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ENGINEERING CHANGE NOTICE

Page 1 of 2

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Proj. ECN

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Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	Wayne D. Winkelman, Data Assessment and Interpretation, R2-12, 376-3339	[] Yes [X] No	02/12/97
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13a. Description of Change

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This ECN was generated in order to revise the document to the new format per Department of Energy performance agreements.

14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
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14b. Justification Details

This document was revised per Department of Energy performance agreements and direction from the Washington State Department of Ecology to revise 23 tank characterization reports (letter dated 7/6/95).

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

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[X] No	Savings	[]	$	Savings	[]	$	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

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

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

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Tank Characterization Report for Single-Shell Tank 241-BX-107

Wayne D. Winkelman
Lockheed Martin Hanford Corp., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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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-BX-107. This report supports the requirements of the Tri-Party Agreement Milestone M-44-05.

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Tank Characterization Report for Single-Shell Tank 241-BX-107

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LIST OF TERMS

1C	first cycle decontamination waste
1C1	first cycle decontamination waste (generated from 1944 to 1951)
1C2	first cycle decontamination waste (generated from 1952 to 1956)
°C	degrees Celsius
°F	degrees Fahrenheit
μCi/g	microcuries per gram
μCi/kg	microcuries per kilogram
μCi/L	microcuries per liter
μeq/g	microequivalents per gram
μg/g	micrograms per gram
μg/mL	micrograms per milliliter
μm	micrograms per milliliter
ANOVA	analysis of variance
Btu/hr	British thermal units per hour
CF	concentration factor
Ci	curies
Ci/L	curies per liter
CLP	Contract Laboratory Program
cm	centimeters
CRQL	contract required quantitation limit
CVAA	cold vapor atomic absorption
DOE	U.S. Department of Energy
DQO	data quality objectives
DSC	differential scanning calorimetry
ft	feet
GHAA	gaseous hydride atomic absorption
g	grams
g/g	grams per gram
g/L	grams per liter
g/mL	grams per milliliter
HDW	Hanford defined waste
IC	ion chromatography
ICP	inductively coupled plasma emission spectroscopy
in.	inches
kg	kilograms
kgal	kilogallons
kL	kiloliters
LFL	lower flammability limit
LL	lower limit

LIST OF TERMS (Continued)

m	meters
m^2	square meters
M	molar
mg/L	milligram per liter
mg/m^3	milligrams per cubic meter
mm	millimeters
mR/hr	milliroentgens per hours
n/a	not applicable
n/d	not decided
n/r	not reported
NPH	normal paraffin hydrocarbon
PF	partitioning factors
PHMC	Project Hanford Management Contractor
ppm	parts per million
ppmv	parts per million by volume
PNNL	Pacific Northwest National Laboratory
SVOA	semivolatile organic analysis
QC	quality control
REML	restricted maximum likelihood estimation
RPD	relative percent difference
TBP	tributyl phosphate
TCLP	toxicity characteristic leaching procedure
TCR	tank characterization report
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TOX/EOX	total extractable organic halides
TOC	total organic carbon
TWRS	Tank Waste Remediation System
UL	upper limit
VOA	volatile organic analysis
W	watts
W/Ci	watts per curie
wt%	weight percent

1.0 INTRODUCTION

One major function 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 and other tank information are compiled and maintained in a tank characterization report (TCR). This report and its appendices serve as the TCR for single-shell tank 241-BX-107. The objectives of this report are: 1) to use characterization data in response to technical issues associated with tank 241-BX-107 waste, and 2) to provide a standard characterization of this waste in terms of a best-basis inventory estimate. Section 2.0 summarizes the response to technical issues, Section 3.0 provides the best-basis inventory estimate, and Section 4.0 makes recommendations about safety status and additional sampling needs. The appendices contain supporting data and information. This report also supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1996), Milestone M-44-05.

