 LA-560-112 Rev. B-1
Density	Solid	n/a	LO-160-103 Rev. B-0
AT	Solid liquid	LA-549-141 Rev. F-0[1] n/a	LA-508-101 Rev. E-1
Sp.G.	Liquid	n/a	LA-510-112 Rev. C-3
IC	Solid liquid	LA-504-101 Rev. E-0[2] n/a	LA-533-105 Rev. D-1
ICP	Solid liquid	LA-549-141 Rev. F-0[1] n/a	LA-505-151 Rev. D-3 LA-505-161 Rev. B-1
TOC	Liquid	n/a	LA-342-100 Rev. E-0
TIC	Liquid	n/a	LA-342-100 Rev. E-0

Notes:

AT = alpha total
Density = bulk density

[1]fusion digest
[2]water digest

B1.2 VAPOR SAMPLING EVENTS

B1.2.1 1996 Vapor Sampling Event

A vapor phase measurement was taken prior to and during the August 1996 core sampling of tank 241-BY-111. These measurements supported the safety screening DQO (Dukelow et al. 1995) The vapor phase screening was taken for flammability issues. The vapor phase measurements were taken 6.1 m (20 ft) below riser 6 in the dome space of the tank and results were obtained in the field (that is, no gas sample was sent to the laboratory for analysis). The results of the vapor phase measurements are provided in Table B2-2.

B1.2.2 1993 Vapor Sampling Event

A vapor phase measurement was taken on March 25, 1993 (Pingel 1993) and the results are reported in Table B2-2.

B1.2.3 1994 Vapor Sampling Event

The tank 241-BY-111 headspace was sampled in May 1994 and November 1994 for gases and vapors to address flammability and industrial hygiene concerns. Results unique to the May 1994 event and essentially all results from the November 1994 event have been reported (Huckaby and Bratzel 1995).

B1.2.4 Historical Sampling Event

There have been no other sampling events before 1993 vapor sampling in tank 241-BY-111.

B2.0 ANALYTICAL RESULTS

B2.1 OVERVIEW

This section summarizes the sampling and analytical results associated with the June 1996 sampling and analysis of tank 241-BY-111. The total alpha activity, percent water, energetics, IC, and ICP analytical results associated with this tank are presented in Table B2-1. These results are documented in Nuzum (1997).

Table B2-1. Analytical Presentation Tables.

Analysis	Table Number
Radionuclide analyses	B2-5
Thermodynamic analyses	B2-6 and B2-7
Physical properties	B2-8 and B2-9
Inorganic analysis	B2-10 through B2-54
Total inorganic carbon	B2-55
Total organic carbon	B2-56

The four QC parameters assessed in conjunction with the tank 241-BY-111 samples were standard recoveries, spike recoveries, duplicate analyses (RPDs), and blanks. The QC criteria specified in the TSAP (Kruger 1996) were 75 to 125 percent recovery for spikes. The QC criteria were ≤20 percent for RPDs. The only QC parameter for which limits are not specified in the TSAP is blank contamination. The limits for blanks are set forth in guidelines followed by the laboratory, and all data results presented in this report have met those guidelines. Sample and duplicate pairs in which any of the QC parameters were outside of these limits are footnoted in the sample mean column of the following data summary tables with an a, b, c, d, e, or f as follows:

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

In each table, the "Mean" column is the average of the result and duplicate values. All values, including those below the detection level (denoted by the less-than symbol, "<"), were averaged. If both sample and duplicate values were non-detected, the mean is expressed as a non-detected value. If one value were detected while the other were not, the mean is expressed as a detected value. If both values were detected, the mean is expressed as a detected value.

B2.2 RADIONUCLIDE ANALYSES

Total alpha activity analyses were performed on direct liquid, core composite subsamples, and the field blank. The solid core composite subsamples were prepared for analysis by performing a fusion digest in duplicate. The sample results for total alpha are given in Table B2-5.

Liquid AT results were below the total alpha activity notification limit of 61.5 μCi/mL. All solid AT results were below the total alpha activity notification limit of 32.7 μCi/g (based on a bulk density of 1.88 g/mL).

As required by the TSAP, AT analyses were requested for lower half segments only. Segment 1 of core 168 was subsampled into two quarter segments A and B, and AT analysis was requested for quarter segment B.

The relative percent difference (RPD) between sample and duplicate exceeded 20 percent for five of seventeen subsamples. Count replicates and similar rerun data in comparison to original samples analyses indicate the high RPDs are due to low sample alpha activity. Continuing reruns were not requested. In addition, a high spike recovery of 46.5 percent was reported for sample S96T005323 (Nuzum 1997). Spike matrix interference was the effect of self-absorption by solids left on the planchet after drying.

B2.3 THERMODYNAMIC ANALYSES

As required by the safety screening and flammable gas DQOs, TGA, and DSC were performed on the solids and liquids.

B2.3.1 Thermogravimetric Analysis

Thermogravimetric analysis measures the mass of a sample while its temperature is increased at a constant rate. Nitrogen is passed over the sample during heating to remove any released gases. Any decrease in the weight of a sample during TGA represents a loss of gaseous matter from the sample, either through evaporation or through a reaction that forms gas phase products. The moisture content is estimated by assuming that all TGA sample weight loss up to a certain temperature (typically 150 to 200 °C [302 to 392 °F]) is due to water evaporation. The temperature limit for moisture loss is chosen by the operator at an inflection point on the TGA plot. Other volatile matter fractions can often be differentiated by inflection points as well.

Tank 241-BY-111 samples were analyzed by TGA using either procedure LA-514-114, Rev. D-0 on a Perkin-Elmer[1] TGA 7 instrument, or procedure LA-560-112, Rev. B-1 on a Mettler[2] TG 50 instrument. The TGA results for tank 241-BY-111 are presented in Table B2-6. All samples exhibited a large weight loss between the ambient temperature and 200 °C (392 °F). The weight percent water values for the drainable liquid and solid samples were between 12.0 and 54.3. RPD between sample and duplicate exceeded 20 percent for three of twenty subsamples. Lower half segments 3 (S96T005157), 4 (S96T005301), and 6A (S96T005558) of core 168 reported RPDs of 37.9 percent, 40.7 percent, and 43.4 percent, respectively. Results for both of these subsamples were near the detection limit of the method, and precision was compromised. Rerun analyses were requested only for sample number S96T005158. The reported RPD for the rerun result was 3.0 percent (Nuzum 1997).

B2.3.2 Differential Scanning Calorimetry

In a DSC analysis, heat absorbed or emitted by a substance is measured while the temperature of the sample is heated at a constant rate. Nitrogen is passed over the sample material to remove any gases being released. The onset temperature for an endothermic or exothermic event is determined graphically.

[1]Perkin-Elmer is a trademark of Perkins Research & Mfg. Co., Inc., Canoga Park, California.

[2]Mettler is a trademark of Mettler Instrument Corporation, Anaheim, California.

The DSC analyses for tank 241-BY-111 were performed using either procedure LA-514-113, Rev. C-1 on a Mettler DSC 20 instrument or procedure LA-514-114, Rev. D-0 on a Perkin-Elmer DSC 7 instrument. No sample exceeded the safety screening DQO decision criteria threshold of 480 J/g. The highest individual sample for solid was 312 J/g. The upper limit of a 95 percent confidence interval on the mean for each sample was calculated and no sample exceeded the safety screening DQO decision criteria threshold of 480 J/g. Relative percent difference between sample and duplicate exceeded 20 percent on six of twenty subsamples. One of these six subsamples, lower half segment 6 of core 171 (S96T005350), was run in triplicate. All six subsamples showed small exotherm peaks. At such levels, the precision of the instrument is compromised, resulting in elevated RPDs (Nuzum 1997). DSC results are presented in Table B2-7.

B2.4 DENSITY AND SPECIFIC GRAVITY

Bulk density analysis was performed on seven of fourteen solid subsamples. As required by the TSAP (Kruger 1996), bulk density was requested only on lower half segments. Segment 1 of core 168 was subsampled into two quarter segments A and B, and bulk density was requested for quarter segment B (S96T005165). Bulk density could not be determined for segment 4 of core 168 (S96T005300) and segment 1 of core 171 (S96T005320) due to subsample dryness. There was not enough sample to analyze segment 3 of core 168 (S96T005155).

Results from bulk density tests ranged from 0.91 g/mL to 1.88 g/mL. The bulk density of 0.91 g/mL for the segment 1 of core 168 does not correspond to the rest of the sample results which ranged from 1.56 g/mL to 1.88 g/mL. Rerun for this sample was not possible due to the lack of sample material. The highest bulk density result of 1.88 g/mL was used to calculate the solid total alpha activity notification limit for this tank (32.7 μCi/g).

Specific gravity results ranged from 1.41 to 1.44 for drainable liquid. There were no exceptions to the quality control parameters stated in the TSAP for these subsamples (Nuzum 1997). Bulk density and specific gravity results are presented in Tables B2-8 and B2-9.

B2.5 INORGANIC ANALYSES

The ICP and IC analyses were performed for the anions and cations respectively. In the sections below, a table is provided for each analyte.

B2.5.1 Inductively Coupled Plasma

The ICP analyses were performed per procedures LA-505-151, Rev. D-3, or LA-505-161, Rev. B-1, depending on the ICP instrument used. A full suite of analytes were reported. Phosphorus was analyzed as a cross-check for the phosphate results reported from IC analyses.

The liquid subsamples were prepared for analysis by an acid adjustment of the direct subsample. Solid subsamples were prepared for analysis by performing both an acid digest and a fusion.

Only the QC for requested analyte, Li, was reviewed for this report. Other "opportunistic" analyte results are included in this appendix. These analytes do not have customer defined QC parameters and are not discussed.

The concentrations of metals in the samples are shown in Tables B2-10 through B2-46. The results from two preparation methods, fusion and acid, are presented for the metals.

B2.5.2 Ion Chromatography

The IC analyses were performed on direct subsamples of liquid samples. The solid subsamples were prepared for analysis by performing a water digest. Samples for ion chromatography were performed in duplicate per procedure LA-533-105, Rev. D-1. All analytes reported by the IC instrument were requested.

Only bromide (Br) analyte results were considered in this report. There were no exceptions to the QC parameters stated in the TSAP for these subsamples. These analytes do not have customer defined QC parameters and are not discussed. IC analyses results are given in Tables B2-47 through B2-54.

B2.6 TOTAL INORGANIC CARBON AND TOTAL ORGANIC CARBON

Total inorganic carbon (TIC) and total organic carbon (TOC) results are presented in Tables B2-55 and B2-56. There were no customer defined TIC QC parameters. For TOC, RPD between sample and duplicate exceeded 20 percent for two of 19 subsamples. One of these two subsamples lower half segment 6A of Core 168 (S96T005158), was run in triplicate. The RPD between the result and triplicate was 4 percent which was well within the QC parameter. Two of 19 subsample spike recoveries were out of the QC parameter of 75 to 125 percent recovery. Segment 4 of Core 168 (S96T005301) was run in triplicate.

B2.7 VAPOR PHASE MEASUREMENT

B2.7.1 1996 Vapor Sampling Event

The vapor phase screening was taken for flammability issues. The vapor phase measurements were taken 6.1 m (20 ft) below riser 6 in the dome space of the tank and results were obtained in the field (that is, no gas sample was sent to the laboratory for analysis). The results (Table B2-2) of the vapor phase measurements indicates that there is no flammability concerns.

B2.7.2 1993 Vapor Sampling Event

A vapor phase measurement was taken in March 25, 1993 (Pingel 1993) and the results are reported in Table B2-2. The vapor phase measurements indicate that there are no flammability concerns.

Table B2-2. Results of Vapor Phase Measurements of Tank 241-BY-111.

Measurement	Results	
	March 25, 1993	August 13, 1996 to August 20, 1996
Total organic carbon	6.1 ppm	5.8 ppm
Lower explosive limit (LEL)	0%	0.3% of LEL
Oxygen	20.6%	20.9%
Ammonia	8.5 ppm	51 ppm
HCN	0 ppm	0 ppm

B2.7.3 1994 Vapor Sampling Event

The tank 241-BY-111 headspace was sampled in May 1994 and November 1994 for gases and vapors to address flammability and industrial hygiene concerns. It was determined that no headspace constituents exceeded the flammability or industrial hygiene notification limits specified in the current *Vapor Sampling and Analysis Plan* (Homi 1995).

Analytical results of sorbent trap and SUMMA[3] canister tank air samples for selected inorganic gases and vapors are given in Table B2-3 in parts per million by volume (ppmv) in dry air.

[3]SUMMA is a trademark of Molectrics, Inc., Cleveland, Ohio.

Table B2-3. Tank 241-BY-111 Inorganic Gas and Vapor Concentrations Analyses by Pacific Northwest National Laboratory.

Compound	CAS[1] Number	Sample Type	Number of Samples	Average (ppmv)
Ammonia, NH_3	7664-41-7	Sorbent Trap	6	59
Carbon Dioxide[2], CO_2	124-38-9	SUMMA™	3	219
Carbon Monoxide[2], CO	630-08-0	SUMMA™	3	<67
Hydrogen[2], H_2	1333-74-0	SUMMA™	3	<160
Nitric Oxide, NO	10102-43-9	Sorbent Trap	6	≤ 0.15
Nitrogen Dioxide, NO_2	10102-44-0	Sorbent Trap	6	≤ 0.15
Nitrous Oxide[2], N_2O	10024-97-2	SUMMA™	3	<67
Water Vapor, H_2O	7732-18-5	Sorbent Trap	6	9,830 (6.9 mg/L)

Notes:

[1]CAS = Chemical Abstracts Service.

[2]PNNL SUMMA™ analyses for inorganic compounds were not completed until 80 days after sample collection, and exceeded the 60-day administratively chosen holding time (Keller 1994).

Listed in Table B2-4 are five organic compounds positively identified and quantitated in SUMMA™ canister samples, and the methane analyses result. Methane was analyzed with the inorganic gases, because it is not detectable by the TO-14 method. Of the original 40 TO-14 analytes, only trichlorofluoromethane was detected above the 0.002 ppmv quantitation limit, and only 4 of the 15 additional target analytes were above the 0.005 ppmv method quantitation limit. Averages reported are from analyses of three SUMMA™ canister samples (Huckaby and Bratzel 1995). The Table B2-4 analytes do not individually or cumulatively represent a flammability hazard.

Table B2-4. Tank 241-BY-111 Quantatively Measured Organic Compounds in SUMMA™ Samples.[1]

Cmpd #	Compound	CAS Number	Average[2] (ppmv)	Standard Deviation (ppmv)	RSD (%)
1	Trichlorofluoromethane	75-69-4	0.129	0.007	6
2	Propanone (acetone)	67-64-1	1.55	0.10	6
3	2-Butanone	78-93-3	0.106	0.003	3
4	n-Heptane	142-82-5	0.040	0.001	15
5	Toluene	108-88-3	0.044	0.003	6
6	Methane[3]	74-82-8	<61.0	—	—

Notes:

CAS = chemical abstract service
RSD = relative standard deviation

[1]Analyses were not completed until 80 days after sample collection, and exceeded the 60-day administratively chosen holding time (Keller 1994).
[2]Average of three samples.
[3]Methane analyses were not completed until 76 days after sample collection, and exceeded the 60-day administratively chosen holding time (Keller 1994).

B2.8 ANALYTICAL DATA TABLES

For most analytes (except for some physical and rheological measurements), the data tables consist of six columns. The first column lists the sample number. Note that for each primary/duplicate pair, the sample number is for the primary result. The second column lists the core from which the samples were derived. The third column lists the sample portion from which the aliquots were taken. The final three columns display the primary and duplicate analytical values and a mean for each sample/duplicate pair.

Table B2-5. Tank 241-BY-111 Analytical Results: Total Alpha. (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
S96T005169	168: 1	Subsegment B	0.0602	0.0474	0.0538[QC:e]
S96T005150	168: 2	Lower half	0.751	<0.274	<0.5125[QC:e]
S96T005160	168: 3	Lower half	<0.389	<0.291	<0.34[QC:e]

Table B2-5. Tank 241-BY-111 Analytical Results: Total Alpha. (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
S96T005305	168: 4	Lower half	<0.296	<0.255	<0.2755
S96T005306	168: 5	Lower half	0.0359	0.0475	0.0417[QC:e]
S96T005311	168: 5A	Lower half	0.03	0.0228	0.0264[QC:c,e]
S96T005161	168: 6A	Lower half	0.00319	0.00356	0.003375[QC:c]
S96T005323	171: 1	Lower half	6.640E-04	0.00105	8.570E-04[QC:c,e]
S96T005337	171: 3	Lower half	0.0583	0.0561	0.0572
S96T005338	171: 4	Lower half	0.0248	0.0286	0.0267
S97T000031	171: 5	Lower half	0.012	0.0106	0.0113
S96T005353	171: 6	Lower half	0.00659	0.0338	0.020195[QC:e]
S96T005388	171: 7	Lower half	0.0132	0.0144	0.0138
Liquids			**µCi/mL**	**µCi/mL**	**µCi/mL**
S96T005314	168: 6	Drainable liquid	0.00745	<0.0108	<0.009125[QC:e,]
S96T005346	171: 5	Drainable liquid	<0.00707	<0.00527	<0.00617[QC:e,f]
S96T005357	171: 6	Drainable liquid	<0.00612	<0.00707	<0.006595[QC:f]

Table B2-6. Tank 241-BY-111 Analytical Results: Percent Water (TGA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
S96T005166	168: 1	Subsegment A	28.33	31.73	30.03
S96T005167	168: 1	Subsegment B	33.76	38.56	36.16
S96T005148	168: 2	Lower half	24.11	24.74	24.425
S96T005157	168: 3	Lower half	17.67	12.04	14.855[QC:e]
S96T005301	168: 4	Lower half	19.6	12.97	16.285[QC:e]
S96T005304	168: 5	Lower half	26.39	27.8	27.095
S96T005310	168: 5A	Lower half	43.01	42.26	42.635
S96T005158	168: 6A	Lower half	30.82	29.91	30.365
S96T005158		Lower half	28.04	43.57	35.805[QC:e]
S96T005321	171: 1	Lower half	0.56	0.58	0.57
S96T005335	171: 3	Lower half	23.68	23.84	23.76
S96T005336	171: 4	Lower half	50.73	48.08	49.405
S96T005342	171: 5	Lower half	52.58	51.59	52.085
S96T005349	171: 6	Upper half	51.45	46.43	48.94
S96T005350		Lower half	44.18	40.4	42.29
S96T005383	171: 7	Upper half	46.03	46.51	46.27
S96T005384		Lower half	50.14	48.3	49.22
Liquids			%	%	%
S96T005314	168: 6	Drainable liquid	54.28	53.81	54.045
S96T005346	171: 5	Drainable liquid	53.96	53.79	53.875
S96T005357	171: 6	Drainable liquid	53.56	53.38	53.47

Table B2-7. Tank 241-BY-111 Analytical Results: Exotherm - Transition 1 (Differential Scanning Calorimetry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Triplicate	Mean
Solids			**J/g**	**J/g**	**J/g**	**J/g**
S96T005166	168: 1	Subsegment A upper half	66.3	60		63.15
S96T005148	168: 2	Lower half	29	48.8		38.9[QC:e]
S96T005157	168: 3	Lower half	46.9	22.9		34.9[QC:e]
S96T005301	168: 4	Lower half	50.7	46.2		48.45
S96T005304	168: 5	Lower half	227.1	208.2		217.65
S96T005158	168: 6A	Lower half	10.8	11.1		10.95
S96T005336	171: 4	Lower half	8.9	10.7		9.8
S96T005342	171: 5	Lower half	57.5	28		42.75[QC:e]
S96T005349	171: 6	Upper half	20.2	7.4		13.8[QC:e]
S96T005350		Lower half	5.4	10.7	8.5	8.2[QC:e]
S96T005383	171: 7	Upper half	36.5	33.6		35.05
S96T005384		Lower half	25.4	23.1		24.25
Liquids			**J/g**	**J/g**	**J/g**	**J/g**
S96T005346	171: 5	Drainable liquid	16.2	14.3		15.25
S96T005357	171: 6	Drainable liquid	17.2	10.6		13.9[QC:e]

Table B2-8. Tank 241-BY-111 Analytical Results: Bulk Density.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Triplicate	Mean
Solids			**g/mL**	**g/mL**	**g/mL**	**g/mL**
S96T005165	168: 1	Subsegment B	0.91	n/a	n/a	0.91
S96T005147	168: 2	Lower half	1.6	n/a	n/a	1.6
S96T005309	168: 5A	Lower half	1.65	n/a	n/a	1.65
S96T005334	171: 4	Lower half	1.56	n/a	n/a	1.56
S96T005341	171: 5	Lower half	1.88	n/a	n/a	1.88
S96T005348	171: 6	Lower half	1.72	n/a	n/a	1.72
S96T005382	171: 7	Lower half	1.8	n/a	n/a	1.8