1.1 SCOPE

The characterization information in this report originated from sample analyses and known (historical) sources. An evaluation has been made of the 1992 sampling event data and the technical issues from the currently applicable data quality objectives (DQOs). The most recent waste sampling of tank 241-BX-107 (May and June 1992) predated the existence of DQOs. Sufficient analyses were performed to meet the needs of the current applicable DQOs and to satisfy the data requirements specified in the waste characterization plan (Hill et al. 1991). Table 1-1 summarizes the most recent sampling event. Appendix A historical information includes surveillance information, records pertaining to waste transfers and tank operations, and expected tank contents derived from a process knowledge model.

Vapor sampling was conducted on November 17, 1995. Appendix B summarizes the data from this event and from several sampling events that were performed before 1992.

Appendix C reports on the statistical analysis and numerical manipulation of data used in issue resolution. Appendix D contains the engineering evaluation establishing the best basis for the inventory estimate. Appendix E is a bibliography that resulted from an in-depth literature search of all known information sources applicable to tank 241-BX-107 and its respective waste types.

Table 1-1. Summary of Recent Sampling Events.

Sample/date	Phase	Location	Segmentation	Recovery
Vapor sample (November 1995)	Gas	Tank headspace	n/a	Good
Push mode sample core 40 (May 14, 1992 to June 14, 1992)	Solid	Riser 7	Some analysis at segment level. Most analysis from core composites.	Partial core obtained; 4.6 segments of 7 expected segments.
Push mode sample core 41 (May 14, 1992 to June 14, 1992)	Solid	Riser 3	Some analysis at segment level. Most analysis from core composites.	Partial core obtained; 4.1 segments of 7 expected segments.

Note:
n/a = not applicable

1.2 TANK BACKGROUND

Tank 241-BX-107 is located in the 200 East Area BX Tank Farm on the Hanford Site. It is the first tank in a three tank cascade series. The tank went into service in 1948 and received first-cycle decontamination waste from B Plant. First cycle decontamination waste (1C) is the primary waste type. It is predicted to compose the solids currently in the tank. The tank received uranium recovery (UR) waste from U Plant in 1953, but most of this waste is thought to have been removed in subsequent transfers from 241-BX-107. The last transfer into tank 241-BX-107 was supernate waste from tank 241-BX-104 in the third quarter of 1968.

Table 1-2 summarizes the description of tank 241-BX-107. The tank has an operating capacity of 2,010 kL (530 kgal) and presently contains an estimated 1,310 kL (345 kgal) of noncomplexed waste (Hanlon 1996). The tank is not on a Watch List (Public Law 101-510).

Table 1-2. Description of Tank 241-BX-107.

TANK DESCRIPTION	
Type	Single-shell
Constructed	1946 to1947
In service	1948
Diameter	22.9 m (75. ft)
Operating depth	5.18 m (17. ft)
Capacity	2,010 kL (530 kgal)
Bottom shape	Dish
Ventilation	Passive
TANK STATUS	
Waste classification	Noncomplexed
Total waste volume	1,310 kL (345 kgal)
Supernatant volume	4 kL (1 kgal)
Saltcake volume	0 kL (0 kgal)
Sludge volume	1,300 kL (344 kgal)
Drainable interstitial liquid volume	110 kL (29 kgal)
Waste surface level (November 11, 1996)	339 cm (133.4 in.)
Temperature (July 1975 to November 1996)	12 °C (54 °F) to 29 °C (84 °F)
Integrity	Sound
Watch List	None
SAMPLING DATE	
Core samples	May to June 1992
Vapor samples	November 1995
SERVICE STATUS	
Declared inactive	1977
Interim isolated	1985
Interim stabilization	1990

Note:

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

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2.0 RESPONSE TO TECHNICAL ISSUES

The following four technical issues were identified for tank 241-BX-107 (Brown et al. 1996).

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

- **Hazardous vapor safety screening**: Does the vapor headspace exceed 25 percent of the lower flammability limit (LFL)? If so, what are the principal fuel components?

  Are compounds of technogical significance present at such a level that the industrial hygiene group should be alerted to their presence to ensure adequate breathing zone monitoring and the safety of future activities in and around the tank? (This issue has been resolved. For information see Hewitt [1996].)

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

- **Pretreatment**: Is the tank waste suitable for sludge washing?

The types of sampling and analysis required to address the above issues are identified in the applicable DQOs. Data from the 1992 analysis of two core samples, tank headspace flammability measurements, vapor samples and historical information, provided the means to respond to these issues. This response is discussed in the following sections. See Appendix B for sample and analysis data for tank 241-BX-107.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-BX-107 for potential safety problems is documented in the safety screening DQO (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 condition is addressed separately.

In addition to analytical requirements, the safety screening DQO also specifies sampling conditions which must be met for a complete safety assessment. If inadequate information exists to determine an appropriate number of samples, two full vertical profiles of waste are required. When sampling to obtain two vertical profiles, the sampling risers must be separated radially to the maximum extent possible. The sampling risers for tank 241-BX-107 met this requirement because the sampling risers were located on opposite sides of the tank.

However, poor sample recoveries for some segments prevented the acquisition of full vertical profiles for the cores. No waste was recovered from segments 1 and 3 of core 40 and segments 1 and 4 of core 41; segment 5 of core 41 had only a five percent recovery.

2.1.1 Exothermic Conditions (Energetics)

The first requirement outlined in the safety screening DQO (Dukelow et al. 1995) is to ensure there are not enough exothermic constituents (organic) in tank 241-BX-107 to cause a safety hazard. The DQO threshold limit for energetics is 480 joules per gram on a dry weight basis. Tank waste energetics were measured, so this parameter can be evaluated. Results obtained using differential scanning calorimetry (DSC) indicated no exothermic reactions were present in any sample (Pool 1994).

2.1.2 Flammable Gas

The determination of tank headspace flammability was not required when the tank was sampled in 1992. However, vapor phase measurements, taken in the tank headspace during the vapor sampling in 1995, indicated that no flammable gas was detected (0 percent of the LFL). Appendix B, Table B2-5 contains data from the vapor phase measurements.

2.1.3 Criticality

The safety threshold limit is 1 g ^{239}Pu per liter of waste. Assuming that all alpha activity is from ^{239}Pu and using the measured density of 1.44 g/mL, 1 g/L of ^{239}Pu is equivalent to 42.7 μCi/g of alpha activity. Waste samples were tested for total alpha activity for each core composite. Concentrations in all samples were well below this limit. The DQO also requires the calculation of a one-sided 95 percent confidence interval on each sample. For tank 241-BX-107, this computation was made only on the tank mean. The upper limit (UL) of the one-sided 95 percent confidence interval on the tank mean was also less than 1 g/L or 42.7 μCi/g; therefore criticality is not a concern in this tank. Appendix B shows the method used to calculate confidence limits, and Appendix C includes the calculations.

2.2 HAZARDOUS VAPOR SAFETY SCREENING

The data required to support hazardous vapor safety screening is documented in the *Data Quality Objective for Tank Hazardous Vapor Safety Screening* (Osborne and Buckley 1995). The vapor screening DQO addresses the following: (1) the potential that may exist for flammable levels of gases and vapors generated or released in waste storage tanks headspace to be above the 25 percent LFL, and (2) the potential that may exist for worker hazards associated with the toxicity of constituents in any fugitive vapor emissions from these tanks.

2.2.1 Flammable Gas

The determination of tank headspace flammability was not required when the tank was sampled in 1992. However, vapor phase measurements, taken in the tank headspace during the vapor sampling in 1995, indicated that no flammable gas was detected (0 percent of the LFL). Appendix B, Table B2-5 contains data from the vapor phase measurements.