Table B2-9. Tank 241-BY-111 Analytical Results: Specific Gravity.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			unitless	unitless	unitless
S96T005314	168: 6	Drainable liquid	1.416	1.42	1.418
S96T005346	171: 5	Drainable liquid	1.433	1.42	1.4265
S96T005357	171: 6	Drainable liquid	1.435	1.414	1.4245

Table B2-10. Tank 241-BY-111 Analytical Results: Aluminum (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	34,300	35,200	34,750[QC:d]
S96T005319		Drainable liquid	121	122	121.5
S96T005153	168: 6A	Drainable liquid	20.1	<20.1	<20.1
S96T005346	171: 5	Drainable liquid	40,700	40,800	40,750[QC:c]
S96T005357	171: 6	Drainable liquid	53,600	53,000	53,300
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A	27,100	25,400	26,250
S96T005169		Subsegment B	2,240	2,220	2,230
S96T005150	168: 2	Lower half	1,800	1,880	1,840
S96T005160	168: 3	Lower half	3,630	4,000	3,815
S96T005305	168: 4	Lower half	5,730	5,750	5,740
S96T005306	168: 5	Lower half	7,170	8,330	7,750
S96T005311	168: 5A	Lower half	16,700	18,000	17,350
S96T005161	168: 6A	Lower half	3,580	3,560	3,570
S96T005323	171: 1	Lower half	57,200	60,800	59,000
S96T005337	171: 3	Lower half	63,900	61,400	62,650
S96T005338	171: 4	Lower half	46,700	20,900	33,800[QC:e]
S97T000031	171: 5	Lower half	20,200	20,800	20,500

Table B2-10. Tank 241-BY-111 Analytical Results: Aluminum (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion (Cont'd)			µg/g	µg/g	µg/g
S96T005352	171: 6	Upper half	30,300	25,200	27,750
S96T005353		Lower half	30,200	45,500	37,850[QC:e]
S96T005387	171: 7	Upper half	38,000	34,700	36,350
S96T005388		Lower half	54,700	52,100	53,400

Table B2-11. Tank 241-BY-111 Analytical Results: Antimony (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<24.1	<24.1	<24.1
S96T005319		Drainable liquid	<1.26	<1.26	<1.26
S96T005153	168: 6A	Drainable liquid	<24.1	<24.1	<24.1
S96T005346	171: 5	Drainable liquid	<24.1	<24.1	<24.1
S96T005357	171: 6	Drainable liquid	<24.1	<24.1	<24.1
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<1,130	<1,120	<1,125
S96T005169		Subsegment B	<1,210	<1,220	<1,215
S96T005150	168: 2	Lower half	<1,110	<1,100	<1,105
S96T005160	168: 3	Lower half	<1,200	<1,160	<1,180
S96T005305	168: 4	Lower half	<1,190	<1,180	<1,185
S96T005306	168: 5	Lower half	<1,220	<1,180	<1,200
S96T005311	168: 5A	Lower half	<1,210	<1,200	<1,205
S96T005161	168: 6A	Lower half	<1,190	<1,200	<1,195
S96T005323	171: 1	Lower half	<1,140	<1,140	<1,140
S96T005337	171: 3	Lower half	<1,130	<1,110	<1,120
S96T005338	171: 4	Lower half	<1,060	<1,070	<1,065
S97T000031	171: 5	Lower half	<1,210	<1,230	<1,220
S96T005352	171: 6	Upper half	<1,180	<1,120	<1,150
S96T005353		Lower half	<1,190	<1,100	<1,145
S96T005387	171: 7	Upper half	<1,090	<1,150	<1,120
S96T005388		Lower half	<1,200	<1,180	<1,190

Table B2-12. Tank 241-BY-111 Analytical Results: Arsenic (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	<40.1	<40.1	<40.1
S96T005319		Drainable liquid	<2.1	<2.1	<2.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	<40.1	<40.1	<40.1
S96T005357	171: 6	Drainable liquid	<40.1	<40.1	<40.1
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A	<1,880	<1,870	<1,875
S96T005169		Subsegment B	<2,020	<2,030	<2,025
S96T005150	168: 2	Lower half	<1,850	<1,830	<1,840
S96T005160	168: 3	Lower half	<1,990	<1,940	<1,965
S96T005305	168: 4	Lower half	<1,980	<1,970	<1,975
S96T005306	168: 5	Lower half	<2,030	<1,970	<2,000
S96T005311	168: 5A	Lower half	<2,010	<2,010	<2,010
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	<1,900	<1,900	<1,900
S96T005337	171: 3	Lower half	<1,880	<1,850	<1,865
S96T005338	171: 4	Lower half	<1,760	<1,780	<1,770
S97T000031	171: 5	Lower half	<2,010	<2,040	<2,025
S96T005352	171: 6	Upper half	<1,970	<1,860	<1,915
S96T005353		Lower half	<1,980	<1,830	<1,905
S96T005387	171: 7	Upper half	<1,820	<1,920	<1,870
S96T005388		Lower half	<2,000	<1,970	<1,985

Table B2-13. Tank 241-BY-111 Analytical Results: Barium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<20.1	<20.1	<20.1
S96T005319		Drainable liquid	<1.05	<1.05	<1.05
S96T005153	168: 6A	Drainable liquid	<20.1	<20.1	<20.1
S96T005346	171: 5	Drainable liquid	<20.1	<20.1	<20.1
S96T005357	171: 6	Drainable liquid	<20.1	<20.1	<20.1
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<941	<933	<937
S96T005169		Subsegment B	<1,010	<1,020	<1,015
S96T005150	168: 2	Lower half	<923	<914	<918.5
S96T005160	168: 3	Lower half	<996	<970	<983
S96T005305	168: 4	Lower half	<988	<987	<987.5
S96T005306	168: 5	Lower half	<1,020	<983	<1,001.5
S96T005311	168: 5A	Lower half	<1,010	<1,000	<1,005
S96T005161	168: 6A	Lower half	<994	<997	<995.5
S96T005323	171: 1	Lower half	<948	<948	<948
S96T005337	171: 3	Lower half	<938	<924	<931
S96T005338	171: 4	Lower half	<882	<888	<885
S97T000031	171: 5	Lower half	<1,010	<1,020	<1,015
S96T005352	171: 6	Upper half	<986	<932	<959
S96T005353		Lower half	<988	<917	<952.5
S96T005387	171: 7	Upper half	<910	<958	<934
S96T005388		Lower half	<998	<986	<992

Table B2-14. Tank 241-BY-111 Analytical Results: Beryllium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<2	<2	<2
S96T005319		Drainable liquid	<0.105	<0.105	<0.105
S96T005153	168: 6A	Drainable liquid	<2	<2	<2
S96T005346	171: 5	Drainable liquid	<2	<2	<2
S96T005357	171: 6	Drainable liquid	<2	<2	<2
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<94.1	<93.3	<93.7
S96T005169		Subsegment B	<101	<102	<101.5
S96T005150	168: 2	Lower half	<92.3	<91.4	<91.85
S96T005160	168: 3	Lower half	<99.6	<97	<98.3
S96T005305	168: 4	Lower half	<98.8	<98.7	<98.75
S96T005306	168: 5	Lower half	<102	<98.3	<100.15
S96T005311	168: 5A	Lower half	<101	<100	<100.5
S96T005161	168: 6A	Lower half	<99.4	<99.7	<99.55
S96T005323	171: 1	Lower half	<94.8	<94.8	<94.8
S96T005337	171: 3	Lower half	<93.8	<92.4	<93.1
S96T005338	171: 4	Lower half	<88.2	<88.8	<88.5
S97T000031	171: 5	Lower half	<101	<102	<101.5
S96T005352	171: 6	Upper half	<98.6	<93.2	<95.9
S96T005353		Lower half	<98.8	<91.7	<95.25
S96T005387	171: 7	Upper half	<91	<95.8	<93.4
S96T005388		Lower half	<99.8	<98.6	<99.2

Table B2-15. Tank 241-BY-111 Analytical Results: Bismuth (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<40.1	<40.1	<40.1
S96T005319		Drainable liquid	<2.1	<2.1	<2.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	<40.1	<40.1	<40.1
S96T005357	171: 6	Drainable liquid	<40.1	<40.1	<40.1
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<1,880	<1,870	<1,875
S96T005169		Subsegment B	<2,020	<2,030	<2,025
S96T005150	168: 2	Lower half	<1,850	<1,830	<1,840
S96T005160	168: 3	Lower half	<1,990	<1,940	<1,965
S96T005305	168: 4	Lower half	<1,980	<1,970	<1,975
S96T005306	168: 5	Lower half	<2,030	<1,970	<2,000
S96T005311	168: 5A	Lower half	<2,010	<2,010	<2,010
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	<1,900	<1,900	<1,900
S96T005337	171: 3	Lower half	<1,880	<1,850	<1,865
S96T005338	171: 4	Lower half	<1,760	<1,780	<1,770
S97T000031	171: 5	Lower half	<2,010	<2,040	<2,025
S96T005352	171: 6	Upper half	<1,970	<1,860	<1,915
S96T005353		Lower half	<1,980	<1,830	<1,905
S96T005387	171: 7	Upper half	<1,820	<1,920	<1,870
S96T005388		Lower half	<2,000	<1,970	<1,985

Table B2-16. Tank 241-BY-111 Analytical Results: Boron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	29.5	31.5	30.5
S96T005319		Drainable liquid	10.1	10.2	10.15
S96T005153	168: 6A	Drainable liquid	<20.1	<20.1	<20.1
S96T005346	171: 5	Drainable liquid	32.9	28.5	30.7
S96T005357	171: 6	Drainable liquid	32.5	30.8	31.65
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<941	<933	<937
S96T005169		Subsegment B	<1,010	<1,020	<1,015
S96T005150	168: 2	Lower half	<923	<914	<918.5
S96T005160	168: 3	Lower half	<996	<970	<983
S96T005305	168: 4	Lower half	<988	<987	<987.5
S96T005306	168: 5	Lower half	<1,020	<983	<1,001.5
S96T005311	168: 5A	Lower half	<1,010	<1,000	<1,005
S96T005161	168: 6A	Lower half	<994	<997	<995.5
S96T005323	171: 1	Lower half	<948	<948	<948
S96T005337	171: 3	Lower half	<938	<924	<931
S96T005338	171: 4	Lower half	<882	<888	<885
S97T000031	171: 5	Lower half	<1,010	<1,020	<1,015
S96T005352	171: 6	Upper half	<986	<932	<959
S96T005353		Lower half	<988	<917	<952.5
S96T005387	171: 7	Upper half	<910	<958	<934
S96T005388		Lower half	<998	<986	<992

Table B2-17. Tank 241-BY-111 Analytical Results: Cadmium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	<2	<2	<2
S96T005319		Drainable liquid	<0.105	<0.105	<0.105
S96T005153	168: 6A	Drainable liquid	<2	<2	<2
S96T005346	171: 5	Drainable liquid	<2	<2	<2
S96T005357	171: 6	Drainable liquid	<2	<2	<2
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A	<94.1	<93.3	<93.7
S96T005169		Subsegment B	<101	<102	<101.5
S96T005150	168: 2	Lower half	<92.3	<91.4	<91.85
S96T005160	168: 3	Lower half	<99.6	<97	<98.3
S96T005305	168: 4	Lower half	<98.8	<98.7	<98.75
S96T005306	168: 5	Lower half	<102	<98.3	<100.15
S96T005311	168: 5A	Lower half	<101	<100	<100.5
S96T005161	168: 6A	Lower half	<99.4	<99.7	<99.55
S96T005323	171: 1	Lower half	<94.8	<94.8	<94.8
S96T005337	171: 3	Lower half	<93.8	<92.4	<93.1
S96T005338	171: 4	Lower half	<88.2	<88.8	<88.5
S97T000031	171: 5	Lower half	<101	<102	<101.5
S96T005352	171: 6	Upper half	<98.6	<93.2	<95.9
S96T005353		Lower half	<98.8	<91.7	<95.25
S96T005387	171: 7	Upper half	<91	<95.8	<93.4
S96T005388		Lower half	<99.8	<98.6	<99.2

Table B2-18. Tank 241-BY-111 Analytical Results: Calcium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	<40.1	<40.1	<40.1
S96T005319		Drainable liquid	<2.1	<2.1	<2.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	<40.1	<40.1	<40.1
S96T005357	171: 6	Drainable liquid	<40.1	<40.1	<40.1
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A	<1,880	<1,870	<1,875
S96T005169		Subsegment B	<2,020	<2,030	<2,025
S96T005150	168: 2	Lower half	<1,850	<1,830	<1,840
S96T005160	168: 3	Lower half	<1,990	<1,940	<1,965
S96T005305	168: 4	Lower half	<1,980	<1,970	<1,975
S96T005306	168: 5	Lower half	<2,030	<1,970	<2,000
S96T005311	168: 5A	Lower half	<2,010	<2,010	<2,010
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	26,900	26,100	26,500
S96T005337	171: 3	Lower half	5,010	5,430	5,220
S96T005338	171: 4	Lower half	15,300	4,120	9,710[QC:e]
S97T000031	171: 5	Lower half	<2,010	<2,040	<2,025
S96T005352	171: 6	Upper half	<1,970	<1,860	<1,915
S96T005353		Lower half	<1,980	<1,830	<1,905
S96T005387	171: 7	Upper half	<1,820	<1,920	<1,870
S96T005388		Lower half	<2,000	<1,970	<1,985

Table B2-19. Tank 241-BY-111 Analytical Results: Cerium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<40.1	<40.1	<40.1
S96T005319		Drainable liquid	<2.1	<2.1	<2.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	<40.1	<40.1	<40.1
S96T005357	171: 6	Drainable liquid	<40.1	<40.1	<40.1
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment	<1,880	<1,870	<1,875
S96T005169		Subsegment B	<2,020	<2,030	<2,025
S96T005150	168: 2	Lower half	<1,850	<1,830	<1,840
S96T005160	168: 3	Lower half	<1,990	<1,940	<1,965
S96T005305	168: 4	Lower half	<1,980	<1,970	<1,975
S96T005306	168: 5	Lower half	<2,030	<1,970	<2,000
S96T005311	168: 5A	Lower half	<2,010	<2,010	<2,010
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	<1,900	<1,900	<1,900
S96T005337	171: 3	Lower half	<1,880	<1,850	<1,865
S96T005338	171: 4	Lower half	<1,760	<1,780	<1,770
S97T000031	171: 5	Lower half	<2,010	<2,040	<2,025
S96T005352	171: 6	Upper half	<1,970	<1,860	<1,915
S96T005353		Lower half	<1,980	<1,830	<1,905
S96T005387	171: 7	Upper half	<1,820	<1,920	<1,870
S96T005388		Lower half	<2,000	<1,970	<1,985

Table B2-20. Tank 241-BY-111 Analytical Results: Chromium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	6,970	7,250	7,110[QC:d]
S96T005319		Drainable liquid	73.6	74.2	73.9
S96T005153	168: 6A	Drainable liquid	8.2	7.52	7.86
S96T005346	171: 5	Drainable liquid	7,130	7,030	7,080[QC:e]
S96T005357	171: 6	Drainable liquid	4,030	3,960	3,995
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A upper half	412	427	419.5
S96T005169		Subsegment B	870	913	891.5
S96T005150	168: 2	Lower half	783	798	790.5
S96T005160	168: 3	Lower half	1,760	1,870	1,815
S96T005305	168: 4	Lower half	2,380	2,390	2,385
S96T005306	168: 5	Lower half	2,910	3,470	3,190
S96T005311	168: 5A	Lower half	4,600	4,890	4,745
S96T005161	168: 6A	Lower half	820	883	851.5
S96T005323	171: 1	Lower half	<190	<190	<190
S96T005337	171: 3	Lower half	1,660	1,630	1,645
S96T005338	171: 4	Lower half	1,880	1,820	1,850
S97T000031	171: 5	Lower half	3,600	3,630	3,615
S96T005352	171: 6	Upper half	3,610	2,600	3,105[QC:e]
S96T005353		Lower half	2,320	5,680	4,000[QC:e]
S96T005387	171: 7	Upper half	1,500	1,400	1,450
S96T005388		Lower half	1,820	1,430	1,625[QC:e]

Table B2-21. Tank 241-BY-111 Analytical Results: Cobalt (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<8.02	<8.02	<8.02
S96T005319		Drainable liquid	<0.42	<0.42	<0.42
S96T005153	168: 6A	Drainable liquid	<8.02	<8.02	<8.02
S96T005346	171: 5	Drainable liquid	<8.02	<8.02	<8.02
S96T005357	171: 6	Drainable liquid	<8.02	<8.02	<8.02
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<376	<373	<374.5
S96T005169		Subsegment B	<404	<407	<405.5
S96T005150	168: 2	Lower half	<369	<365	<367
S96T005160	168: 3	Lower half	<398	<388	<393
S96T005305	168: 4	Lower half	<395	<395	<395
S96T005306	168: 5	Lower half	<406	<393	<399.5
S96T005311	168: 5A	Lower half	<402	<401	<401.5
S96T005161	168: 6A	Lower half	<397	<399	<398
S96T005323	171: 1	Lower half	<379	<379	<379
S96T005337	171: 3	Lower half	<375	<370	<372.5
S96T005338	171: 4	Lower half	<353	<355	<354
S97T000031	171: 5	Lower half	<403	<409	<406
S96T005352	171: 6	Upper half	<395	<373	<384
S96T005353		Lower half	<395	<367	<381
S96T005387	171: 7	Upper half	<364	<383	<373.5
S96T005388		Lower half	<399	<394	<396.5

Table B2-22. Tank 241-BY-111 Analytical Results: Copper (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<4.01	<4.01	<4.01
S96T005319		Drainable liquid	<0.21	<0.21	<0.21
S96T005153	168: 6A	Drainable liquid	<4.01	<4.01	<4.01
S96T005346	171: 5	Drainable liquid	<4.01	<4.01	<4.01
S96T005357	171: 6	Drainable liquid	<4.01	<4.01	<4.01
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<188	<187	<187.5
S96T005169		Subsegment B	<202	<203	<202.5
S96T005150	168: 2	Lower half	<185	<183	<184
S96T005160	168: 3	Lower half	<199	<194	<196.5
S96T005305	168: 4	Lower half	<198	<197	<197.5
S96T005306	168: 5	Lower half	<203	<197	<200
S96T005311	168: 5A	Lower half	<201	<201	<201
S96T005161	168: 6A	Lower half	<199	<199	<199
S96T005323	171: 1	Lower half	<190	<190	<190
S96T005337	171: 3	Lower half	<188	<185	<186.5
S96T005338	171: 4	Lower half	<176	<178	<177
S97T000031	171: 5	Lower half	<201	<204	<202.5
S96T005352	171: 6	Upper half	<197	<186	<191.5
S96T005353		Lower half	<198	<183	<190.5
S96T005387	171: 7	Upper half	<182	<192	<187
S96T005388		Lower half	<200	<197	<198.5

Table B2-23. Tank 241-BY-111 Analytical Results: Iron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S96T005314	168: 6	Drainable liquid	<20.1	<20.1	<20.1
S96T005319		Drainable liquid	<1.05	<1.05	<1.05
S96T005153	168: 6A	Drainable liquid	<20.1	<20.1	<20.1
S96T005346	171: 5	Drainable liquid	<20.1	<20.1	<20.1
S96T005357	171: 6	Drainable liquid	<20.1	<20.1	<20.1
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
S96T005168	168: 1	Subsegment A	4,980	4,570	4,775
S96T005169		Subsegment B	3,190	3,320	3,255
S96T005150	168: 2	Lower half	2,040	2,130	2,085
S96T005160	168: 3	Lower half	2,230	2,190	2,210
S96T005305	168: 4	Lower half	1,830	1,730	1,780
S96T005306	168: 5	Lower half	1,540	1,860	1,700
S96T005311	168: 5A	Lower half	<1,010	<1,000	<1,005
S96T005161	168: 6A	Lower half	<994	<997	<995.5
S96T005323	171: 1	Lower half	37,900	34,700	36,300
S96T005337	171: 3	Lower half	8,330	9,070	8,700
S96T005338	171: 4	Lower half	20,900	6,140	13,520[QC:e]
S97T000031	171: 5	Lower half	<1,010	<1,020	<1,015
S96T005352	171: 6	Upper half	<986	<932	<959
S96T005353		Lower half	<988	<917	<952.5
S96T005387	171: 7	Upper half	<910	<958	<934
S96T005388		Lower half	<998	<986	<992