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. The only analyte to exceed the threshold limits of the vapor safety screening DQO was ammonia. Ammonia had a concentration of 83 ppm (volume basis), well over the DQO threshold limit of 25 ppm (volume basis). This issue has been resolved in *Tank Waste Remediation System Resolution of Potentially Hazardous Tank Vapors Issue* (Hewitt 1996).

2.3 ORGANIC SOLVENTS

The data required to support the organic solvent screening issue are documented in the 93-5 implementation plan (DOE-RL 1996). A new DQO is being developed to address the organic solvent issue. In the interim, tanks are to be sampled for total nonmethane hydrocarbon to determine whether an organic extractant pool greater than 1 m^2 exists (Cash 1996). The purpose of this assessment is to ensure that the organic solvent pool is not large enough to cause an organic solvent pool fire or ignition of organic solvents. Vapor samples taken November, 1995, showed that the concentration of total nonmethane organic hydrocarbon in tank 241-BX-107 was 2.08 mg/m^3 (Evans et al. 1996). The size of the organic extractant pool will be determined by the organics program, based on the vapor data, tank headspace temperature, and the tank ventilation rate.

2.4 PRETREATMENT

Waste from tank 241-BX-107 was provided for sludge washing evaluation (Colton 1996). For details of this evaluation, refer to *Washing and Caustic Leaching of Hanford Tank Sludges: Results of 1995 Studies* (Rapko et al. 1995).

2.5 OTHER TECHNICAL ISSUES

A factor in assessing tank safety is the heat generation from radioactive decay. Table 2-1 shows the tank heat load calculated from the best-basis inventory data in Section 3.0 was 282 W (962 Btu/hr). The Agnew et al. (1996) estimate of heat load was 117 W (400 Btu/hr), and the heat load estimate based on the tank headspace temperature was 1,352 W (4,615 Btu/hr) (Kummerer 1995). These estimates are well below the 11,700 W (40,000 Btu/hr) operating specification limit for single-shell tanks (Smith 1986).

Table 2-1. Tank 241-BX-107 Radionuclide Inventory and Projected Heat Load.

Radionuclide	Projected Inventory (Ci)	Decay Heat Generation Rate (W/Ci)	Decay Heat Generation (W)
^{137}Cs	32,600	0.00472	154
$^{89/90}Sr$	18,500	0.00670	124
^{99}Tc	69.2	5.01E-04	0.0347
^{241}Am	24.4	0.0328	0.800
$^{239/240}Pu$	107	0.0305	3.26
Total Watts			282

2.6 SUMMARY

The analytical results showed that no analyte exceeded the safety decision threshold limits. Table 2-2 summarizes the analyses results.

Table 2-2. Summary of Safety Screening Results.

Issue	Sub-issue	Result
Safety	Energetics	No exotherms were observed in any sample.
	Criticality	All analyses were well below 42.7 μCi/g.
	Flammable gas	0 percent of the LFL.
Hazardous safety vapor screening	Flammable gas	See safety screening flammable gas.
	Toxicity	411 analytes were within the toxicity threshold limits; ammonia was not.
Organic solvents	Solvent Pool	Total nonmethane organic hydrocarbon was 2.08 mg/m^3 to be determined by the safety program.

3.0 BEST-BASIS INVENTORY ESTIMATE

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessments 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, processes, and facilities for retrieving wastes and processing them into a form suitable for long-term storage. Chemical and radiological inventory information are generally derived using three approaches: (1) component inventories are estimated using the results of sample analyses, (2) component inventories are predicted using the Hanford defined waste (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 from these different approaches is often inconsistent.

An effort is underway (Kupfer et al. 1995) to provide waste inventory estimates that will serve as the standard characterization for the various waste management activities. As part of this effort, an evaluation of available chemical information for tank 241-BX-107 was performed. It included the following:

- Data from two push mode 1992 core samples (Raphael 1994)
- An inventory estimate generated by the HDW model (Agnew et al. 1996)
- Evaluation of the first cycle decontamination/cladding waste and tributyl phosphate (TBP) flowsheets (Schneider 1951).

Based on this evaluation, a best-basis inventory was developed. In general, the sample-based TCR results were used because they were consistent with other results.

Tables 3-1 and 3-2 show the best-basis inventory for tank 241-BX-107. Appendix D contains the details of the inventory evaluation.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BX-107. (2 sheets)

Analyte	Total inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	26,900	S	
Ag	12	S	
As	.8	S	
Ba	15	S	
Be	3	S	
Bi	41,900	S	
Ca	745	S	
Ce	335	S	
Cd	8	S	
Cl	2,140	S	
Co	13	S	
TIC as CO_3	2,180	S	
Cr	1,820	S	
Cu	97	S	
F	17,300	S	
Fe	20,900	S	
Hg	1.0	S	
K	495	S	
La	15	S	
Mg	299	S	
Mn	121	S	
Na	192,000	S	
Ni	23	S	
NO_2	15,300	S	
NO_3	258,000	S	

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BX-107. (2 sheets)

Analyte	Total inventory (kg)	Basis (S, M, or E)[1]	Comment
OH	n/r		
Pb	118	S	
P as PO_4	135,000	S	
Si	12,800	S	
S as SO_4	25,000	S	
Sr	316	S	
TOC	1,500	S	
U_{TOTAL}	9,100	S	
Zr	256	S	

Notes:

n/r = not reported

[1]S = Based on 1992 core sample data (see Appendix B), M = Hanford Defined Waste model-based, E = Engineering assessment-based

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BX-107.

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	1.09	S	
^{14}C	0.489	S	
^{90}Sr	18,600	S	
^{99}Tc	69.4	S	
^{137}Cs	32,700	S	
^{238}U	1.4	S	
^{239}Pu	108	S	
^{241}Am	24.4	S	

Note:

[1]S = Based on 1992 core sample data, (see Appendix B), M = Hanford Defined Waste model-based, E = Engineering assessment-based

4.0 RECOMMENDATIONS

The sampling and analysis activities performed for tank 241-BX-107 did not meet all requirements of the safety screening DQO (Dukelow et al. 1995) because two full verticle cores were not obtained. However, the waste missed due to mechanical failures of the sampling equipment is not expected to be significantly different from the other tank waste. In addition to the analytical results from the current sampling event, a characterization best-basis inventory was developed for the tank contents.

Table 4-1 summarizes the status of the Project Hanford Management Contract (PHMC) TWRS Program review and acceptance of the sampling and analysis results reported in this tank characterization report. Column 1 lists all DQOs applicable to this tank. Column 2 indicates whether the requirements of the DQO were met by the sampling and analysis activities performed in 1992 and 1995 with a "yes" or "no." Column 3 indicates concurrence and acceptance by the program in TWRS that is responsible for the DQO and that the sampling and analysis activities performed adequately met the needs of the DQO. A "yes" or "no" in column 3 indicates acceptance or disapproval of the sampling and analysis information in the TCR. If the results/information have not been reviewed, "n/r" is shown in the column. If the results/information have been reviewed, but acceptance or disapproval has not been decided, "n/d" is shown in the column.

Table 4-1. Acceptance of Tank 241-BX-107 Sampling and Analysis.

Issue	Sampling and Analysis Performed	TWRS[1] Program Acceptance
Safety screening DQO	Partial	Yes
Vapor screening	Yes	Yes
Pretreatment	Yes	n/d
Organic solvents	Yes	Yes

Note:

[1]PHMC TWRS Program Office

Table 4-2 summarizes the status of TWRS Program review and acceptance of the evaluations and other characterization information contained in this report. The evaluations specifically outlined in this report are the best-basis inventory evaluation and the evaluation to determine whether the tank is safe, conditionally safe, or unsafe. Column 1 lists the different evaluations performed in this report. Columns 2 and 3 are in the same format as Table 4-1. The manner in which concurrence and acceptance are summarized is the same as that in Table 4-1.