Table B2-24. Tank 241-BY-111 Analytical Results: Lanthanum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<20.1	<20.1	<20.1
S96T005319		Drainable liquid	<1.05	<1.05	<1.05
S96T005153	168: 6A	Drainable liquid	<20.1	<20.1	<20.1
S96T005346	171: 5	Drainable liquid	<20.1	<20.1	<20.1
S96T005357	171: 6	Drainable liquid	<20.1	<20.1	<20.1
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<941	<933	<937
S96T005169		Subsegment B	<1,010	<1,020	<1,015
S96T005150	168: 2	Lower half	<923	<914	<918.5
S96T005160	168: 3	Lower half	<996	<970	<983
S96T005305	168: 4	Lower half	<988	<987	<987.5
S96T005306	168: 5	Lower half	<1,020	<983	<1,001.5
S96T005311	168: 5A	Lower half	<1,010	<1,000	<1,005
S96T005161	168: 6A	Lower half	<994	<997	<995.5
S96T005323	171: 1	Lower half	<948	<948	<948
S96T005337	171: 3	Lower half	<938	<924	<931
S96T005338	171: 4	Lower half	<882	<888	<885
S97T000031	171: 5	Lower half	<1,010	<1,020	<1,015
S96T005352	171: 6	Upper half	<986	<932	<959
S96T005353		Lower half	<988	<917	<952.5
S96T005387	171: 7	Upper half	<910	<958	<934
S96T005388		Lower half	<998	<986	<992

Table B2-25. Tank 241-BY-111 Analytical Results: Lead (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	80	90.2	85.1
S96T005319		Drainable liquid	<2.1	<2.1	<2.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	82.6	80.3	81.45
S96T005357	171: 6	Drainable liquid	110	97.5	103.75
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<1,880	<1,870	<1,875
S96T005169		Subsegment B	<2,020	<2,030	<2,025
S96T005150	168: 2	Lower half	<1,850	<1,830	<1,840
S96T005160	168: 3	Lower half	<1,990	<1,940	<1,965
S96T005305	168: 4	Lower half	<1,980	<1,970	<1,975
S96T005306	168: 5	Lower half	<2,030	<1,970	<2,000
S96T005311	168: 5A	Lower half	<2,010	<2,010	<2,010
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	<1,900	<1,900	<1,900
S96T005337	171: 3	Lower half	<1,880	<1,850	<1,865
S96T005338	171: 4	Lower half	<1,760	<1,780	<1,770
S97T000031	171: 5	Lower half	<2,010	<2,040	<2,025
S96T005352	171: 6	Upper half	<1,970	<1,860	<1,915
S96T005353		Lower half	<1,980	<1,830	<1,905
S96T005387	171: 7	Upper half	<1,820	<1,920	<1,870
S96T005388		Lower half	<2,000	<1,970	<1,985

Table B2-26. Tank 241-BY-111 Analytical Results: Lithium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	4.48	4.62	4.55
S96T005319		Drainable liquid	2,250	2,250	2,250
S96T005153	168: 6A	Drainable liquid	2,030	1,870	1,950
S96T005346	171: 5	Drainable liquid	<4.01	<4.01	<4.01
S96T005357	171: 6	Drainable liquid	<4.01	<4.01	<4.01
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<188	<187	<187.5
S96T005169		Subsegment B	<202	<203	<202.5
S96T005150	168: 2	Lower half	<185	<183	<184
S96T005160	168: 3	Lower half	<199	<194	<196.5
S96T005305	168: 4	Lower half	<198	<197	<197.5
S96T005306	168: 5	Lower half	<203	<197	<200
S96T005311	168: 5A	Lower half	<201	<201	<201
S96T005161	168: 6A	Lower half	206	209	207.5
S96T005323	171: 1	Lower half	<190	<190	<190
S96T005337	171: 3	Lower half	<188	<185	<186.5
S96T005338	171: 4	Lower half	<176	<178	<177
S97T000031	171: 5	Lower half	<201	<204	<202.5
S96T005352	171: 6	Upper half	<197	<186	<191.5
S96T005353		Lower half	<198	<183	<190.5
S96T005387	171: 7	Upper half	<182	<192	<187
S96T005388		Lower half	<200	<197	<198.5

Table B2-27. Tank 241-BY-111 Analytical Results: Magnesium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<40.1	<40.1	<40.1
S96T005319		Drainable liquid	<2.1	<2.1	<2.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	<40.1	<40.1	<40.1
S96T005357	171: 6	Drainable liquid	<40.1	<40.1	<40.1
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<1,880	<1,870	<1,875
S96T005169		Subsegment B	<2,020	<2,030	<2,025
S96T005150	168: 2	Lower half	<1,850	<1,830	<1,840
S96T005160	168: 3	Lower half	<1,990	<1,940	<1,965
S96T005305	168: 4	Lower half	<1,980	<1,970	<1,975
S96T005306	168: 5	Lower half	<2,030	<1,970	<2,000
S96T005311	168: 5A	Lower half	<2,010	<2,010	<2,010
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	10,200	8,690	9,445
S96T005337	171: 3	Lower half	<1,880	<1,850	<1,865
S96T005338	171: 4	Lower half	5,530	<1,780	<3,655[QC:e]
S97T000031	171: 5	Lower half	<2,010	<2,040	<2,025
S96T005352	171: 6	Upper half	<1,970	<1,860	<1,915
S96T005353		Lower half	<1,980	<1,830	<1,905
S96T005387	171: 7	Upper half	<1,820	<1,920	<1,870
S96T005388		Lower half	<2,000	<1,970	<1,985

Table B2-28. Tank 241-BY-111 Analytical Results: Manganese (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	<4.01	<4.01	<4.01
S96T005319		Drainable liquid	<0.21	<0.21	<0.21
S96T005153	168: 6A	Drainable liquid	<4.01	<4.01	<4.01
S96T005346	171: 5	Drainable liquid	<4.01	<4.01	<4.01
S96T005357	171: 6	Drainable liquid	<4.01	<4.01	<4.01
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A	<188	<187	<187.5
S96T005169		Subsegment B	<202	<203	<202.5
S96T005150	168: 2	Lower half	<185	<183	<184
S96T005160	168: 3	Lower half	<199	<194	<196.5
S96T005305	168: 4	Lower half	<198	<197	<197.5
S96T005306	168: 5	Lower half	<203	<197	<200
S96T005311	168: 5A	Lower half	<201	<201	<201
S96T005161	168: 6A	Lower half	<199	<199	<199
S96T005323	171: 1	Lower half	705	631	668
S96T005337	171: 3	Lower half	257	255	256
S96T005338	171: 4	Lower half	442	199	320.5[QC:e]
S97T000031	171: 5	Lower half	<201	<204	<202.5
S96T005352	171: 6	Upper half	<197	<186	<191.5
S96T005353		Lower half	<198	484	<341[QC:e]
S96T005387	171: 7	Upper half	<182	<192	<187
S96T005388		Lower half	<200	<197	<198.5

Table B2-29. Tank 241-BY-111 Analytical Results: Molybdenum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	31.5	32.6	32.05
S96T005319		Drainable liquid	1.4	1.43	1.415
S96T005153	168: 6A	Drainable liquid	<20.1	<20.1	<20.1
S96T005346	171: 5	Drainable liquid	34.4	34	34.2
S96T005357	171: 6	Drainable liquid	34.3	31.8	33.05
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<941	<933	<937
S96T005169		Subsegment B	<1,010	<1,020	<1,015
S96T005150	168: 2	Lower half	<923	<914	<918.5
S96T005160	168: 3	Lower half	<996	<970	<983
S96T005305	168: 4	Lower half	<988	<987	<987.5
S96T005306	168: 5	Lower half	<1,020	<983	<1,001.5
S96T005311	168: 5A	Lower half	<1,010	<1,000	<1,005
S96T005161	168: 6A	Lower half	<994	<997	<995.5
S96T005323	171: 1	Lower half	<948	<948	<948
S96T005337	171: 3	Lower half	<938	<924	<931
S96T005338	171: 4	Lower half	<882	<888	<885
S97T000031	171: 5	Lower half	<1,010	<1,020	<1,015
S96T005352	171: 6	Upper half	<986	<932	<959
S96T005353		Lower half	<988	<917	<952.5
S96T005387	171: 7	Upper half	<910	<958	<934
S96T005388		Lower half	<998	<986	<992

Table B2-30. Tank 241-BY-111 Analytical Results: Neodymium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<40.1	<40.1	<40.1
S96T005319		Drainable liquid	<2.1	<2.1	<2.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	<40.1	<40.1	<40.1
S96T005357	171: 6	Drainable liquid	<40.1	<40.1	<40.1
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<1,880	<1,870	<1,875
S96T005169		Subsegment B	<2,020	<2,030	<2,025
S96T005150	168: 2	Lower half	<1,850	<1,830	<1,840
S96T005160	168: 3	Lower half	<1,990	<1,940	<1,965
S96T005305	168: 4	Lower half	<1,980	<1,970	<1,975
S96T005306	168: 5	Lower half	<2,030	<1,970	<2,000
S96T005311	168: 5A	Lower half	<2,010	<2,010	<2,010
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	<1,900	<1,900	<1,900
S96T005337	171: 3	Lower half	<1,880	<1,850	<1,865
S96T005338	171: 4	Lower half	<1,760	<1,780	<1,770
S97T000031	171: 5	Lower half	<2,010	<2,040	<2,025
S96T005352	171: 6	Upper half	<1,970	<1,860	<1,915
S96T005353		Lower half	<1,980	<1,830	<1,905
S96T005387	171: 7	Upper half	<1,820	<1,920	<1,870
S96T005388		Lower half	<2,000	<1,970	<1,985

Table B2-31. Tank 241-BY-111 Analytical Results: Nickel (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S96T005314	168: 6	Drainable liquid	<8.02	<8.02	<8.02
S96T005319		Drainable liquid	<0.42	<0.42	<0.42
S96T005153	168: 6A	Drainable liquid	<8.02	<8.02	<8.02
S96T005346	171: 5	Drainable liquid	<8.02	<8.02	<8.02
S96T005357	171: 6	Drainable liquid	<8.02	<8.02	<8.02
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
S96T005168	168: 1	Subsegment A	969	905	937
S96T005169		Subsegment B	1,540	1,160	1,350[QC:e]
S96T005150	168: 2	Lower half	4,490	1,320	2,905[QC:e]
S96T005160	168: 3	Lower half	1,830	1,800	1,815
S96T005305	168: 4	Lower half	1,160	1,550	1,355[QC:e]
S96T005306	168: 5	Lower half	1,450	3,250	2,350[QC:e]
S96T005311	168: 5A	Lower half	<402	887	<644.5[QC:e]
S96T005161	168: 6A	Lower half	3,730	1,400	2,565[QC:e]
S96T005323	171: 1	Lower half	13,700	19,300	16,500[QC:e]
S96T005337	171: 3	Lower half	2,420	4,710	3,565[QC:e]
S96T005338	171: 4	Lower half	8,260	3,480	5,870[QC:e]
S96T005352	171: 6	Upper half	1,880	19,900	10,890[QC:e]
S96T005353		Lower half	7,220	1.860E+05	96,610[QC:e]
S96T005387	171: 7	Upper half	3,530	4,600	4,065[QC:e]
S96T005388		Lower half	1,910	2,270	2,090

Table B2-32. Tank 241-BY-111 Analytical Results: Phosphorus (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	324	319	321.5
S96T005319		Drainable liquid	7.74	8.29	8.015
S96T005153	168: 6A	Drainable liquid	<80.2	<80.2	<80.2
S96T005346	171: 5	Drainable liquid	306	331	318.5
S96T005357	171: 6	Drainable liquid	343	321	332
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	4,710	4,450	4,580
S96T005169		Subsegment B	<4,040	<4,070	<4,055
S96T005150	168: 2	Lower half	4,380	4,660	4,520
S96T005160	168: 3	Lower half	6,290	7,360	6,825
S96T005305	168: 4	Lower half	<3,950	<3,950	<3,950
S96T005306	168: 5	Lower half	24,700	9,950	17,325[QC:e]
S96T005311	168: 5A	Lower half	6,530	4,500	5,515[QC:e]
S96T005161	168: 6A	Lower half	60,200	57,700	58,950
S96T005323	171: 1	Lower half	<3,790	<3,790	<3,790
S96T005337	171: 3	Lower half	<3,750	<3,700	<3,725
S96T005338	171: 4	Lower half	<3,530	5,310	<4,420[QC:e]
S97T000031	171: 5	Lower half	7,830	6,880	7,355
S96T005352	171: 6	Upper half	<3,950	<3,730	<3,840
S96T005353		Lower half	<3,950	6,750	<5,350[QC:e]
S96T005387	171: 7	Upper half	<3,640	<3,830	<3,735
S96T005388		Lower half	<3,990	<3,940	<3,965

Table B2-33. Tank 241-BY-111 Analytical Results: Potassium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	4,690	4,910	4,800[QC:d]
S96T005319		Drainable liquid	75.9	80.8	78.35
S96T005153	168: 6A	Drainable liquid	<200	<200	<200
S96T005346	171: 5	Drainable liquid	5,230	5,260	5,245
S96T005357	171: 6	Drainable liquid	5,340	5,190	5,265

Table B2-34. Tank 241-BY-111 Analytical Results: Samarium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S96T005314	168: 6	Drainable liquid	<40.1	<40.1	<40.1
S96T005319		Drainable liquid	<2.1	<2.1	<2.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	<40.1	<40.1	<40.1
S96T005357	171: 6	Drainable liquid	<40.1	<40.1	<40.1
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
S96T005168	168: 1	Subsegment A	<1,880	<1,870	<1,875
S96T005169		Subsegment B	<2,020	<2,030	<2,025
S96T005150	168: 2	Lower half	<1,850	<1,830	<1,840
S96T005160	168: 3	Lower half	<1,990	<1,940	<1,965
S96T005305	168: 4	Lower half	<1,980	<1,970	<1,975
S96T005306	168: 5	Lower half	<2,030	<1,970	<2,000
S96T005311	168: 5A	Lower half	<2,010	<2,010	<2,010
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	<1,900	<1,900	<1,900
S96T005337	171: 3	Lower half	<1,880	<1,850	<1,865
S96T005338	171: 4	Lower half	<1,760	<1,780	<1,770
S97T000031	171: 5	Lower half	<2,010	<2,040	<2,025
S96T005352	171: 6	Upper half	<1,970	<1,860	<1,915
S96T005353		Lower half	<1,980	<1,830	<1,905
S96T005387	171: 7	Upper half	<1,820	<1,920	<1,870
S96T005388		Lower half	<2,000	<1,970	<1,985

Table B2-35. Tank 241-BY-111 Analytical Results: Selenium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	40.9	42.2	41.55
S96T005319		Drainable liquid	<2.1	<2.1	<2.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	<40.1	<40.1	<40.1
S96T005357	171: 6	Drainable liquid	<40.1	<40.1	<40.1
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A	<1,880	<1,870	<1,875
S96T005169		Subsegment B	<2,020	<2,030	<2,025
S96T005150	168: 2	Lower half	<1,850	<1,830	<1,840
S96T005160	168: 3	Lower half	<1,990	<1,940	<1,965
S96T005305	168: 4	Lower half	<1,980	<1,970	<1,975
S96T005306	168: 5	Lower half	<2,030	<1,970	<2,000
S96T005311	168: 5A	Lower half	<2,010	<2,010	<2,010
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	<1,900	<1,900	<1,900
S96T005337	171: 3	Lower half	<1,880	<1,850	<1,865
S96T005338	171: 4	Lower half	<1,760	<1,780	<1,770
S97T000031	171: 5	Lower half	<2,010	<2,040	<2,025
S96T005352	171: 6	Upper half	<1,970	<1,860	<1,915
S96T005353		Lower half	<1,980	<1,830	<1,905
S96T005387	171: 7	Upper half	<1,820	<1,920	<1,870
S96T005388		Lower half	<2,000	<1,970	<1,985

Table B2-36. Tank 241-BY-111 Analytical Results: Silicon (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	481	504	492.5[QC:d]
S96T005319		Drainable liquid	56.7	58	57.35
S96T005153	168: 6A	Drainable liquid	60.4	51.4	55.9
S96T005346	171: 5	Drainable liquid	238	238	238
S96T005357	171: 6	Drainable liquid	299	284	291.5
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	1,050	<933	<991.5
S96T005169		Subsegment B	3,000	2,910	2,955
S96T005150	168: 2	Lower half	1,490	1,460	1,475
S96T005160	168: 3	Lower half	1,460	1,780	1,620
S96T005305	168: 4	Lower half	1,210	1,290	1,250
S96T005306	168: 5	Lower half	2,150	3,210	2,680[QC:e]
S96T005311	168: 5A	Lower half	3,970	3,130	3,550[QC:e]
S96T005161	168: 6A	Lower half	1,630	1,460	1,545
S96T005323	171: 1	Lower half	2.760E+05	2.730E+05	2.745E+05
S96T005337	171: 3	Lower half	48,100	51,400	49,750
S96T005338	171: 4	Lower half	1.320E+05	38,800	85,400[QC:e]
S97T000031	171: 5	Lower half	1,660	1,800	1,730
S96T005352	171: 6	Upper half	<986	<932	<959
S96T005353		Lower half	<988	2,010	<1,499[QC:e]
S96T005387	171: 7	Upper half	1,070	1,350	1,210[QC:e]
S96T005388		Lower half	1,400	1,430	1,415

Table B2-37. Tank 241-BY-111 Analytical Results: Silver (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	15.1	14.6	14.85
S96T005319		Drainable liquid	0.277	0.248	0.2625
S96T005153	168: 6A	Drainable liquid	<4.01	<4.01	<4.01
S96T005346	171: 5	Drainable liquid	15.8	15.7	15.75
S96T005357	171: 6	Drainable liquid	16.1	16.1	16.1
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A	<188	<187	<187.5
S96T005169		Subsegment B	<202	<203	<202.5
S96T005150	168: 2	Lower half	<185	<183	<184
S96T005160	168: 3	Lower half	<199	<194	<196.5
S96T005305	168: 4	Lower half	<198	<197	<197.5
S96T005306	168: 5	Lower half	<203	<197	<200
S96T005311	168: 5A	Lower half	<201	<201	<201
S96T005161	168: 6A	Lower half	<199	<199	<199
S96T005323	171: 1	Lower half	<190	<190	<190
S96T005337	171: 3	Lower half	<188	<185	<186.5
S96T005338	171: 4	Lower half	<176	<178	<177
S97T000031	171: 5	Lower half	<201	<204	<202.5
S96T005352	171: 6	Upper half	<197	<186	<191.5
S96T005353		Lower half	<198	<183	<190.5
S96T005387	171: 7	Upper half	<182	<192	<187
S96T005388		Lower half	<200	<197	<198.5

Table B2-38. Tank 241-BY-111 Analytical Results: Sodium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	2.060E+05	2.130E+05	2.095E+05[QC:d]
S96T005319		Drainable liquid	3,350	3,360	3,355
S96T005153	168: 6A	Drainable liquid	1,650	1,530	1,590
S96T005346	171: 5	Drainable liquid	2.190E+05	2.160E+05	2.175E+05[QC:e]
S96T005357	171: 6	Drainable liquid	2.240E+05	2.200E+05	2.220E+05
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A	2.540E+05	2.610E+05	2.575E+05
S96T005169		Subsegment B	2.640E+05	2.590E+05	2.615E+05
S96T005150	168: 2	Lower half	2.960E+05	2.930E+05	2.945E+05
S96T005160	168: 3	Lower half	3.070E+05	3.000E+05	3.035E+05
S96T005305	168: 4	Lower half	2.900E+05	2.940E+05	2.920E+05
S96T005306	168: 5	Lower half	2.640E+05	2.630E+05	2.635E+05
S96T005311	168: 5A	Lower half	2.180E+05	2.120E+05	2.150E+05
S96T005161	168: 6A	Lower half	2.440E+05	2.480E+05	2.460E+05
S96T005323	171: 1	Lower half	47,100	47,400	47,250
S96T005337	171: 3	Lower half	1.930E+05	1.900E+05	1.915E+05
S96T005338	171: 4	Lower half	1.550E+05	2.310E+05	1.930E+05[QC:e]
S97T000031	171: 5	Lower half	2.430E+05	2.360E+05	2.395E+05
S96T005352	171: 6	Upper half	2.640E+05	2.760E+05	2.700E+05[QC:e]
S96T005353		Lower half	2.720E+05	5.460E+05	4.090E+05[QC:e]
S96T005387	171: 7	Upper half	2.330E+05	2.360E+05	2.345E+05[QC:e]
S96T005388		Lower half	2.160E+05	2.060E+05	2.110E+05

Table B2-39. Tank 241-BY-111 Analytical Results: Strontium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**μg/mL**	**μg/mL**	**μg/mL**
S96T005314	168: 6	Drainable liquid	<4.01	<4.01	<4.01
S96T005319		Drainable liquid	<0.21	<0.21	<0.21
S96T005153	168: 6A	Drainable liquid	<4.01	<4.01	<4.01
S96T005346	171: 5	Drainable liquid	<4.01	<4.01	<4.01
S96T005357	171: 6	Drainable liquid	<4.01	<4.01	<4.01
Solids: fusion			**μg/g**	**μg/g**	**μg/g**
S96T005168	168: 1	Subsegment A	<188	<187	<187.5
S96T005169		Subsegment B	<202	<203	<202.5
S96T005150	168: 2	Lower half	<185	<183	<184
S96T005160	168: 3	Lower half	<199	<194	<196.5
S96T005305	168: 4	Lower half	<198	<197	<197.5
S96T005306	168: 5	Lower half	<203	<197	<200
S96T005311	168: 5A	Lower half	<201	<201	<201
S96T005161	168: 6A	Lower half	<199	<199	<199
S96T005323	171: 1	Lower half	336	379	357.5
S96T005337	171: 3	Lower half	<188	<185	<186.5
S96T005338	171: 4	Lower half	204	<178	<191
S97T000031	171: 5	Lower half	<201	<204	<202.5
S96T005352	171: 6	Upper half	<197	<186	<191.5
S96T005353		Lower half	<198	<183	<190.5
S96T005387	171: 7	Upper half	<182	<192	<187
S96T005388		Lower half	<200	<197	<198.5

Table B2-40. Tank 241-BY-111 Analytical Results: Sulfur (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	534	506	520
S96T005319		Drainable liquid	66.1	68.1	67.1
S96T005153	168: 6A	Drainable liquid	<40.1	<40.1	<40.1
S96T005346	171: 5	Drainable liquid	547	563	555
S96T005357	171: 6	Drainable liquid	590	618	604
Solids: fusion			μg/g	μg/g	μg/g
S96T005168	168: 1	Subsegment A	15,700	15,600	15,650
S96T005169		Subsegment B	23,500	24,300	23,900
S96T005150	168: 2	Lower half	21,900	21,800	21,850
S96T005160	168: 3	Lower half	18,800	18,200	18,500
S96T005305	168: 4	Lower half	16,100	16,100	16,100
S96T005306	168: 5	Lower half	13,600	17,500	15,550[QC:e]
S96T005311	168: 5A	Lower half	7,430	5,930	6,680[QC:e]
S96T005161	168: 6A	Lower half	<1,990	<1,990	<1,990
S96T005323	171: 1	Lower half	<1,900	<1,900	<1,900
S96T005337	171: 3	Lower half	12,300	12,100	12,200
S96T005338	171: 4	Lower half	6,710	9,340	8,025[QC:e]
S97T000031	171: 5	Lower half	7,720	7,330	7,525
S96T005352	171: 6	Upper half	18,100	10,400	14,250[QC:e]
S96T005353		Lower half	8,480	15,100	11,790[QC:e]
S96T005387	171: 7	Upper half	11,400	12,400	11,900
S96T005388		Lower half	8,600	6,790	7,695[QC:e]

Table B2-41. Tank 241-BY-111 Analytical Results: Thallium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<80.2	<80.2	<80.2
S96T005319		Drainable liquid	<4.2	<4.2	<4.2
S96T005153	168: 6A	Drainable liquid	<80.2	<80.2	<80.2
S96T005346	171: 5	Drainable liquid	<80.2	<80.2	<80.2
S96T005357	171: 6	Drainable liquid	<80.2	<80.2	<80.2
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A upper half	<3,760	<3,730	<3,745
S96T005169		Subsegment B	<4,040	<4,070	<4,055
S96T005150	168: 2	Lower half	<3,690	<3,650	<3,670
S96T005160	168: 3	Lower half	<3,980	<3,880	<3,930
S96T005305	168: 4	Lower half	<3,950	<3,950	<3,950
S96T005306	168: 5	Lower half	<4,060	<3,930	<3,995
S96T005311	168: 5A	Lower half	<4,020	<4,010	<4,015
S96T005161	168: 6A	Lower half	<3,970	<3,990	<3,980
S96T005323	171: 1	Lower half	<3,790	<3,790	<3,790
S96T005337	171: 3	Lower half	<3,750	<3,700	<3,725
S96T005338	171: 4	Lower half	<3,530	<3,550	<3,540
S97T000031	171: 5	Lower half	<4,030	<4,090	<4,060
S96T005352	171: 6	Upper half	<3,950	<3,730	<3,840
S96T005353		Lower half	<3,950	<3,670	<3,810
S96T005387	171: 7	Upper half	<3,640	<3,830	<3,735
S96T005388		Lower half	<3,990	<3,940	<3,965

Table B2-42. Tank 241-BY-111 Analytical Results: Titanium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**μg/mL**	**μg/mL**	**μg/mL**
S96T005314	168: 6	Drainable liquid	<4.01	<4.01	<4.01
S96T005319		Drainable liquid	<0.21	<0.21	<0.21
S96T005153	168: 6A	Drainable liquid	<4.01	<4.01	<4.01
S96T005346	171: 5	Drainable liquid	<4.01	<4.01	<4.01
S96T005357	171: 6	Drainable liquid	<4.01	<4.01	<4.01
Solids: fusion			**μg/g**	**μg/g**	**μg/g**
S96T005168	168: 1	Subsegment A	<188	<187	<187.5
S96T005169		Subsegment B	<202	<203	<202.5
S96T005150	168: 2	Lower half	<185	<183	<184
S96T005160	168: 3	Lower half	<199	<194	<196.5
S96T005305	168: 4	Lower half	<198	<197	<197.5
S96T005306	168: 5	Lower half	<203	<197	<200
S96T005311	168: 5A	Lower half	<201	<201	<201
S96T005161	168: 6A	Lower half	<199	<199	<199
S96T005323	171: 1	Lower half	5,740	5,650	5,695
S96T005337	171: 3	Lower half	821	1,120	970.5[QC:e]
S96T005338	171: 4	Lower half	3,030	699	1,864.5[QC:e]
S97T000031	171: 5	Lower half	<201	<204	<202.5
S96T005352	171: 6	Upper half	<197	<186	<191.5
S96T005353		Lower half	<198	<183	<190.5
S96T005387	171: 7	Upper half	<182	<192	<187
S96T005388		Lower half	<200	<197	<198.5

Table B2-43. Tank 241-BY-111 Analytical Results: Total Uranium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<200	<200	<200
S96T005319		Drainable liquid	<10.5	<10.5	<10.5
S96T005153	168: 6A	Drainable liquid	<200	<200	<200
S96T005346	171: 5	Drainable liquid	<200	<200	<200
S96T005357	171: 6	Drainable liquid	<200	<200	<200
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<9,410	<9,330	<9,370
S96T005169		Subsegment B	<10,100	<10,200	<10,150
S96T005150	168: 2	Lower half	<9,230	<9,140	<9,185
S96T005160	168: 3	Lower half	<9,960	<9,700	<9,830
S96T005305	168: 4	Lower half	<9,880	<9,870	<9,875
S96T005306	168: 5	Lower half	<10,200	<9,830	<10,015
S96T005311	168: 5A	Lower half	<10,100	<10,000	<10,050
S96T005161	168: 6A	Lower half	<9,940	<9,970	<9,955
S96T005323	171: 1	Lower half	<9,480	<9,480	<9,480
S96T005337	171: 3	Lower half	<9,380	<9,240	<9,310
S96T005338	171: 4	Lower half	<8,820	<8,880	<8,850
S97T000031	171: 5	Lower half	<10,100	<10,200	<10,150
S96T005352	171: 6	Upper half	<9,860	<9,320	<9,590
S96T005353		Lower half	<9,880	<9,170	<9,525
S96T005387	171: 7	Upper half	<9,100	<9,580	<9,340
S96T005388		Lower half	<9,980	<9,860	<9,920

Table B2-44. Tank 241-BY-111 Analytical Results: Vanadium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<20.1	<20.1	<20.1
S96T005319		Drainable liquid	<1.05	<1.05	<1.05
S96T005153	168: 6A	Drainable liquid	<20.1	<20.1	<20.1
S96T005346	171: 5	Drainable liquid	<20.1	<20.1	<20.1
S96T005357	171: 6	Drainable liquid	<20.1	<20.1	<20.1
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<941	<933	<937
S96T005169		Subsegment B	<1,010	<1,020	<1,015
S96T005150	168: 2	Lower half	<923	<914	<918.5
S96T005160	168: 3	Lower half	<996	<970	<983
S96T005305	168: 4	Lower half	<988	<987	<987.5
S96T005306	168: 5	Lower half	<1,020	<983	<1,001.5
S96T005311	168: 5A	Lower half	<1,010	<1,000	<1,005
S96T005161	168: 6A	Lower half	<994	<997	<995.5
S96T005323	171: 1	Lower half	<948	<948	<948
S96T005337	171: 3	Lower half	<938	<924	<931
S96T005338	171: 4	Lower half	<882	<888	<885
S97T000031	171: 5	Lower half	<1,010	<1,020	<1,015
S96T005352	171: 6	Upper half	<986	<932	<959
S96T005353		Lower half	<988	<917	<952.5
S96T005387	171: 7	Upper half	<910	<958	<934
S96T005388		Lower half	<998	<986	<992

Table B2-45. Tank 241-BY-111 Analytical Results: Zinc (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	11.3	11.2	11.25
S96T005319		Drainable liquid	1.92	1.94	1.93
S96T005153	168: 6A	Drainable liquid	<4.01	<4.01	<4.01
S96T005346	171: 5	Drainable liquid	<4.01	<4.01	<4.01
S96T005357	171: 6	Drainable liquid	<4.01	<4.01	<4.01
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<188	<187	<187.5
S96T005169		Subsegment B	<202	<203	<202.5
S96T005150	168: 2	Lower half	<185	<183	<184
S96T005160	168: 3	Lower half	<199	<194	<196.5
S96T005305	168: 4	Lower half	<198	<197	<197.5
S96T005306	168: 5	Lower half	<203	<197	<200
S96T005311	168: 5A	Lower half	<201	<201	<201
S96T005161	168: 6A	Lower half	<199	<199	<199
S96T005323	171: 1	Lower half	349	276	312.5[QC:e]
S96T005337	171: 3	Lower half	<188	<185	<186.5
S96T005338	171: 4	Lower half	183	<178	<180.5
S97T000031	171: 5	Lower half	<201	<204	<202.5
S96T005352	171: 6	Upper half	<197	<186	<191.5
S96T005353		Lower half	<198	<183	<190.5
S96T005387	171: 7	Upper half	<182	<192	<187
S96T005388		Lower half	<200	<197	<198.5

Table B2-46. Tank 241-BY-111 Analytical Results: Zirconium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<4.01	<4.01	<4.01
S96T005319		Drainable liquid	<0.21	<0.21	<0.21
S96T005153	168: 6A	Drainable liquid	<4.01	<4.01	<4.01
S96T005346	171: 5	Drainable liquid	<4.01	<4.01	<4.01
S96T005357	171: 6	Drainable liquid	<4.01	<4.01	<4.01
Solids: fusion			µg/g	µg/g	µg/g
S96T005168	168: 1	Subsegment A	<188	<187	<187.5
S96T005169		Subsegment B	<202	<203	<202.5
S96T005150	168: 2	Lower half	<185	<183	<184
S96T005160	168: 3	Lower half	<199	<194	<196.5
S96T005305	168: 4	Lower half	<198	<197	<197.5
S96T005306	168: 5	Lower half	<203	<197	<200
S96T005311	168: 5A	Lower half	<201	<201	<201
S96T005161	168: 6A	Lower half	<199	<199	<199
S96T005323	171: 1	Lower half	<190	<190	<190
S96T005337	171: 3	Lower half	<188	<185	<186.5
S96T005338	171: 4	Lower half	<176	<178	<177
S97T000031	171: 5	Lower half	<201	<204	<202.5
S96T005352	171: 6	Upper half	<197	<186	<191.5
S96T005353		Lower half	<198	<183	<190.5
S96T005387	171: 7	Upper half	<182	<192	<187
S96T005388		Lower half	<200	<197	<198.5

Table B2-47. Tank 241-BY-111 Analytical Results: Bromide (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S96T005170	168: 1	Subsegment A	<510.4	<509	<509.7
S96T005171		Subsegment B	<489.3	<494	<491.65
S96T005151	168: 2	Lower half	<995.9	<1,020	<1,007.95
S96T005162	168: 3	Lower half	<945.9	<964	<954.95
S96T005307	168: 4	Lower half	<949.2	<939	<944.1
S96T005308	168: 5	Lower half	<956.2	<977	<966.6
S96T005312	168: 5A	Lower half	<1,046	<999	<1,022.5
S96T005163	168: 6A	Lower half	1,569	1,510	1,539.5
S96T005324	171: 1	Lower half	<23.59	<22.7	<23.145
S96T005339	171: 3	Lower half	<500.5	<496	<498.25
S96T005340	171: 4	Lower half	<477.3	<472	<474.65
S96T005344	171: 5	Lower half	<1,021	<984	<1,002.5
S96T005354	171: 6	Upper half	<973.8	<941	<957.4
S96T005355		Lower half	<963.7	<991	<977.35
S96T005389	171: 7	Upper half	<473.5	<470	<471.75
S96T005390		Lower half	<489	<482	<485.5
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<643.9	<644	<643.95
S96T005319		Drainable liquid	29,320	29,500	29,410
S96T005153	168: 6A	Drainable liquid	31,530	31,700	31,615
S96T005346	171: 5	Drainable liquid	<517.6	<518	<517.8
S96T005357	171: 6	Drainable liquid	<517.6	<518	<517.8

Table B2-48. Tank 241-BY-111 Analytical Results: Chloride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			$\mu g/g$	$\mu g/g$	$\mu g/g$
S96T005170	168: 1	Subsegment A	233.3	283	258.15
S96T005171		Subsegment B	581	319	450[QC:e]
S96T005151	168: 2	Lower half	166.1	278	222.05[QC:e]
S96T005162	168: 3	Lower half	472.3	525	498.65
S96T005307	168: 4	Lower half	940.2	953	946.6
S96T005308	168: 5	Lower half	984.5	1,080	1,032.25
S96T005312	168: 5A	Lower half	2,694	2,530	2,612
S96T005163	168: 6A	Lower half	422.5	440	431.25
S96T005324	171: 1	Lower half	17.55	35.4	26.475[QC:e]
S96T005339	171: 3	Lower half	384.9	284	334.45[QC:e]
S96T005340	171: 4	Lower half	869.6	956	912.8
S96T005344	171: 5	Lower half	1,598	1,430	1,514
S96T005354	171: 6	Upper half	2,410	2,690	2,550
S96T005355		Lower half	1,643	2,100	1,871.5[QC:e]
S96T005389	171: 7	Upper half	2,968	2,740	2,854
S96T005390		Lower half	3,109	2,950	3,029.5
Liquids			$\mu g/mL$	$\mu g/mL$	$\mu g/mL$
S96T005314	168: 6	Drainable liquid	4,725	3,490	4,107.5[QC:e]
S96T005319		Drainable liquid	83.79	83.8	83.795
S96T005153	168: 6A	Drainable liquid	34.56	39.3	36.93
S96T005346	171: 5	Drainable liquid	4,058	4,130	4,094
S96T005357	171: 6	Drainable liquid	6,213	6,270	6,241.5

Table B2-49. Tank 241-BY-111 Analytical Results: Fluoride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			μg/g	μg/g	μg/g
S96T005170	168: 1	Subsegment A	13,630	13,300	13,465
S96T005171		Subsegment B	18,850	18,800	18,825
S96T005151	168: 2	Lower half	14,780	17,200	15,990
S96T005162	168: 3	Lower half	13,030	15,100	14,065
S96T005307	168: 4	Lower half	13,780	15,200	14,490
S96T005308	168: 5	Lower half	9,445	9,570	9,507.5
S96T005312	168: 5A	Lower half	2,729	3,330	3,029.5
S96T005163	168: 6A	Lower half	14,150	20,100	17,125[QC:e]
S96T005324	171: 1	Lower half	35.3	28.9	32.1
S96T005339	171: 3	Lower half	9,684	10,100	9,892
S96T005340	171: 4	Lower half	7,300	5,880	6,590[QC:e]
S96T005344	171: 5	Lower half	6,745	7,790	7,267.5
S96T005354	171: 6	Upper half	6,813	11,700	9,256.5[QC:e]
S96T005355		Lower half	5,435	6,670	6,052.5[QC:e]
S96T005389	171: 7	Upper half	8,649	8,660	8,654.5
S96T005390		Lower half	2,859	3,330	3,094.5
Liquids			μg/mL	μg/mL	μg/mL
S96T005314	168: 6	Drainable liquid	349.1	257	303.05[QC:e]
S96T005319		Drainable liquid	23.77	23.7	23.735
S96T005153	168: 6A	Drainable liquid	<13.33	<13.3	<13.315
S96T005346	171: 5	Drainable liquid	340.6	331	335.8
S96T005357	171: 6	Drainable liquid	296.8	297	296.9

Table B2-50. Tank 241-BY-111 Analytical Results: Nitrate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S96T005170	168: 1	Subsegment A	14,430	14,300	14,365
S96T005171		Subsegment B	18,890	16,900	17,895
S96T005151	168: 2	Lower half	2.642E+05	1.810E+05	2.226E+05[QC:e]
S96T005162	168: 3	Lower half	3.578E+05	3.060E+05	3.319E+05
S96T005307	168: 4	Lower half	2.809E+05	2.860E+05	2.835E+05
S96T005308	168: 5	Lower half	2.451E+05	2.480E+05	2.466E+05
S96T005312	168: 5A	Lower half	1.423E+05	1.390E+05	1.407E+05
S96T005163	168: 6A	Lower half	2.379E+05	1.410E+05	1.895E+05[QC:e]
S96T005324	171: 1	Lower half	374.1	726	550.05[QC:e]
S96T005339	171: 3	Lower half	14,010	13,300	13,655
S96T005340	171: 4	Lower half	1.240E+05	89,400	1.067E+05[QC:e]
S96T005344	171: 5	Lower half	2.086E+05	1.820E+05	1.953E+05
S96T005354	171: 6	Upper half	1.409E+05	1.000E+05	1.205E+05[QC:e]
S96T005355		Lower half	2.194E+05	1.480E+05	1.837E+05[QC:e]
S96T005389	171: 7	Upper half	1.524E+05	1.530E+05	1.527E+05
S96T005390		Lower half	96,460	98,000	97,230
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	2.547E+05	2.550E+05	2.549E+05[QC:e]
S96T005319		Drainable liquid	2,759	2,770	2,764.5
S96T005153	168: 6A	Drainable liquid	2,049	2,090	2,069.5
S96T005346	171: 5	Drainable liquid	1.811E+05	1.870E+05	1.841E+05
S96T005357	171: 6	Drainable liquid	1.646E+05	1.610E+05	1.628E+05

Table B2-51. Tank 241-BY-111 Analytical Results: Nitrite (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			**μg/g**	**μg/g**	**μg/g**
S96T005170	168: 1	Subsegment A	3,799	3,790	3,794.5
S96T005171		Subsegment B	4,218	3,930	4,074
S96T005151	168: 2	Lower half	2,631	2,950	2,790.5
S96T005162	168: 3	Lower half	7,715	8,590	8,152.5
S96T005307	168: 4	Lower half	14,040	14,600	14,320
S96T005308	168: 5	Lower half	16,230	18,400	17,315
S96T005312	168: 5A	Lower half	36,270	34,300	35,285
S96T005163	168: 6A	Lower half	4,074	3,720	3,897
S96T005324	171: 1	Lower half	116.6	183	149.8[QC:e]
S96T005339	171: 3	Lower half	3,556	3,490	3,523
S96T005340	171: 4	Lower half	11,680	12,500	12,090
S96T005344	171: 5	Lower half	21,500	18,900	20,200
S96T005354	171: 6	Upper half	29,140	28,800	28,970
S96T005355		Lower half	20,580	26,200	23,390[QC:e]
S96T005389	171: 7	Upper half	36,330	34,000	35,165
S96T005390		Lower half	38,030	36,200	37,115
Liquids			**μg/mL**	**μg/mL**	**μg/mL**
S96T005314	168: 6	Drainable liquid	67,910	28,800	48,355[QC:e]
S96T005319		Drainable liquid	885.8	877	881.4
S96T005153	168: 6A	Drainable liquid	381.1	371	376.05
S96T005346	171: 5	Drainable liquid	56,580	57,400	56,990
S96T005357	171: 6	Drainable liquid	58,730	58,200	58,465

Table B2-52. Tank 241-BY-111 Analytical Results: Oxalate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S96T005170	168: 1	Subsegment A	30,300	30,100	30,200
S96T005171		Subsegment B	42,520	39,400	40,960
S96T005151	168: 2	Lower half	33,820	39,700	36,760
S96T005162	168: 3	Lower half	24,040	28,300	26,170
S96T005307	168: 4	Lower half	30,230	33,400	31,815
S96T005308	168: 5	Lower half	21,320	22,800	22,060
S96T005312	168: 5A	Lower half	12,970	13,700	13,335
S96T005163	168: 6A	Lower half	7,585	5,710	6,647.5[QC:e]
S96T005324	171: 1	Lower half	<19.82	52.9	<36.36[QC:e]
S96T005339	171: 3	Lower half	34,380	32,300	33,340
S96T005340	171: 4	Lower half	13,490	12,000	12,745
S96T005344	171: 5	Lower half	17,950	16,600	17,275
S96T005354	171: 6	Upper half	5,626	6,820	6,223
S96T005355		Lower half	5,983	7,270	6,626.5
S96T005389	171: 7	Upper half	13,430	12,700	13,065
S96T005390		Lower half	11,510	13,200	12,355
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<540.9	<541	<540.95
S96T005319		Drainable liquid	<116.7	<117	<116.85
S96T005153	168: 6A	Drainable liquid	<116.7	<117	<116.85
S96T005346	171: 5	Drainable liquid	2,991	<435	<1,713[QC:e]
S96T005357	171: 6	Drainable liquid	<434.8	<435	<434.9