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-BX-107.

Issue	Evaluation Performed	TWRS[1] Program Acceptance
Safety categorization (tank is safe)	Partial	n/d

Note:

[1]TWRS PHMC Program Office

No further sampling and analysis is required.

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APPENDIX A

HISTORICAL TANK INFORMATION

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APPENDIX A

HISTORICAL TANK INFORMATION

Appendix A describes tank 241-BX-107 based on historical information. For this report, historical information includes information about the fill history, waste types, surveillance, or modeling data about the tank. This information may be useful for supporting conclusions based on sampling and analysis.

This appendix contains the following information:

- **Section A1:** Current tank status of the tank, including the current waste levels and the tank stabilization and isolation.
- **Section A2:** Information about tank design.
- **Section A3:** Process knowledge of the tank, that is, the waste transfer history and the estimated contents of the tank based on modeling data.
- **Section A4:** Surveillance data for tank 241-BX-107, including surface level readings, temperatures, and a description of the waste surface based on photographs.
- **Section A5:** References for Appendix A.

A1.0 CURRENT TANK STATUS

As of August 31, 1996, tank 241-BX-107 contained 1,310 kL (345 kgal) of noncomplexed waste (Hanlon 1996). The waste volumes were estimated using an ENRAF[1] surface level gauge and photographic evaluation. Table A1-1 shows the volumes of the waste phases found in the tank.

Tank 241-BX-107 was declared inactive in 1977. The tank is passively ventilated, categorized as sound, and is not on a Watch List (Public Law 101-510). The tank was partially interim isolated in June 1985 and interim stabilized in September 1990.

[1]ENRAF is a trademark of the ENRAF Corporation, Houston, Texas.

Table A1-1. Estimated Tank Contents.[1]

Waste Form	Estimated Volume	
	kL	kgal
Total waste	1,310	345
Supernatant liquid	4	1
Sludge	1,300	344
Saltcake	0	0
Drainable interstitial liquid	110	29
Drainable liquid remaining	114	30
Pumpable liquid remaining	87	23

Note:
[1]For definitions and calculation methods, refer to Appendix C of Hanlon (1996).

A2.0 TANK DESIGN AND BACKGROUND

The BX Tank Farm was constructed between 1946 and 1947 in the 200 East Area. The tank farm contains twelve single-shell tanks. Each tank has a capacity of 2,010 kL (530 kgal), a diameter of 22.9 m (75.0 ft), and an operating depth of 5.18 m (17.0 ft). The tanks were designed to hold concentrated, nonboiling supernate. The maximum design temperature for liquid storage is 104 °C (220 °F) (Brevick et al. 1996).

Tank 241-BX-107 entered service in 1948; it is the first in a three tank cascade series. The single-shell tanks are constructed of 30-cm (1.0-ft)-thick reinforced concrete with a 6.35 mm (0.25 in.) mild carbon steel liner on the sides, a 9.53 mm (0.375 in.) liner on the bottom, and a 38-cm (1.25-ft)-thick domed concrete top. The tanks have a dished bottom with a 1.2 m (4 ft) radius knuckle. The tanks are set on a reinforced concrete foundation.

The surface level is monitored through riser 8 with an ENRAF™ gauge. Riser 4 contains a thermocouple tree. An interior tank photograph from 1990 shows a saltwell screen and pump in riser 13. Table A2-1 lists tank 241-BX-107 risers, their size, and description. Figure A2-1 shows the riser configuration, and Figure A2-2 is a tank cross section showing the approximate waste level and a schematic of the tank equipment. Tank 241-BX-107 has 12 risers. Risers 2, 3, 5, 6, and 7 are tentatively available for sampling (Lipnicki 1996). Risers 2, 3, 6, and 7 are 30 cm (12 in.) in diameter, and riser 5 has a diameter of 10 cm (4 in.).