Table B2-53. Tank 241-BY-111 Analytical Results: Phosphate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S96T005170	168: 1	Subsegment A	13,370	13,200	13,285
S96T005171		Subsegment B	14,540	22,000	18,270[QC:e]
S96T005151	168: 2	Lower half	8,401	7,550	7,975.5
S96T005162	168: 3	Lower half	13,170	13,500	13,335
S96T005307	168: 4	Lower half	9,598	8,460	9,029
S96T005308	168: 5	Lower half	11,440	12,000	11,720
S96T005312	168: 5A	Lower half	7,776	7,360	7,568
S96T005163	168: 6A	Lower half	1.273E+05	1.840E+05	1.557E+05[QC:e]
S96T005324	171: 1	Lower half	57	49.8	53.4
S96T005339	171: 3	Lower half	6,178	9,000	7,589[QC:e]
S96T005340	171: 4	Lower half	10,800	5,210	8,005[QC:e]
S96T005344	171: 5	Lower half	10,370	22,600	16,485[QC:e]
S96T005354	171: 6	Upper half	9,579	5,590	7,584.5[QC:e]
S96T005355		Lower half	2,741	1,770	2,255.5[QC:e]
S96T005389	171: 7	Upper half	2,305	6,070	4,187.5[QC:e]
S96T005390		Lower half	4,203	3,530	3,866.5
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	<618.1	924	<771.05[QC:e]
S96T005319		Drainable liquid	<133.3	<133	<133.15
S96T005153	168: 6A	Drainable liquid	<133.3	<133	<133.15
S96T005346	171: 5	Drainable liquid	580.6	825	702.8[QC:e]
S96T005357	171: 6	Drainable liquid	682.2	679	680.6

Table B2-54. Tank 241-BY-111 Analytical Results: Sulfate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S96T005170	168: 1	Subsegment A	52,900	51,400	52,150
S96T005171		Subsegment B	79,600	71,900	75,750
S96T005151	168: 2	Lower half	58,940	69,300	64,120
S96T005162	168: 3	Lower half	46,970	56,600	51,785
S96T005307	168: 4	Lower half	52,630	57,900	55,265
S96T005308	168: 5	Lower half	38,270	40,200	39,235
S96T005312	168: 5A	Lower half	9,919	16,800	13,359.5[QC:e]
S96T005163	168: 6A	Lower half	3,269	1,480	2,374.5[QC:e]
S96T005324	171: 1	Lower half	208.8	277	242.9[QC:e]
S96T005339	171: 3	Lower half	41,560	41,600	41,580
S96T005340	171: 4	Lower half	28,810	25,900	27,355
S96T005344	171: 5	Lower half	23,220	22,700	22,960
S96T005354	171: 6	Upper half	32,430	47,700	40,065[QC:e]
S96T005355		Lower half	23,730	29,800	26,765[QC:e]
S96T005389	171: 7	Upper half	41,070	43,900	42,485
S96T005390		Lower half	20,840	24,400	22,620
Liquids			µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	1,278	1,520	1,399
S96T005319		Drainable liquid	<153.3	<153	<153.15
S96T005153	168: 6A	Drainable liquid	<153.3	<153	<153.15
S96T005346	171: 5	Drainable liquid	<571.5	<571	<571.25
S96T005357	171: 6	Drainable liquid	743.5	<571	<657.25[QC:e]

Table B2-55. Tank 241-BY-111 Analytical Results: Total Inorganic Carbon.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Triplicate	Mean
Solids			µg/g	µg/g	µg/g	µg/g
S96T005166	168: 1	Subsegment A	54,500	56,300		55,400
S96T005167		Subsegment B	40,300	41,000		40,650
S96T005148	168: 2	Lower half	30,600	36,000		33,300
S96T005157	168: 3	Lower half	44,100	25,500	37,100	35,566.7[QC:c,e]
S96T005301	168: 4	Lower half	19,300	12,300	17,000	16,200[QC:e]
S96T005304	168: 5	Lower half	29,900	25,200		27,550
S96T005310	168: 5A	Lower half	8,390	9,320		8,855[QC:d]
S96T005158	168: 6A	Lower half	1,310	1,320		1,315
S96T005321	171: 1	Lower half	1,030	1,000		1,015
S96T005335	171: 3	Lower half	40,100	40,900		40,500
S96T005336	171: 4	Lower half	8,410	8,710		8,560
S96T005342	171: 5	Lower half	16,400	17,700		17,050[QC:d]
S96T005349	171: 6	Upper half	16,400	11,200	14,900	14,166.7[QC:e]
S96T005350		Lower half	17,900	11,000	14,000	14,300[QC:e]
S96T005383	171: 7	Upper half	2,880	2,360		2,620
S96T005384		Lower half	4,200	4,320		4,260
Liquids			µg/mL	µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	3,710	4,110		3,910[QC:f]
S96T005346	171: 5	Drainable liquid	2,920	2,980		2,950[QC:f]
S96T005357	171: 6	Drainable liquid	1,730	1,920		1,825[QC:f]

Table B2-56. Tank 241-BY-111 Analytical Results: Total Organic Carbon.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Triplicate	Mean
Solids			µg/g	µg/g	µg/g	µg/g
S96T005166	168: 1	Subsegment A	7,990	8,200		8,095
S96T005167		Subsegment B	11,300	11,600		11,450
S96T005148	168: 2	Lower half	11,600	11,200		11,400
S96T005157	168: 3	Lower half	8,960	9,370		9,165
S96T005301	168: 4	Lower half	7,540	8,000	8,690	8,076.67[QC:d]
S96T005304	168: 5	Lower half	10,000	9,030		9,515
S96T005310	168: 5A	Lower half	3,000	3,420		3,210
S96T005158	168: 6A	Lower half	1,750	2,430	1,680	1,953.33[QC:e]
S96T005321	171: 1	Lower half	1,320	1,120		1,220
S96T005335	171: 3	Lower half	9,820	10,000		9,910
S96T005336	171: 4	Lower half	4,870	3,790		4,330[QC:e]
S96T005342	171: 5	Lower half	5,130	5,150		5,140[QC:e]
S96T005349	171: 6	Upper half	2,120	2,360		1,506.67
S96T005350		Lower half	2,640	2,540		1,740
S96T005383	171: 7	Upper half	4,250	4,350		4,300
S96T005384		Lower half	4,920	4,180		4,550
Liquids			µg/mL	µg/mL	µg/mL	µg/mL
S96T005314	168: 6	Drainable liquid	1,350	1,480		1,415[QC:f]
S96T005346	171: 5	Drainable liquid	1,210	1,250		1,230[QC:f]
S96T005357	171: 6	Drainable liquid	1,140	1,240		1,190[QC:f]

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS

The purpose of this chapter is to discuss the overall quality and consistency of the current sampling results for tank 241-BY-111.

This section also evaluates sampling and analysis factors that may impact interpretation of the data. These factors are used to assess the overall quality and consistency of the data and to identify any limitations in the use of the data.

B3.1 FIELD OBSERVATIONS

The safety screening DQO requirement (Dukelow 1995) that at least two widely spaced risers be sampled. This was only partially fulfilled because only partial core samples could be obtained by the push method. Additional samples are required to more fully characterize this tank. Sample recovery was poor (less than 30 percent for most of the segments) for the risers sampled and full vertical profiles were not obtained from either riser. Hydrostatic head fluid (HHF) intrusions were negligible.

Nine segments per core were expected to be taken from tank 241-BY-111. However, sampling problems prevented obtaining nine segments from both cores. Only six push mode core segments and seven segments were obtained from risers 4 and 15, respectively. At that depth, the sampling system should have been sampling MW, which is not expected to cause difficulty in sampling.

Because of the incomplete recovery of these core samples, the representativeness of the samples is brought into question. The bottommost 144 cm (57 in.) of core 168 and the bottommost 96 cm (38 in.) of core 171 were not obtained. Because the full depth of the waste was not sampled, the requirement that full vertical profiles of the waste be obtained was not met.

B3.2 QUALITY CONTROL ASSESSMENT

The usual quality control assessment includes an evaluation of the appropriate standard recoveries, spike recoveries, duplicate analyses, and blanks that are performed in conjunction with the chemical analyses. All the pertinent quality control tests were conducted on the 1996 core samples, allowing a full assessment regarding the accuracy and precision of the data. The TSAP (Kruger 1996) established the specific criteria for all analytes. Sample and duplicate pairs that had one or more QC results outside the specified criteria were identified by footnotes in the data summary tables.

The standard and spike recovery results provide an estimate of the accuracy of the analysis. If a standard or spike recovery is above or below the given criterion, the analytical results may be biased high or low, respectively. The precision is estimated by the relative percent difference (RPD), which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times one hundred.

In summary, the vast majority of the QC results were within the boundaries specified in the TSAPs. The discrepancies mentioned here and footnoted in the data summary tables should not impact either the validity or the use of the data. All the discussion for various results have been discussed in previous sections.

B3.3 DATA CONSISTENCY CHECKS

Comparisons of different analytical methods can help to assess the consistency and quality of the data. Several comparison were possible with the data set provided by the two core samples. Including a comparison of phosphorous as analyzed by ICP with phosphate as analyzed by IC, and of sulfur as analyzed by ICP with sulfate as analyzed by IC.
In addition, mass and charge balances were calculated to help assess the overall data consistency.

B3.3.1 Comparison of Results from Different Analytical Methods

The following data consistency checks compare the results from two analytical methods for a given analyte. A close comparison between the two methods can strengthen the credibility of both results; a poor comparison may bring the reliability of the data or the assumptions about the waste into question. All segment analytical mean results were taken from tables in Section B2.0.

The analytical phosphorus mean result as determined by ICP was 9,810 μg/g which converts to 30,000 μg/g of phosphate. This does not compare well with the IC phosphate mean result of 20,000 μg/g. The RPD between these two phosphate results was 40 percent and strongly suggests that a substantial portion of the phosphate in this waste is insoluble.

The ICP sulfur value in the saltcake of 11,800 μg/g converts to 35,400 μg/g of sulfate (assuming all the sulfur is present as sulfate). This compares favorably with the IC sulfate result of 34,400 μg/g. The RPD between the two sulfate estimates was a low 3.0 percent, meaning that almost all of the sulfur/sulfate in the saltcake was soluble.

B3.3.2 Mass and Charge Balance

The principle objective in performing mass and charge balances is to determine if the measurements are consistent. In calculating the balances, only analytes listed in Section B2.0 detected at a concentration of 1,000 μg/g or greater were considered.

Except sodium, all cations listed in Table B3-1 were assumed to be in their most common hydroxide or oxide form, and the concentrations of the assumed species were calculated stoichiometrically. Because precipitates are neutral species, all positive charge was attributed to the sodium cation. Acetate and carbonate were the species assumed; they were derived from the total organic carbon and total inorganic carbon analyses, respectively. The other anionic analytes listed in Table B3-2 were assumed to be present as mostly sodium salts and were expected to balance the positive charge exhibited by the cations. Sulfur present as the sulfate ion, was assumed to be completely water soluble, and appeared only in the anion mass and charge calculations. Phosphate was calculated from phosphorus and appears only in the anion mass and charge calculations. The concentrations of cationic species in Table B3-1, the anionic species in Table B3-2, and the percent water were ultimately used to calculate the mass balance.

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

Mass balance = % water + 0.0001 x {total analyte concentration}
= % water + 0.0001 x $\{FeO(OH) + Cr(OH)_3 + SiO_2 + Na^+ + C_2H_3O_2^- + CO_3^{-2}$
$+ Al(OH)_4^- + F^- + Cl^- + NO_3^- + NO_2^- + (COO)_2^{-2} + PO_4^{-3} + SO_4^{-2}\}$

The total analyte concentrations calculated from the above equation was 703,000 μg/g. The mean weight percent water obtained from thermogravimetric analysis was 31.7 percent (See Section B3.4.1). The mass balance resulting from adding the percent water to the total analyte concentration is 112 percent (Table B3-3).

Table B3-1. Cation Mass and Charge Data.

Analyte	Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge (μeq/g)
Chromium	2,060	$Cr(OH)_3$	4,080	0.00
Iron	5,960	FeO(OH)	9,470	0.00
Silicon	34,500	SiO_2	73,900	0.00
Sodium	241,000	Na^+	241,000	10,500
Totals			328,000	10,500

Table B3-2. Anion Mass and Charge Data.

Analyte	Concentration ($\mu g/g$)	Assumed Species	Concentration of Assumed Species ($\mu g/g$)	Charge ($\mu eq/g$)
Aluminum	25,000	$Al(OH)_4^-$	87,900	263
Acetate (TOC)	6,100	$C_2H_3O_2^-$	30,000	506
Carbonate (TIC)	19,500	CO_3^{-2}	97,500	3,250
Fluoride	9,620	F^-	9,620	506
Chloride	1,090	Cl^-	1,090	31
Nitrate	153,200	NO_3^-	153,200	2,470
Nitrite	14,200	NO_2^-	14,200	309
Oxalate	19,300	$(COO)_2^{-2}$	19,300	438
Phosphate[1]	30,000	PO_4^{-3}	30,000	946
Sulfate	34,400	SO_4^{-2}	34,400	715
Totals			477,000	9,430

Note:
[1]Calculated from phosphorus results.

Table B3-3. Solid Mass Balance Totals.

	Concentrations ($\mu g/g$)	Charge ($\mu eq/g$)
Total from Table B3-1 (cations)	328,000	10,500
Total from Table B3-2 (anions)	477,000	-9,430
Water %	317,000	0.00
Sub-total	1,120,000	1,070

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

Total cations (microequivalents) = $Na^+/23.0$ = 10,500 microequivalents

Total anions (microequivalents) = $Al(OH)_4^-/95.0 + C_2H_3O_2^-/59.0 + CO_3^{-2}/30.0 + F^-/19.0 + Cl^-/35.5 + NO_3^-/62.0 + NO_2^-/46.0 + (COO)_2^{-2}/44.0 + PO_4^{-3}/31.7 + SO_4^{-2}/48.1$ = -9,430 microequivalents

The charge balance was 1.11. 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 positive charge was 1,070 microequivalents. In summary, the above calculations yield reasonable mass and charge balance values (close to 1.00 for charge balance and 100 percent for mass balance), indicating that the analytical results are generally consistent.

B3.4 MEAN CONCENTRATIONS AND CONFIDENCE INTERVALS

The following evaluation was performed on the analytical data from the samples from tank 241-BY-111.

Because an inventory estimate is needed without comparing it to a threshold value, two-sided 95 percent confidence intervals on the mean inventory are computed. This was done with segment-level data.

The lower and upper limits (LL and UL) to a two-sided 95 percent confidence interval for the mean are

$$\hat{\mu} \pm t_{(df,0.025)} \times \hat{\sigma}_{\hat{\mu}}.$$

In this equation, $\hat{\mu}$ is the estimate of the mean concentration, $\hat{\sigma}_{\hat{\mu}}$ is the estimate of the standard deviation of the mean concentration, and $t_{(df,0.025)}$ is the quantile from Student's t distribution with degrees of freedom (df) for a two-sided 95 percent confidence interval.

The mean, $\hat{\mu}$, and the standard deviation, $\hat{\sigma}_{\hat{\mu}}$, were estimated using restricted maximum likelihood estimation (REML) methods. The degrees of freedom, for tank 241-BY-111, is the number of cores sampled minus one.

B3.4.1 Liquid and Solid Segment Means

The statistics in this section were based on analytical data from the most recent sampling event of tank 241-BY-111. Analysis of variance (ANOVA) techniques were used to estimate the mean, and calculate confidence limits on the mean, for all analytes that had at least 50 percent of reported values above the detection limit. If at least 50 percent of the reported values were above the detection limit, all of the data was used in the computations. The detection limit was used as the value for nondetected results. No ANOVA estimates were computed for analytes with less than 50 percent detected values. Only arithmetic means were computed for these analytes.

The results given below are ANOVA estimates based on the core segment data from core 168 and core 171 for tank 241-BY-111. Estimates of the mean concentration, and confidence interval on the mean concentration, are given in Table B3-4 for solid segment sample data and given in Table B3-5 for liquid segment sample data. The lower limit, LL, to a 95 percent confidence interval can be negative. Because an actual concentration of less than zero is not possible, the lower limit is reported as zero, whenever this occurred.

Table B3-4. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Solid Segment Sample Data. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
% Water	%	3.17E+01	4.61E+00	1	0.00E+00	9.03E+01
Alpha[2]	µCi/g	1.02E-01	7.87E-02	1	0.00E+00	1.10E+00
Bulk Density	g/mL	1.57E+00	1.76E-01	1	0.00E+00	3.81E+00
DSC-Dry	J/g	5.17E+01	1.89E+01	1	0.00E+00	2.91E+02
ICP.f.Al	µg/g	2.50E+04	1.64E+04	1	0.00E+00	2.34E+05
ICP.f.Sb[1]	µg/g	<1.16E+03	n/a	n/a	n/a	n/a
ICP.f.As[1]	µg/g	<1.93E+03	n/a	n/a	n/a	n/a
ICP.f.Ba[1]	µg/g	<9.66E+02	n/a	n/a	n/a	n/a
ICP.f.Be[1]	µg/g	<9.66E+01	n/a	n/a	n/a	n/a
ICP.f.Bi[1]	µg/g	<1.93E+03	n/a	n/a	n/a	n/a
ICP.f.B[1]	µg/g	<9.66E+02	n/a	n/a	n/a	n/a
Bromide[1]	µg/g	<7.71E+02	n/a	n/a	n/a	n/a
ICP.f.Cd[1]	µg/g	<9.66E+01	n/a	n/a	n/a	n/a
ICP.f.Ca[1]	µg/g	<4.18E+03	n/a	n/a	n/a	n/a
ICP.f.Ce[1]	µg/g	<1.93E+03	n/a	n/a	n/a	n/a
Chloride	µg/g	1.09E+03	2.70E+02	1	0.00E+00	4.53E+03
ICP.f.Cr[2]	µg/g	2.06E+03	3.78E+02	1	0.00E+00	6.86E+03
ICP.f.Co[1]	µg/g	<3.86E+02	n/a	n/a	n/a	n/a
ICP.f.Cu[1]	µg/g	<1.93E+02	n/a	n/a	n/a	n/a
Fluoride	µg/g	9.62E+03	3.29E+03	1	0.00E+00	5.14E+04
ICP.f.Fe[2]	µg/g	5.96E+03	4.10E+03	1	0.00E+00	5.81E+04
ICP.f.La[1]	µg/g	<9.66E+02	n/a	n/a	n/a	n/a
ICP.f.Pb[1]	µg/g	<1.93E+03	n/a	n/a	n/a	n/a
ICP.f.Li[1]	µg/g	<1.94E+02	n/a	n/a	n/a	n/a
ICP.f.Mg[1]	µg/g	<2.52E+03	n/a	n/a	n/a	n/a
ICP.f.Mn[1]	µg/g	<2.46E+02	n/a	n/a	n/a	n/a

Table B3-4. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Solid Segment Sample Data. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
ICP.f.Mo[1]	μg/g	<9.66E+02	n/a	n/a	n/a	n/a
ICP.f.Nd[1]	μg/g	<1.93E+03	n/a	n/a	n/a	n/a
Nitrate	μg/g	1.53E+05	5.16E+04	1	0.00E+00	8.09E+05
Nitrite	μg/g	1.42E+04	3.42E+03	1	0.00E+00	5.77E+04
Oxalate[2]	μg/g	1.93E+04	5.45E+03	1	0.00E+00	8.86E+04
Phosphate	μg/g	2.00E+04	1.23E+04	1	0.00E+00	1.76E+05
ICP.f.P[2]	μg/g	9.81E+03	4.92E+03	1	0.00E+00	7.23E+04
ICP.f.Sm[1]	μg/g	<1.93E+03	n/a	n/a	n/a	n/a
ICP.f.Se[1]	μg/g	<1.93E+03	n/a	n/a	n/a	n/a
ICP.f.Si[2]	μg/g	3.45E+04	3.33E+04	1	0.00E+00	4.58E+05
ICP.f.Ag[1]	μg/g	<1.93E+02	n/a	n/a	n/a	n/a
ICP.f.Na	μg/g	2.41E+05	2.64E+04	1	0.00E+00	5.77E+05
ICP.f.Sr[1]	μg/g	<2.05E+02	n/a	n/a	n/a	n/a
Sulfate	μg/g	3.44E+04	7.28E+03	1	0.00E+00	1.27E+05
ICP.f.S[2]	μg/g	1.18E+04	2.79E+03	1	0.00E+00	4.73E+04
TIC	μg/g	1.95E+04	5.25E+03	1	0.00E+00	8.62E+04
TOC[3]	μg/g	6.10E+03	1.53E+03	1	0.00E+00	2.55E+04
ICP.f.Tl[1]	μg/g	<3.86E+03	n/a	n/a	n/a	n/a
ICP.f.Ti[1]	μg/g	<6.92E+02	n/a	n/a	n/a	n/a
ICP.f.U[1]	μg/g	<9.66E+03	n/a	n/a	n/a	n/a
ICP.f.V[1]	μg/g	<9.66E+02	n/a	n/a	n/a	n/a
ICP.f.Zn[1]	μg/g	<2.01E+02	n/a	n/a	n/a	n/a
ICP.f.Zr[1]	μg/g	<1.93E+02	n/a	n/a	n/a	n/a

Notes:

n/a = not applicable.

[1]More than 50 percent of the analytical results were less than values; therefore, confidence intervals were not computed.

[2]Some "less-than" values are in the analytical results.

[3]Wet Basis.

Table B3-5. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Segment Sample Data. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
% Water	%	5.38E+01	1.84E-01	1	5.15E+01	5.62E+01
SpG	g/mL	1.42E+00	3.61E-03	1	1.38E+00	1.47E+00
DSC-Dry	J/g	1.59E+01	1.57E+01	1	0.00E+00	2.16E+02
Alpha[1]	µCi/mL	<7.30E-03	n/a	n/a	n/a	n/a
ICP.a.Al	µg/mL	4.13E+04	6.12E+03	1	0.00E+00	1.19E+05
ICP.a.Sb[1]	µg/mL	<2.41E+01	n/a	n/a	n/a	n/a
ICP.a.As[1]	µg/mL	<4.01E+01	n/a	n/a	n/a	n/a
ICP.a.Ba[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
ICP.a.Be[1]	µg/mL	<2.00E+00	n/a	n/a	n/a	n/a
ICP.a.Bi[1]	µg/mL	<4.01E+01	n/a	n/a	n/a	n/a
ICP.a.B	µg/mL	3.10E+01	6.98E-01	1	2.21E+01	3.98E+01
Bromide[1]	µg/mL	<5.60E+02	n/a	n/a	n/a	n/a
ICP.a.Cd[1]	µg/mL	<2.00E+00	n/a	n/a	n/a	n/a
ICP.a.Ca[1]	µg/mL	<4.01E+01	n/a	n/a	n/a	n/a
ICP.a.Ce[1]	µg/mL	<4.01E+01	n/a	n/a	n/a	n/a
Chloride	µg/mL	4.79E+03	5.07E+02	1	0.00E+00	1.12E+04
ICP.a.Cr	µg/mL	6.13E+03	7.63E+02	1	0.00E+00	1.58E+04
ICP.a.Co[1]	µg/mL	<8.02E+00	n/a	n/a	n/a	n/a
ICP.a.Cu[1]	µg/mL	<4.01E+00	n/a	n/a	n/a	n/a
Fluoride	µg/mL	3.12E+02	1.42E+01	1	1.32E+02	4.92E+02
ICP.a.Fe[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
ICP.a.La[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
ICP.a.Pb	µg/mL	9.01E+01	4.85E+00	1	2.85E+01	1.52E+02
ICP.a.Li[1]	µg/mL	<4.19E+00	n/a	n/a	n/a	n/a
ICP.a.Mg[1]	µg/mL	<4.01E+01	n/a	n/a	n/a	n/a
ICP.a.Mn[1]	µg/mL	<4.01E+00	n/a	n/a	n/a	n/a
ICP.a.Mo	µg/mL	3.29E+01	7.81E-01	1	2.30E+01	4.29E+01
ICP.a.Nd[1]	µg/mL	<4.01E+01	n/a	n/a	n/a	n/a
ICP.a.Ni[1]	µg/mL	<8.02E+00	n/a	n/a	n/a	n/a
Nitrate	µg/mL	2.14E+05	4.07E+04	1	0.00E+00	7.32E+05

Table B3-5. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Segment Sample Data. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
Nitrite	μg/mL	5.46E+04	5.43E+03	1	0.00E+00	1.24E+05
Oxalate[1]	μg/mL	<8.96E+02	n/a	n/a	n/a	n/a
Phosphate[2]	μg/mL	7.18E+02	5.34E+01	1	4.00E+01	1.40E+03
ICP.a.P	μg/mL	3.24E+02	5.06E+00	1	2.60E+02	3.88E+02
ICP.a.K	μg/mL	5.03E+03	2.27E+02	1	2.14E+03	7.92E+03
ICP.a.Sm[1]	μg/mL	<4.01E+01	n/a	n/a	n/a	n/a
ICP.a.Se[1]	μg/mL	<4.06E+01	n/a	n/a	n/a	n/a
ICP.a.Si	μg/mL	3.78E+02	1.14E+02	1	0.00E+00	1.83E+03
ICP.a.Ag	μg/mL	1.54E+01	5.37E-01	1	8.57E+00	2.22E+01
ICP.a.Na	μg/mL	2.15E+05	5.12E+03	1	1.50E+05	2.80E+05
ICP.a.Sr[1]	μg/mL	<4.01E+00	n/a	n/a	n/a	n/a
Sulfate[2]	μg/mL	1.01E+03	3.93E+02	1	0.00E+00	6.00E+03
ICP.a.S	μg/mL	5.51E+02	2.97E+01	1	1.74E+02	9.29E+02
TIC	μg/mL	3.12E+03	7.61E+02	1	0.00E+00	1.28E+04
TOC[3]	μg/mL	1.31E+03	1.02E+02	1	8.06E+00	2.61E+03
ICP.a.Tl[1]	μg/mL	<8.02E+01	n/a	n/a	n/a	n/a
ICP.a.Ti[1]	μg/mL	<4.01E+00	n/a	n/a	n/a	n/a
ICP.a.U[1]	μg/mL	<2.00E+02	n/a	n/a	n/a	n/a
ICP.a.V[1]	μg/mL	<2.01E+01	n/a	n/a	n/a	n/a
ICP.a.Zn[1]	μg/mL	<6.42E+00	n/a	n/a	n/a	n/a
ICP.a.Zr[1]	μg/mL	<4.01E+00	n/a	n/a	n/a	n/a

Notes:

n/a = not applicable

[1]More than 50 percent of the analytical results were less than values; therefore, confidence intervals were not computed.

[2]Some "less-than" values are in the analytical results.

[3]Wet Basis.

B3.4.2 Analysis of Variance Models

A statistical model is needed to account for the spatial and measurement variability in $\hat{\sigma}_{\hat{\mu}}$. This cannot be done using an ordinary standard deviation of the data (Snedecor and Cochran 1980).

The statistical model fit to the solid segment data for bulk density is

$$Y_{ij} = \mu + C_i + A_{ij},$$

$$I=1,\ldots,a,\ j=1,\ldots,n_i,$$

where

Y_{ij}	=	laboratory results from the j^{th} duplicate from the i^{th} core in the tank
μ	=	the grand mean
C_i	=	the effect of the i^{th} core
A_{ij}	=	the effect of the j^{th} analytical result from the i^{th} core
a	=	the number of cores
n_i	=	the number of analytical results from the i^{th} core

The variable C_i is assumed to be a random effect. This variable and A_{ij} are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^{2©}$ and $\sigma^2(A)$, respectively. Estimates of $\sigma^{2©}$ and $\sigma^2(A)$ were obtained using reduction estimated maximum likelihood (REML) techniques. This method, applied to variance component estimation, is described in Harville (1977). The statistical results were obtained using the statistical analysis package S-PLUS[4] (StatSci 1993).

The statistical model fit to all liquid segment data and the solid segment data for alpha is

$$Y_{ijk} = \mu + C_i + S_{ij} + A_{ijk},$$

$$I=1,\ldots,a,\ j=1,\ldots,b_i,\ k=1,\ldots n_{ij}$$

where

Y_{ijk}	=	laboratory results from the k^{th} duplicate from the j^{th} segment in the i^{th} core in the tank

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S-PLUS is a trademark of Statistical Sciences, Incorporated, Seattle, Washington.

μ	=	the grand mean
C_i	=	the effect of the i^th^ core
S_{ij}	=	the effect of the j^th^ segment from the i^th^ core
A_{ijk}	=	the effect of the k^th^ analytical result from the j^th^ segment from the i^th^ core
a	=	the number of cores
b_i	=	the number of segments from the i^th^ core
n_{ij}	=	the number of analytical results from the j^th^ segment from the i^th^ core

The variables C_i and S_{ij} are assumed to be a random effect. This variable and A_{ij} are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(C)$, $\sigma^2(S)$, and $\sigma^2(A)$, respectively. Estimates of $\sigma^2(C)$, $\sigma^2(S)$, and $\sigma^2(A)$ were obtained using REML techniques. This method, applied to variance component estimation, is described in Harville (1977). The statistical results were obtained using the statistical analysis package S-PLUS™ (StatSci 1993).

The statistical model fit to the remaining solid segment data is

$$Y_{ijkm} = \mu + C_i + S_{ij} + L_{ijk} + A_{ijkm},$$

$$I=1,\ldots,a,\ j=1,\ldots,b_i,\ k=1,\ldots,c_{ij},\ m=1,\ldots,d_{ijk}$$

where

Y_{ijkm}	=	laboratory results from the m^th^ duplicate in the k^th^ location in the j^th^ segment in the i^th^ core in the tank
μ	=	the grand mean
C_i	=	the effect of the i^th^ core
S_{ij}	=	the effect of the j^th^ segment in the i^th^ core
L_{ijk}	=	the effect of the k^th^ location in the j^th^ segment in the i^th^ core
A_{ijkm}	=	the effect of the m^th^ duplicate result in the k^th^ location in the j^th^ segment in the i^th^ core
a	=	the number of cores

b_i = the number of segments in the i^{th} core

c_{ij} = the number of locations from the j^{th} segment in the i^{th} core

n_{ijk} = the number of analytical results from the k^{th} location in the j^{th} segment in the i^{th} core

The variable C_i, S_{ij}, and L_{ijk} are assumed to be random effects. These variables and A_{ijkm} are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(C)$, $\sigma^2(S)$, $\sigma^2(L)$, and $\sigma^2(A)$, respectively. Estimates of $\sigma^2(C)$, $\sigma^2(S)$, $\sigma^2(L)$, and $\sigma^2(A)$ were obtained using REML techniques. This method, applied to variance component estimation, is described in Harville (1977). The statistical results were obtained using statistical analysis package S-PLUS™ (StatSci 1993).

B4.0 APPENDIX B REFERENCES

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

Appendix C provides the results of the statistical analyses required for the applicable DQOs reports for tank 241-BY-111 including statistical and other numerical manipulations. Appendix C includes the following:

- **Section C1.0**: Statistical analysis supporting the Safety Screening DQO (Dukelow et al. 1995). Specifically, confidence intervals were needed to support the plutonium (criticality) and DSC threshold limit.

- **Section C2.0**: Appendix C References

C1.0 STATISTICS FOR SAFETY SCREENING DATA QUALITY OBJECTIVES

The safety screening DQO (Dukelow et al. 1995) defines acceptable decision confidence limits in terms of one-sided 95 percent confidence intervals. In this appendix, one-sided confidence limits supporting the safety screening DQO are calculated for tank 241-BY-111. All data in this section are from the final laboratory data package for the 1996 core sampling event for tank 241-BY-111 (Nuzum 1997).

Confidence intervals were computed for each sample number from tank 241-BY-111 analytical data. The sample numbers and confidence intervals are provided in Table C1-1 for alpha and in Table C1-2 for DSC.

The upper limit (UL) of a one-sided 95 percent confidence interval on the mean is

$$\hat{\mu} + t_{(df,0.05)} * \hat{\sigma}_{\hat{\mu}}.$$

In this equation, $\hat{\mu}$ is the arithmetic mean of the data, $\hat{\sigma}_{\hat{\mu}}$ is the estimate of the standard deviation of the mean, and $t_{(df,0.05)}$ is the quantile from Student's t distribution with df (degrees of freedom) for a one-sided 95 percent confidence interval.

For the tank 241-BY-111 data (per sample number), df equals the number of observations minus one.

The UL of the 95 percent confidence interval for each sample number based on alpha data is listed in Table C1-1. Each confidence interval can be used to make the following statement. If the upper limit is less than 32.7 μCi/g (61.5 μCi/mL for liquid), reject the null hypothesis that the alpha is greater than or equal to 32.7 μCi/g (61.5 μCi/mL for liquid) at the 0.05 level of significance. The results indicate there is no criticality concern for tank 241-BY-111.

The UL of the 95 percent confidence interval for each sample number based on DSC data is listed in Table C1-2. Each confidence interval can be used to make the following statement. If the upper limit is less than 480 J/g, reject the null hypothesis that DSC is greater than or equal to 480 J/g at the 0.05 level of significance. The results indicate that there is no energetics concern for the sampled waste.

Table C1-1. 95 Percent Confidence Interval Upper Limits for Alpha for Tank 241-BY-111. (Units are μCi/g or μCi/mL)

Sample Number	Sample Description	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	UL
S96T005169	Core 168, Segment 1, quarter B	5.38E-02	6.40E-03	9.42E-02
S96T005150[1]	Core 168, Segment 2, lower half	5.13E-01	2.39E-01	2.02E+00
S96T005160[1,2]	Core 168, Segment 3, lower half	3.40E-01	4.90E-02	6.49E-01
S96T005305[1,2]	Core 168, Segment 4, lower half	2.76E-01	2.05E-02	4.05E-01
S96T005306	Core 168, Segment 5, lower half	4.17E-02	5.80E-03	7.83E-02
S96T005311	Core 168, Segment 5A, lower half	2.64E-02	3.60E-03	4.91E-02
S96T005314[1]	Core 168, Segment 6, drainable liquid	9.13E-03	1.68E-03	1.97E-02
S96T005161	Core 168, Segment 6A, lower half	3.38E-03	1.85E-04	4.54E-03
S96T005323	Core 171, Segment 1, lower half	8.57E-04	1.93E-04	2.08E-03
S96T005337	Core 171, Segment 3, lower half	5.72E-02	1.10E-03	6.41E-02
S96T005338	Core 171, Segment 4, lower half	2.67E-02	1.90E-03	3.87E-02
S96T005346[1,2]	Core 171, Segment 5, drainable liquid	6.17E-03	9.00E-04	1.19E-02
S97T000031	Core 171, Segment 5, lower half	1.13E-02	7.00E-04	1.57E-02
S96T005357[1,2]	Core 171, Segment 6, drainable liquid	6.60E-03	4.75E-04	9.59E-03
S96T005353	Core 171, Segment 6, lower half	2.02E-02	1.36E-02	1.06E-01
S96T005388	Core 171, Segment 7, lower half	1.38E-02	6.00E-04	1.76E-02

Notes:

[1]The duplicate was less than the detection limit.

[2]The sample was less than the detection limit.

Table C1-2. 95 Percent Confidence Interval Upper Limits for Differential Scanning Calorimetry for Tank 241-BY-111. (J/g Dry)

Sample Number	Sample Description	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	UL
S96T005166	Core 168, Segment 1, Qtr. A	9.83E+01	4.75E+00	1.28E+02
S96T005167	Core 168, Segment 1, Qtr. B	0.00E+00	0.00E+00	0.00E+00
S96T005148	Core 168, Segment 2, lower half	5.15E+01	1.31E+01	1.34E+02
S96T005157	Core 168, Segment 3, lower half	4.10E+01	1.41E+01	1.30E+02
S96T005301	Core 168, Segment 4, lower half	5.79E+01	2.70E+00	7.49E+01
S96T005304	Core 168, Segment 5, lower half	2.99E+02	1.30E+01	3.81E+02
S96T005310	Core 168, Segment 5A, lower half	0.00E+00	0.00E+00	0.00E+00
S96T005314	Core 168, Segment 6, drainable liquid	0.00E+00	0.00E+00	0.00E+00
S96T005158	Core 168, Segment 6A, lower half	1.71E+01	2.50E-01	1.86E+01
S96T005321	Core 171, Segment 1, lower half	0.00E+00	0.00E+00	0.00E+00
S96T005335	Core 171, Segment 3, lower half	0.00E+00	0.00E+00	0.00E+00
S96T005336	Core 171, Segment 4, lower half	1.94E+01	1.80E+00	3.08E+01
S96T005346	Core 171, Segment 5, drainable liquid	3.31E+01	2.05E+00	4.60E+01
S96T005342	Core 171, Segment 5, lower half	8.92E+01	3.08E+01	2.84E+02
S96T005357	Core 171, Segment 6, drainable liquid	2.99E+01	7.10E+00	7.47E+01
S96T005349	Core 171, Segment 6, upper half	2.71E+01	1.26E+01	1.06E+02
S96T005350	Core 171, Segment 6, lower half	1.39E+01	4.57E+00	4.28E+01
S96T005383	Core 171, Segment 7, upper half	6.57E+01	2.20E+00	7.96E+01
S96T005384	Core 171, Segment 7, lower half	4.78E+01	2.25E+00	6.20E+01

C2.0 APPENDIX C REFERENCES

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS STANDARD INVENTORY FOR TANK 241-BY-111

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BY-111

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for tank 241-BY-111 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Available waste (chemical) information for tank 241-BY-111 includes the following:

- Data from two partial push-mode core samples that were collected in 1996. See Appendix B for data.
- The inventory estimate for this tank generated from the Hanford Defined Waste (HDW) model developed at Los Alamos National Laboratory, (Agnew et al. 1997a).
- Data from other tanks identified historically as having the same BY saltcake (BYSltCk) waste type. (See Section D3.3 for specific tanks and references.)

A list of references used in this evaluation is provided at the end of this Appendix (Section D5.0).

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Sampling-based inventories (see Appendix B), derived from the analytical concentration data from the core samples, and the HDW model inventories are compared in Tables D2-1 and D2-2. Table D2-1 compares nonradioactive components on a kilogram (kg) basis, and Table D2-2 compares the radioactive components on a total curie basis. The HDW model document (Agnew et al. 1997a) provides tank content estimates in terms of component concentrations and inventories. The chemical species in Table D2-1 are reported without charge designation per the best-basis inventory convention.

Sampling-based inventories listed in Appendix B were calculated by multiplying the mean concentration of an analyte by the current waste mass, derived using the current tank volume and the mean density of the waste. However, the sample data are based on incomplete core samples. A full profile of the waste was not obtained. The tank is reported to contain 1,740 kL (459 kgal) of total waste, partitioned as 1,660 kL (438 kgal) of saltcake and 80 kL (21 kgal) of sludge by (Hanlon 1997), and the mean density is reported to be 1.57 g/mL (Appendix B).

The HDW model inventory is based on a waste volume of 1,740 kL (459 kgal) and a density of 1.63 g/mL. The waste in the HDW model is partitioned in this manner: 1,640 kL (433 kgal) BY saltcake, and 100 kL (26 kgal) metal waste sludge.

The sampling-based inventory was developed by assuming that the last unsampled portion of the waste at the tank bottom had the same mean concentrations as the rest of the tank. In one core only six of nine segments were recovered, and the other core had seven of nine segments recovered. It is possible that a small layer of ferrocyanide waste or another unspecified sludge remains in the bottom of this tank, but no firm documentation is available to support this assumption. The assumption used for this assessment is that there is no sludge at the bottom of the tank (see Sections D3.1 and D3.2). The potential sludge layer is only a small portion of this tank's waste volume (<5 percent). Only a sample taken from the bottom of the tank can indicate if this is correct.

Table D2-1. Sampling-Based and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-BY-111. (2 sheets)

Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)	Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)
Al	68,300	93,400	NO_3	418,000	665,000
Bi	<5,280	307	OH	NR	290,000
Ca	<11,400	5,120	Oxalate	52,800	0.387
Cl	2,990	7,650	Pb	<5,280	1,930
Cr	5,630	4,690	P as PO_4	54,500	14,400
F[3]	26,300	1,730	Si	94,200	3,530
Fe	16,300	2,650	S as SO_4	93,900	31,200
Hg	NR	11.9	Sr	<559	0
K	NR	2,550	TIC as CO_3	266,000	60,800
La	<2,640	0.466	TOC	16,700	11,900
Mn	<672	292	U_{total}	<26,400	51,500
Na	660,000	505,000	Zr	<528	5.08

Table D2-1. Sampling-Based and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-BY-111. (2 sheets)

Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)	Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)
NH_4	NR	375	H_2O (wt%)	31.7	36.9
Ni	NR	1,300	Density (kg/L)	1.57	1.63
NO_2	38,800	126,000			

Notes:

NR = not reported
HDW = Hanford defined waste

[1]Appendix B
[2]Agnew et al. (1997a)
[3]Fluoride based on water soluble portion only.

Table D2-2. Sampling-Based and Hanford Defined Waste Defined Model-Based Inventory Estimates for Radioactive Components in Tank 241-BY-111.

Analyte	Sampling[1] Inventory Estimate (Ci)	HDW[2] Inventory Estimate (Ci)	Analyte	Sampling[1] Inventory Estimate (Ci)	HDW[2] Inventory Estimate (Ci)
^{90}Sr	NR	209,000	$^{239/240}Pu$	NR	149
^{137}Cs	NR	247,000			

Notes:

[1]Appendix B
[2]Agnew et al. (1997a)

D3.0 COMPONENT INVENTORY EVALUATION

The following evaluation of tank contents is performed to identify potential errors and/or missing information that would influence the sample-based and HDW model component inventories.

D3.1 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT

The reported waste types in tank 241-BY-111 are as follows. (See Appendix A for a detailed summary of the waste transfer history.)

(Agnew et al. 1997a and 1997b): MW, BYSltCk
(Hill et al. 1995): TBP-F, EB-ITS, OWW, CW

Abbreviations:

BYSltCk	=	BY Saltcake (same as EB-ITS)
TBP-F	=	Tributyl phosphate-ferrocyanide scavenged UR (TBP) supernatants (Equivalent to HDW Model defined waste PFeCN2)
CW	=	Coating waste from the bismuth phosphate process
EB-ITS	=	Evaporator bottoms from in-tank solidification
MW	=	Metal waste from the bismuth phosphate process
OWW	=	Organic Solvent Wash Waste from PUREX Plant

The estimated volumes of waste are addressed in Section D2.0.

A sludge layer may or may not exist at the bottom of tank 241-BY-111. During 1955, the tank was sluiced, and was declared empty in May of 1955 (Rodenhizer 1987). However, the HDW assumes that none of the MW solids were removed during the sluicing and attributes 98.4 kL (26 kgal) of the waste volume to MW sludge.

There is also a stronger possibility that TBP-F supernatants, transferred to the tank after it was sluiced, deposited sludge in the tank (Anderson 1990 and Agnew et al.1997b). Grigsby et al. (1992) strongly suggests a sludge layer in this tank, but because the sampling did not extend to the projected bottom 2 to 3 segments of the tank, none of these assumptions can be verified. The potential sludge layer is only a small portion of this tank's waste volume (<5 percent), and only a sample taken at the bottom of the tank could verify its existence.

The position taken in this document is that a sludge layer does not exist, and that the data taken from the core sample event can be extended to the unsampled portion of the tank.

D3.2 ASSUMPTIONS USED

The following sections provide an engineering evaluation of tank 241-BY-111 contents. For this evaluation, the following assumptions and observations were made:

- Total waste mass is calculated using the sampling-based measured density of 1.57 g/mL and the tank volume listed in (Hanlon 1997) (1,740 kL [459 kgal]). In (Hanlon 1997) 80 kL (21 kgal) are listed as sludge while (Agnew et al. 1997a) lists 100 kL (26 kgal) as sludge. The sampling based inventories and this assessment assume no sludge layer. As a result, the inventory estimates are not made on exactly the same waste type basis but are close (if MW is discounted).

- Only the BYSltCk waste stream contributed to solids formation.

- No radiolysis of NO_3 to NO_2 and no additions of NO_2 to the waste for corrosion purposes are factored into this evaluation.

D3.3 BASIS FOR CALCULATIONS USED IN THIS EVALUATION

Table D3-1 summarizes the engineering evaluation approach used on tank 241-BY-111.

Table D3-1. Assessment Methodology Used For Tank 241-BY-111.

Type of Waste	How Calculated	Check Method
Supernatant	No supernatant predicted	n/a
Saltcake Vol. = 1,740 kL (459 kgal)	Used the sample-based inventory, which was calculated by multiplying the average tank analyte concentration by the total mass of the waste in tank 241-BY-111. The density used was the average measured density (1.57 g/mL).	Used sample-based concentrations for three other 241-BY tanks, multiplied by saltcake total mass in tank 241-BY-111. The density used was the density of tank 241-BY-111 (1.57 g/mL). As a second check method, the average concentration of tanks 241-BY-102, 241-BY-111 and 241-BY-112 were used with the density of tank 241-BY-111 (1.57 g/mL)
Sludge	No sludge predicted.	n/a

BY saltcake (BYSltCk), the abbreviation used by Agnew et al. (1997a), denotes salt waste supernatants that were evaporated and concentrated using in-tank heaters. In-tank solidification (ITS) campaigns were performed in the BY Tank Farm from 1964 through 1976. Evaporated waste supernatants originated primarily from the $BiPO_4$ process operations in B Plant. Heaters were placed in tanks 241-BY-101, 241-BY-102, and 241-BY-112. Tank 241-BY-101 was heated for only a short time. The heater was then transferred to tank 241-BY-102. Certain BY tanks were designated as feed tanks. Concentrates from the heated tanks were transferred to other tanks in the BY tank farm and some BX tank farm tanks where they cooled and crystallized (Agnew et al. 1997b). Analyses have shown that the saltcake compositions for these tanks are somewhat different than those for the tanks that contained the heaters (Sasaki et al. 1997).

A defined waste composition for BYSltCk is provided in Agnew et al. (1997a). Because of the complicated waste supernatant transfer history of feed to the ITS campaign and the lack of a flowsheet basis for the waste, it is difficult to perform an independent assessment to estimate a saltcake composition that can be compared to the model-based BYSltCk composition. However, samples from BY tank farm tanks other than tank 241-BY-111 that contain BYSltCk which did not contain in-tank heaters have been analyzed and the results have been reported. The analytical results for these tanks were evaluated at the core segment level, and the BYSltCk was identified. Table D3-2 summarizes the compositions of saltcake from tank 241-BY-105, 241-BY-106, and 241-BY-110, based on the segment-level analysis reported, respectively, in Simpson et al. (1996a), Bell et al. (1996), and Simpson et al. (1996b). For comparison, the waste component concentrations for tank 241-BY-111 and the BYSltCk defined waste composition from Agnew et al. (1997a) are also shown in Table D3-2 as well as the total calculated inventory for tank 241-BY-111.

As indicated in Table D3-2, the concentrations of major waste components such as sodium, aluminum, nitrate, fluoride, and sulfate vary among the three comparison tanks (tanks 241-BY-105, 241-BY-106, and 241-BY-110) by no more than a factor of about three. However, the variation among tanks for minor components is much higher.

Note that the fluoride, iron, oxalate, silicon, phosphate, and sulfate concentrations in tank 241-BY-111 samples are higher than the corresponding average concentrations of those components in the three BY farm comparison tanks. A few other analyte concentrations may also be higher in tank 241-BY-111 but are reported as less than values. The high sulfate and phosphate concentrations in tank 241-BY-111, as compared to other tanks without a ITS unit, are apparently compensated by lower nitrate concentrations than for the other tanks without a ITS unit. Some of the apparent anomalies for tank 241-BY-111 likely result from the use of tank 241-BY-112 as the ITS unit 2 (ITS-2). Tank 241-BY-111 received several direct inputs from 241-BY-112 which contained the heater, whereas several of the other BY farm tanks received some previously cooled evaporated supernatant from tank 241-BY-112. In particular, components with slightly lower solubilities would likely concentrate and precipitate from solution and collect on or near the cooler surfaces of the ITS unit in tanks 241-BY-112 or in 241-BY-111, which received more waste from 241-BY-112.

The average sampling-based composition for tanks 241-BY-105, 241-BY-106, and 241-BY-110 compares favorably with the HDW model BYSltCk composition than does the tank 241-BY-111 composition for some analytes and less favorably in others. The HDW do not consistently compare well with any of the tanks.

The total estimated inventories for tank 241-BY-111, from this engineering assessment, were determined by taking the average concentration of the three tanks (241-BY-105, 241-BY-106, and 241-BY-110) and multiplying by 459 (kgal) by 3785 (kgal to L) and by 1.57 kg/L (the density of 241-BY-111) and then by dividing by 1,000,000 (conversion factor to report as kg).

Table D3-2. Concentrations of Components in BY Tank Farm Saltcake Samples. (2 sheets)

Analyte	Component Concentration (μg/g)						
	BY-105	BY-106	BY-110	Average Concentration	BY-111[1]	BY-111 Total Inventory (kg)	HDW Avg.[2] BYSltCk
Non-radioactive components							
Al	18,400	20,400	14,100	17,633	25,000	48,100	34,974
Bi	55.6	NR	NR	55.6	<1,930	152	114.9
Ca	216	308	400	308	<4,180	840	1,791
Chloride	897	2,060	2,250	1,736	1,090	4,730	2,860
Cr	321	855	2,900	1,359	2,060	3,710	1,754
Fluoride	4,100	5,130	5,420	4,883	9,620	13,300	649
Fe	476	215	924	538	5,960	1,470	749
Pb	50.3	64.5	130	82	<1,930	223	721
Mn	54.8	9.57	52.8	39.1	<246	107	109
Ni	75.9	47.9	193	106	NR	288	487
Nitrate	491,000	329,000	184,000	335,000	153,000	913,000	249,000
Nitrite	9,410	32,100	30,600	24,037	14,200	65,600	47,144
Oxalate	11,300	8,990	13,600	11,297	19,300	30,800	0.145
Phosphate	4,890	5,270	14,200	8,120	20,000	22,100	3,998
P	1,010	1,032	4,650	2,231	9,810	NR	NR
K	712	2,470	1,930	1,704	NR	4,650	956
Si	180	184	451	272	34,500	741	1,320
Na	198,000	203,000	237,000	213,000	241,000	580,000	185,000
Sr	88.3	44.4	58.1	64	<205	173	0
Sulfate	10,600	11,300	18,400	13,433	34,400	36,600	11,373
S	3,140	3,280	5,950	4,123	11,800	NR	NR
TIC	NR	7,359	31,800	19,580	19,500	53,400	3,718
TOC	3,250	2,500	5,920	3,890	6,100	10,600	NR
U	261	164.2	697	374	<9,660	1,020	3,930
Zr	5.23	6.28	14.4	8.64	<201	24	1.9
Density (g/mL)	NR	1.71	NR	1.71	1.57	1.57	1.63
wt% H_2O	16.1	25.5	23.2	21.6	31.7	31.7	36.1

Table D3-2. Concentrations of Components in BY Tank Farm Saltcake Samples. (2 sheets)

Analyte	Component Concentration (μCi/g)						
	BY-105	BY-106	BY-110	Average Concentration	BY-111[1]	BY-111 Total Inventory (kCi)	HDW Avg.[2] BYSltCk
Radionuclides							
^{90}Sr	NR	<4.26	22.5	22.5	NR	226	78
^{137}Cs	NR	106	60	83	NR	61	92.2
$^{239/240}$Pu	NR	NR	0.0192	0.0192	NR	0.52	0.056

Note:
[1]From Appendix B.
[2]Agnew et al. (1997a).

The component concentrations in tank 241-BY-111 appear more like those for the tanks that contained the ITS units (241-BY-112 or 241-BY-102), than the other tanks listed in Table D3-2. This was somewhat unexpected because tank 241-BY-111 did not have an ITS unit and, as such, it was expected that the component concentrations in tank 241-BY-111 would be more closely aligned to other BY farm tanks without an ITS unit.

A second engineering assessment was performed in which the analyte concentrations for tank 241-BY-111 were compared to those two ITS unit tanks, tank 241-BY-102 and tank 241-BY-112 (Table D3-3). Tank 241-BY-111 was included in the average of the three tanks. These three tanks form a group that can be used to predict concentrations of similar tanks and to be compared to the HDW model inventories for such tanks. These tanks show more variability because of the ITS units, and in using all three tanks, the larger differences are buffered. The sampling-based average of these three tanks will be compared to the HDW model for evaluation. By including 241-BY-111 in this assessment, the reported value for the engineering assessment of each analyte is lowered by an average of about 7 percent. For those analytes with more variance this percent may be higher as is it lower for others.

This assessment estimates the total inventories for tank 241-BY-111, by multiplying the average analyte concentrations for these three tanks by 459 (kgal), by 3785 (kgal to L), and by 1.57 kg/L (the density of 241-BY-111) and by dividing by 1,000,000 (conversion factor to report as kg).

Table D3-3. Tank 241-BY-111 Inventory Calculations.

	μg/g	μg/g	μg/g	μg/g	BY-111 SC (kg)
Element	BY-102(SC)	BY-111(SC)	BY-112(SC)	Average Concentration	(SC Volume of 459 kgal)
Al	41,600	25,000	18,200	28,267	77,100
Bi	<2,030	<1,930	<2,040	<2,000	<5,490
Ca	<2,100	<4,180	<2,040	<2,774	<7,610
Chloride	1,220	1,090	1,150	1,153	3,150
Cr	1,870	2,060	17,500	7,143	19,500
Fluoride	18,000	9,620	9,410	12,343	33,700
Fe	1,860	5,960	2,960	3,593	9,800
Pb	<2,030	<1,930	<2,040	<2,000	<5,490
Mn	372	<246	<292	372	1,020
Ni	4,820	NR	NR	4,820	13,100
NO_3	95,000	153,000	73,400	107,133	292,000
NO_2	13,900	14,200	20,400	16,167	44,100
Oxalate	19,300	19,300	29,600	22,733	62,000
PO_4	27,000	20,000	16,600	21,200	57,800
P	<9,500	9,810	<7,770	9,810	26,800
K	NR	NR	NR	NR	NR
Si	4,350	34,500	2,430	13,760	37,500
Na	267,000	241,000	334,000	280,667	766,000
Sr	<203	<205	<204	<204	<560
SO_4	57,700	34,400	25,000	39,033	106,000
S	17,300	11,800	9,800	12,967	35,400
TIC	27,800	19,500	40,700	29,300	79,900
TOC	4,360	6,100	8,510	6,320	17,300
U	<10,000	<9,660	<10,200	<9,954	<27,300
Zr	<203	<201	<204	<203	<557
Radionuclides					
μCi/g	BY-102(SC)	BY-111 (SC)	BY-112(SC)	AVERAGE	Total 241-BY-112
^{90}Sr	NR	NR	NR	NR	NR
^{137}Cs	NR	NR	NR	NR	NR
$^{239/240}Pu$	NR	NR	NR	NR	NR

Notes:

NR = not reported

SC = Saltcake

D3.4 ESTIMATED COMPONENT INVENTORIES

Estimated chemical inventories for tank 241-BY-111 are summarized in Table D3-4. Shown are the sample-based inventory, and the inventory estimated by the HDW model. Also shown are the predicted engineering assessment inventories from Tables D3-2 and D3-3. The first engineering assessment inventory is based on the average analytical values for the three BY farm comparison tanks without ITS units (241-BY-105, 241-BY-106, and 241-BY-110). The second engineering assessment inventory is based on the average of the two ITS tanks, 241-BY-102 and 241-BY-112, with the non-ITS tank 241-BY-111. Comments and observations are provided in the following text.

Tanks 241-BY-112 and tank 241-BY-102 were the designated tanks in the BY tank farm for the ITS heaters. Because of its configuration (that is, a heater in one tank and subsequent tanks connected in a series for cooling the concentrated supernatant), the ITS system caused a different mix of analytes to settle in the ITS heater tanks and apparently the initial cooling tank, 241-BY-111, than in the tanks further down stream.

For example, there is significantly less nitrate and nitrite in tank 241-BY-111 than in the other BY comparison tanks (241-BY-105, 241-BY-106, and 241-BY-110). There also appears to be higher concentrations of silicon, sulfate, phosphate, fluoride, and iron than in the BY saltcake in the first set of three comparison tanks (see Section D3.3). At this time, there is no way to accurately predict the saltcake analytical values through an engineering assessment, other than by using analytical data from other tanks containing BYSltCk. However, because of the unique position of the tank 241-BY-111 between the boiler tank (241-BY-112) and the other downstream cooling tanks and the substantial differences in solution equilibria between these situations, using either case (boiler or downstream) exclusively as a basis for representing 241-BY-111 will not provide an accurate description of the tank composition, although the boiler comparison still comes closest in most cases.

Table D3-4. Comparison of Selected Component Inventory Estimates for Tank 241-BY-111 Waste. (2 sheets)

Component	Engineering Assessment (kg)[1]	Engineering Assessment (kg)[2]	Sample-based (kg)	HDW Estimate (kg)
Al	48,100	76,600	68,300	93,400
Bi	152	<5,450	<5,280	307
Ca	840	<7,560	<11,400	5,120
Cl	4,730	3,120	2,990	7,650
Cr	3,710	19,300	5,630	4,690
F	13,300	33,400	26,300	1,730
Fe	1,470	9,730	16,300	2,650
K	4,650	NR	NR	2,550

Table D3-4. Comparison of Selected Component Inventory Estimates for Tank 241-BY-111 Waste. (2 sheets)

Component	Engineering Assessment (kg)[1]	Engineering Assessment (kg)[2]	Sample-based (kg)	HDW Estimate (kg)
La	NR	<2,640	<2,640	0.466
Mn	107	1,010	<672	292
Na	580,000	760,000	660,000	505,000
Ni	288	13,100	NR	547
NO_3	913,000	290,000	418,000	665,000
NO_2	65,600	43,800	38,800	126,000
Oxalate	30,800	61,600	52,800	0.387
Pb	223	<5,450	<5,280	1,930
PO_4	22,100	57,400	54,500	14,400
Si	741	37,300	94,200	3,530
SO_4	36,600	106,000	93,900	31,200
Sr	173	<556	<559	0
TIC	267,000	400,000	266,000	12,200[3]
TOC	10,600	17,300	16,700	11,900
U	1,020	<27,100	<26,400	51,500
Zr	24	<553	<528	5.08
H_2O (percent)	31.7	31.7	31.7	36.9

Notes:

[1]Based on average concentrations for components in tanks 241-BY-105, 241-BY-106, and 241-BY-110.
[2]Based on average concentrations for components in tanks 241-BY-102, 241-BY-111, and 241-BY-112.
[3]TIC calculated from CO_3

The HDW model does not properly represent the decreased solubilities for components in tank 241-BY-111 (for example, phosphate, sulfate, and fluoride) that are normally quite soluble in other tanks containing BYSltCk. The increased temperatures and rapid boil-off in tank 241-BY-112 likely resulted in a concentration and precipitation of these components, not only in that tank but in immediate transfers to tank 241-BY-111. The concentrated supernatants were also transferred to other BY farm tanks for cooling and further precipitation of the more soluble components.

Because of the unique history of tank 241-BY-102 and 241-BY-112 as ITS evaporator tanks and the relationship of 241-BY-111 to 241-BY-112, it is judged the analytical data from the

1996 core sample best represents the component concentrations for this tank. This receiver tank, 241-BY-111, exhibits concentrations much like the two ITS evaporator tanks. This was not expected based on data from other tanks but may have been anticipated based on a careful consideration of physical principles. The waste in the other BY receiver tanks exhibit markedly different concentrations of certain components.

For presently unexplained reasons, core 171 for tank 241-BY-111 has an unusually high concentration of Si. The high Si concentrations were consistently observed for segments 1-4 for this core. The sample data from this tank are thus used as the inventory for Si.

Total Hydroxide. Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases, this approach requires that other analyte (for example, sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments, significant figures are retained. This charge balance approach is consistent with that used by Agnew et al. (1997a).

Radionuclides were not measured in tanks 241-BY-102, 241-BY-111, or 241-BY-112. The best basis Radionuclide values were either engineering assessment values based on the heat load of tank 241-BY-111 from Kummerer (1995), engineering assessment #1, (Grigsby et al. 1992), or HDW values.

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processing and facilities for retrieving wastes, and processing them into a form that is suitable for long-term storage.

Chemical and radiological inventory information are generally derived using three approaches: 1) component inventories are estimated using results of sample analyses, 2) component inventories are estimated using the HDW model based on process knowledge and historical information, or 3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data. The information derived from these different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and

LeClair 1996). As part of this effort, an evaluation of available chemical information for tank 241-BY-111 was performed, including the following:

- Data from two partial 1996 push-mode core samples (Appendix B)

- An inventory estimate generated by the HDW model (Agnew et al. 1997a)

- Evaluation of the BYSltCk data from other BY Tank Farm tanks.
  Two engineering assessments were performed. One compared this tank to other BY Farm tanks without ITS heaters. The second engineering assessment compared this tank to the two ITS evaporator tanks (241-BY-102 and 241-BY-112). The composition of the waste in tank 241-BY-111 is more like that for the two tanks with the ITS heaters.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-111. The sampling-based inventory was chosen as the best basis for those analytes for which sampling-based analytical values were available, for the following reasons:

- The sample-based inventory analytical concentrations for tank 241-BY-111 compared favorably to those of other BY tanks, specifically the evaporator tanks for the ITS.

- No methodology is available to fully predict BYSltCk from process flowsheet or historical records.

- Waste transfer records are not complete and not always accurate.

For those few analytes for which no values could be calculated from the sample-based inventory, the engineering evaluation data or the HDW model values were used. These values are less reliable than the values for which sample data are available.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-111. When the sample-based inventory had a high less-than value or was not measured, the engineering assessment-based values were used (if applicable). Some high less-than values are reported because all three tanks used in the second engineering assessment also had high less than values. Results for radionuclides were not available for the sample-based inventory. The best-basis radionuclide values were either engineering assessment values based on the heat load of tank 241-BY-112 from Kummerer (1995) or HDW model values. The HDW model was used only where no other data were available. The best-basis inventory for tank 241-BY-111 is presented in Tables D4-1 and D4-2.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-111 (Effective May 31, 1997). (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	68,300	S	---
Bi	307	M	---
Ca	840	E	---
Cl	2,990	S	---
TIC as CO_3	266,000	S	---
Cr	5,630	S	---
F	26,300	S	---
Fe	16,300	S	---
Hg	11.9	M	No sample basis
K	4,650	S	Used average concentration from other tanks in BY Farm, these tanks are less representative of tank 241-BY-111, but have data.
La	0.47	M	---
Mn	<672	S	---
Na	660,000	S	---
Ni	13,100	M	This could be high by a factor of up to ten as Ni was not measured in the tank and the other non heater tanks are much lower.
NO_2	38,800	S	---
NO_3	418,000	S	---
OH_{TOTAL}	172,000	C	Calculated from charge balance
[2]Pb	223	E	---
PO_4	54,500	S	---
Si	94,200	S	This value very high but seems to be representative of several layers.
SO_4	93,900	S	---
Sr	173	E	---
TOC	16,700	S	---

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-111 (Effective May 31, 1997). (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
U_{TOTAL}	<26,400	S	Using average concentration from other tanks in BY Farm <27,100
Zr	24	E	---

Notes:

[1]S = Sample-based, M = HDW model-base, E = Engineering assessment-based, and C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_3, NO_2, PO_4, SO_4 and SiO_3.

[2]Based on average concentrations for components in tanks 241-BY-105, 241-BY-106, and 241-BY-110.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994 (Effective May 31, 1997). (2 sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	214	M	
^{14}C	55.9	M	
^{59}Ni	5.95	M	
^{60}Co	52.1	M	
^{63}Ni	591	M	
^{79}Se	4.68	M	
^{90}Sr	151,000	E	HDW estimate was 209,000
^{90}Y	151,000	E	Based on ^{90}Sr
^{93}Zr	22.6	M	
^{93m}Nb	16.3	M	
^{99}Tc	310	M	
^{106}Ru	0.0104	M	
^{113m}Cd	120	M	
^{125}Sb	234	M	
^{126}Sn	7.00	M	
^{129}I	0.601	M	
^{134}Cs	2.54	M	
^{137}Cs	171,000	E	HDW estimate was 247,000

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994 (Effective May 31, 1997). (2 sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{137m}Ba	162,000	E	Based on ^{137}Cs
^{151}Sm	16,200	M	
^{152}Eu	7.34	M	
^{154}Eu	880	M	
^{155}Eu	445	M	
^{226}Ra	2.38E-04	M	
^{227}Ac	0.00321	M	
^{228}Ra	2.79	M	
^{229}Th	0.0643	M	
^{231}Pa	0.0164	M	
^{232}Th	0.103	M	
^{232}U	15.5	M	
^{233}U	59.5	M	
^{234}U	17.7	M	
^{235}U	0.764	M	
^{236}U	0.227	M	
^{237}Np	1.04	M	
^{238}Pu	4.15	M	
^{238}U	22.5	M	
^{239}Pu	149	M	
^{240}Pu	25.5	M	
^{241}Am	72.9	M	
^{241}Pu	299	M	
^{242}Cm	9.64E-04	M	
^{242}Pu	0.00144	M	
^{243}Am	0.00252	M	
^{243}Cm	1.96E-05	M	
^{244}Cm	3.34E-04	M	

Notes:

[1]S = Sample-based, M = HDW model-based, and E = Engineering assessment-based

D5.0 APPENDIX D REFERENCES

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-BY-111

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-BY-111

Appendix E provides a bibliography of information that supports the characterization of tank 241-BY-111. This bibliography represents an in-depth literature search of all known information sources that provide sampling, analysis, surveillance, and modeling information, as well as processing occurrences associated with tank 241-BY-111 and its respective waste types.

The references in this bibliography are separated into three broad categories containing references broken down into subgroups. These categories and their subgroups are listed below.

I. NON-ANALYTICAL DATA

- Ia. Models/Waste Type Inventories/Campaign Information
- Ib. Fill History/Waste Transfer Records
- Ic. Surveillance/Tank Configuration
- Id. Sample Planning/Tank Prioritization
- Ie. Data Quality Objectives/Customers of Characterization Data

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

- IIa. Sampling of tank 241-BY-111
- IIb. Sampling of BY Saltcake Waste Type

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

- IIIa. Inventories Using both Campaign and Analytical Information
- IIIb. Compendium of Existing Physical and Chemical Documented Data Sources

This bibliography is broken down into the appropriate sections of material to use, with an annotation at the end of each reference, or set of references, describing the information source. Where possible, a reference is provided for information sources. A majority of the information listed below may be found in the Lockheed Martin Hanford Corporation Tank Characterization and Safety Resource Center.

I. NON-ANALYTICAL DATA

Ia. Models/Waste Type Inventories/Campaign Information

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

- Document contains single-shell tank fill history and primary campaign/waste type information up to 1981.

Jungfleisch, F. M., and B. C. Simpson, 1993, *Preliminary Estimation of the Waste Inventories in Hanford Tanks Through 1980*, WHC-SD-WM-TI-057, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Document describes a model for estimating tank waste inventories using process knowledge, radioactive decay estimates using ORIGEN, and assumptions about waste types, solubility, and constraints.

Nguyen, D. M., 1989, *Data Analysis of Conditions in Single-Shell Tanks Suspected of Containing Ferrocyanide*, (internal letter #13314-89-025 to N. W. Kirch, March 2), Westinghouse Hanford Company, Richland, Washington.

- Letter gives estimates of the ferrocyanide content in a few tanks.

Schneider, K. J., 1951, *Flowsheets and Flow Diagrams of Precipitation Separations Process*, HW-23043, Hanford Atomic Products Operation, Richland, Washington.

- Document contains compositions of process stream waste before transfer to 200 Area waste tanks.

Ib. Fill History/Waste Transfer Records

Agnew, S. F., P. Baca, R. A. Corbin, T. B. Duran, and K. A. Jurgensen, 1997, *Waste Status and Transaction Record Summary, WSTRS Rev. 4*, LA-UR-97-311, Rev. 0, Los National Laboratory, Los Alamos, New Mexico.

- Document contains spreadsheets depicting all known tank additions/transfers.

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

- Document contains tank fill histories and primary campaign/waste type information up to 1981.

Ic. Surveillance/Tank Configuration

Alstad, A. T., 1993, *Riser Configuration Document for Single-Shell Waste Tanks*, WHC-SD-WM-TI-553, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document shows riser location in relation to tank aerial view as well as a description of each riser and its contents.

Lipnicki, J., 1996, *Waste Tank Risers Available for Sampling*, WHC-SD-WM-TI-710, Rev. 3, Westinghouse Hanford Company, Richland, Washington.

- Document gives an assessment of riser locations for each tank; however, not all tanks are included/completed. Also included is an estimate of the risers available for sampling.

Tran, T. T., 1993, *Thermocouple Status Single-Shell & Double-Shell Waste Tanks*, WHC-SD-WM-TI-553, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document provides thermocouple location and status information for double- and single-shell tanks.

Welty, R. K., 1988, *Waste Storage Tank Status and Leak Detection Criteria*, WHC-SD-WM-TI-356, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document provides leak detection information for all single- and double-shell tanks. Liquid level, liquid observation well, and dry well readings are included.

Id. Sample Planning/Tank Prioritization

Brown, T. M., T. J. Kunthara, S. J. Eberlein, and J. W. Hunt, 1996, *Tank Waste Characterization Basis*, WHC-SD-WM-TA-164, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

- Document establishes an approach to determine the priority for tank sampling and characterization and identifies high priority tanks for sampling.

Kruger, A. A., 1996, *Tank 241-BY-111 Push Mode Core Sampling and Analysis Plan*, WHC-SD-WM-TSAP-106, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Document contains detailed sampling and analysis scheme for core samples to be taken from tank 241-BY-111 to address applicable DQOs.

Mulkey, C. H., 1996, *Single-Shell Tank System Waste Analysis Plan*, WHC-EP-0356, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Document is the waste analysis plan for single-shell tanks as required by WAC-173-303 and 40 CFR Part 265.

Osborne, J. W., 1994a, *Letter of Instruction to Sandia National Laboratory and Oregon Graduate Institute of Science and Technology for Analysis of Summa Canister Samples Collected From Tanks 241-BY-103, 241-BY-104, 241-BY-105, 241-BY-106, 241-BY-107, 241-BY-108, and 241-BY-111*, (external letter #9452039 to Dr. W. Einfeld, March 23), Westinghouse Hanford Company, Richland, Washington.

- Letter identifies which analysis are required for several BY Farm vapor samples.

Osborne, J. W., 1994b, *Letter of Instruction to Pacific Northwest Laboratory for Analysis of Summa Canister and Inorganic Gas and Vapor Samples Collected From Tanks 241-BY-103, 241-BY-104, 241-BY-105, 241-BY-106, 241-BY-107, 241-BY-108, and 241-BY-111*, (external letter #9452036 to Dr. Steve Goheen, March 23), Westinghouse Hanford Company, Richland, Washington.

- Letter identifies which analysis are required for several BY Farm vapor samples.

Stanton, G. A., 1996, *Baseline Sampling Schedule, Change 96-04*, (internal letter 75610-96-11 to Distribution, August 22), Westinghouse Hanford Company, Richland, Washington.

- Letter provides a tank waste sampling schedule through fiscal year 2002 and lists samples taken since 1994.

Winkelman, W. D., 1996, *Tank 241-BY-111 Tank Characterization Plan*, WHC-SD-WM-TP-280, Rev. 3, Lockheed Martin Hanford Corporation, Richland, Washington.

- Document discusses all relevant DQOs and how their requirements will be met for tank 241-BY-111.

Winkelman, W. D., J. W. Hunt, and L. J. Fergestrom, 1996, *Fiscal Year 1997 Tank Waste Analysis Plan*, WHC-SD-WM-PLN-120, Rev. 1, Lockheed Martin Hanford Corp., Richland, Washington.

- Document contains *Hanford Federal Facility Agreement and Consent Order* requirement driven TWRS characterization program information and a list of tanks addressed in fiscal year 1997.

Ie. Data Quality Objectives/Customers of Characterization Data

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.

- DQO used to determine if tanks are under safe operating conditions.

Meacham, J. E., 1996a, *Implementation Change Concerning Organic DQO, Rev. 2*, (internal letter #2N160-96-006 to Distribution, December 2), Duke Engineering & Services, Inc., Richland, Washington.

- Letter changes organic DQO strategy to test for TOC for any exotherm.

Meacham, J. E., 1996b, *Increase Scope To Organic DQO*, (internal letter #2N160-96-003 to J. G. Kristofzski, October 31), Duke Engineering & Services, Inc., Richland, Washington.

- Letter increases scope of organic DQO to all single-shell tanks.

Osborne, J. W., J. L. Huckaby, E. R. Hewitt, C. M. Anderson, D. D. Mahlum, B. A. Pulsipher, and J. Y. Young, 1994, *Data Quality Objectives for Generic In-Tank Health and Safety Vapor Issue Resolution*, WHC-SD-WM-DQO-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- DQO used to determine if tank vapor spaces contain potentially flammable levels of gases and vapors and or if there is a potential for worker hazards associated with the toxicity of constituents in any vapor emissions from the tanks.

Osborne, J. W., and L. L. Buckley, 1995, *Data Quality Objective for Tank Hazardous Vapor Safety Screening*, WHC-SD-WM-DQO-002, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

- DQO used to determine if tank vapor spaces contain potentially hazardous gases and vapors.

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.

- DQO used to categorize organic tanks as "safe", "conditionally safe", or "unsafe" based on fuel and moisture concentrations and to support resolution of the safety issue.

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

IIa. Sampling of Tank 241-BY-111

Caprio, G. S., 1995, *Vapor and Gas Sampling of Single-Shell Tank 241-BY-111 Using the Vapor Sampling System*, WHC-SD-WM-RPT-124, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains vapor sampling analytical results from November 1994.

Fowler, K. D., 1993, *Head Space Sampling of Tank 241-BY-111*, (internal letter #7K210-93-036 to G. T. Dukelow, March 29), Westinghouse Hanford Company, Richland, Washington.

- Document contains vapor sampling analytical results from March 1993.

Huckaby, J. L., and D. R. Bratzel, 1995, *Tank 241-BY-111 Headspace Gas and Vapor Characterization Results for Samples Collected in May 1994 and November 1994*, WHC-SD-WM-ER-440, Rev. 1A, Westinghouse Hanford Company, Richland, Washington.

- Document contains vapor sampling analytical results from May and November 1994.

Nuzum, J. L., 1997, *Final Report for Tank 241-BY-111 Push Mode,* HNF-SD-WM-DP-202, Rev. 0, Rust Federal Service of Hanford, Inc., Richland, Washington.

- Document contains analytical results from August 1996 push mode core sampling event.

IIb. Sampling of BY Saltcake Waste Type

Bell, K. E., J. Franklin, J. Stroup, and J. L. Huckaby, 1996, *Tank Characterization Report for Single-Shell Tank 241-BY-106*, WHC-SD-WM-ER-616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains characterization data for the waste in tank 241-BY-106, which includes BY saltcake.

Benar, C. J., J. G. Field, and L. C. Amato, 1996, *Tank Characterization Report for Single-Shell Tank 241-BY-104*, WHC-SD-WM-ER-608, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains characterization data for the waste in tank 241-BY-104, which includes BY saltcake.

Buckingham, J. S., 1972, *Exothermic Reactions in ITS Feed Solutions*, (internal memorandum to D. J. Larkin, March 17), Atlantic Richfield Hanford Company, Richland, Washington.

- Memorandum contains differential thermal analysis results and gas chromatography results for ITS feed.

Metz, W. P., 1972, *Nitric Acid Neutralization and Concentration of ITS Feed*, (internal memorandum to J. S. Buckingham, June 2), Atlantic Richfield Hanford Company, Richland, Washington.

- Memorandum contains a general chemical analysis of ITS feed.

Simpson, B. C., J. G. Field, and L. M. Sasaki, 1996, *Tank Characterization Report for Single-Shell Tank 241-BY-105*, WHC-SD-WM-ER-598, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains characterization data for the waste in tank 241-BY-105, which includes BY saltcake.

Simpson, B. C., R. D. Cromar, and R. D. Schreiber, 1996, *Tank Characterization Report for Single-Shell Tank 241-BY-110*, WHC-SD-WM-ER-591, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains characterization data for the waste in tank 241-BY-110, which includes BY saltcake.

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

IIIa. Inventories using both Campaign and Analytical Information

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Rev. 4*, LA-UR-96-3860, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Document contains waste type summaries, primary chemical compound/analyte and radionuclide estimates for sludge, supernatant, and solids, as well as SMM, TLM, and individual tank inventory estimates.

Agnew, S. F., R. A. Corbin, J. Boyer, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, B. L. Young, R. Anema, and C. Ungerecht, 1996, *History of Organic Carbon in Hanford HLW Tanks: HDW Model Rev. 3*, LA-UR-96-989, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Document attempts to account for the disposition of soluble organics and provides estimates of TOC content for each tank.

Allen, G. K., 1976, *Estimated Inventory of Chemicals Added to Underground Waste Tanks, 1944 - 1975*, ARH-CD-601B, Rev. 0, Atlantic Richfield Hanford Company, Richland, Washington.

- Document contains major components for waste types and some assumptions. Purchase records are used to estimate chemical inventories.

Allen, G. K., 1975, *Hanford Liquid Waste Inventory as of September 30, 1974*, ARH-CD-229, Rev. 0, Atlantic Richfield Company, Richland, Washington.

- Document contains major components for waste types and some assumptions.

Brevick, C. H., R. L. Newell, and J. W. Funk, 1996, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Area*, WHC-SD-WM-ER-349, Rev. 1A, Westinghouse Hanford Company, Richland, Washington.

- Document contains summary information for tanks in B, BX, and BY Tank Farms as well as in-tank photo collages and inventory estimates.

Klem, M. J., 1988, *Inventory of Chemicals Used at Hanford Production Plants and Support Operations (1944 - 1980)*, WHC-EP-0172, Westinghouse Hanford Company, Richland, Washington.

- Document provides a list of chemicals used in production facilities and support operations that sent wastes to the single-shell tanks. List is based on chemical process flowsheets, essential materials consumption records, letters, reports, and other historical data.

Kupfer, M. J., 1996, *Interim Report: Best Basis Total Chemical and Radionuclide Inventories in Hanford Site Tank Waste*, WHC-SD-WM-TI-740, Rev. B-Draft, Westinghouse Hanford Company, Richland, Washington.

- Document contains a global component inventory for 200 Area waste tanks, currently inventoried are 14 chemical and 2 radionuclide components.

Schmittroth, F. A., 1995, *Inventories for Low-Level Tank Waste*, WHC-SD-WM-RPT-164, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains a global inventory based on process knowledge and radioactive decay estimations using ORIGEN2. Pu and U waste contributions are taken at 1 percent of the amount used in processes. Also compares information on Tc-99 from both ORIGEN2 and analytical data.

Toth, J. J., C. E. Willingham, P. G. Heasler, and P.D. Whitney, 1994, *Organic Carbon in Hanford Single-Shell Tank Waste*, PNL-9434, Pacific Northwest Laboratory, Richland, Washington.

- Document contains organic carbon analytical results and model estimates for tanks.

IIIb. Compendium of Existing Physical and Chemical Documented Data Sources

Agnew, S. F., and J. G. Watkin, 1994, *Estimation of Limiting Solubilities for Ionic Species in Hanford Waste Tank Supernates*, LA-UR-94-3590, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Document gives solubility ranges used for key chemical and radionuclide components based on supernatant sample analyses.

Brevick, C. H., R. L. Newell, and J. W. Funk, 1996, *Supporting Document for the Northeast Quadrant Historical Tank Content Estimate Report for BY Tank Farm*, WHC-SD-WM-ER-312, Rev. 1A, Westinghouse Hanford Company, Richland, Washington.

- Document contains summary information for tanks in the BY Tank Farm as well as appendices containing more detailed information including tank waste level history, tank temperature history, cascade and dry well charts, riser information, in-tank photo collages, and tank layer model bar chart and spreadsheet.

Brevick, C. H., L. A. Gaddis, and E. D. Johnson, 1996, *Tank Waste Source Term Inventory Validation, Vol I, II, and III*, WHC-SD-WM-ER-400, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Document contains a quick reference to sampling information in spreadsheet or graphical form for 24 chemicals and 11 radionuclides for all the tanks.

Hanlon, B. M., 1997, *Waste Tank Summary Report for Month Ending January 31, 1997*, HNF-EP-0182-106, Westinghouse Hanford Company, Richland, Washington.

- This document, updated monthly, contains a summary of: tank waste volumes, Watch List tanks, occurrences, tank integrity information, equipment readings, tank location, leak volumes, and other miscellaneous tank information.

Hill, J. G., G. S. Anderson, and B. C. Simpson, 1995, *The Sort on Radioactive Waste Type Model: A Method to Sort Single-Shell Tanks into Characteristic Groups*, PNL-9814, Rev. 2, Pacific Northwest Laboratory, Richland, Washington.

- Document describes a system of sorting single-shell tanks into groups based on the major waste types contained in each tank.

Husa, E. I., 1993, *Hanford Site Waste Storage Tank Information Notebook*, WHC-EP-0625, Westinghouse Hanford Company, Richland, Washington.

- Document contains in-tank photos and summaries of the tank description, leak detection system, and tank status.

Husa, E. I., 1995, *Hanford Waste Tank Preliminary Dryness Evaluation*, WHC-SD-WM-TI-703, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document gives an assessment of the relative dryness of tank wastes.

Shelton, L. W., 1996, *Chemical and Radionuclide Inventory for Single and Double Shell Tanks*, (internal memorandum 74A20-96-30 to D. J. Washenfelder, February 28), Westinghouse Hanford Company, Richland, Washington.

- Memorandum contains a tank inventory estimate based on analytical information.

Shelton, L. W., 1995a, *Chemical and Radionuclide Inventory for Single and Double Shell tanks*, (internal memorandum #75520-95-007 to R. M. Orme, August 8), Westinghouse Hanford Company, Richland, Washington.

- Memorandum contains a tank inventory estimate based on analytical information.

Shelton, L. W., 1995b, *Radionuclide Inventories for Single and Double Shell Tanks*, (internal memorandum #71320-95-002 to F. M. Cooney, February 14), Westinghouse Hanford Company, Richland, Washington.

- Memorandum contains a tank inventory estimate based on analytical information.

Van Vleet, R. J., 1993, *Radionuclide and Chemical Inventories for the Single Shell Tanks*, WHC-SD-WM-TI-565, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Document contains selected sample analysis tables before 1993 for single-shell tanks.

DISTRIBUTION SHEET

To	From	Page 1 of 2
Distribution	Data Assessment and Interpretation	Date 05/08/97
Project Title/Work Order		EDT No. EDT-617660
Tank Characterization Report for Single-Shell Tank 241-BY-111, HNF-SD-WM-ER-687, Rev. 0		ECN No. N/A

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