Tank 241-BX-107 has four process inlet nozzles and one cascade overflow outlet located approximately 4.8 m (15.75 ft) from the tank bottom (as measured at the tank wall).

Table A2-1. Tank 241-BX-107 Risers.[1]

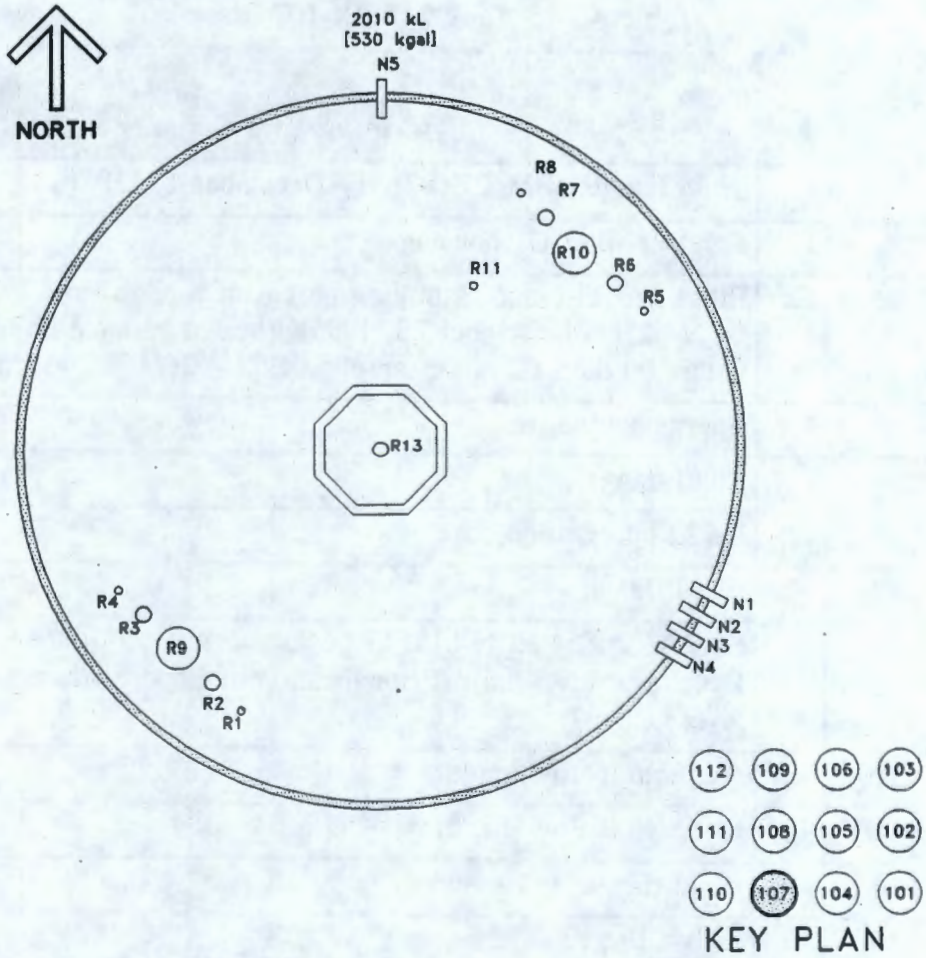
Riser Number	Diameter		Description and Comments
	cm	in.	
1	10	4	Blind flange, (BM CEO-36517 December 11, 1986)
2	30	12	Breather filter/G1 housing
3	30	12	Blind flange, (vapor sampling port with a 12 in. to 4 in. adapter ECN-625880L October 23, 1995), (heated vapor probe was removed within 90 days of vapor sampling ECN-626609L November 2, 1995)
4	10	4	Thermocouple tree
5	10	4	Blind flange
6	30	12	B-222 observation port
7	30	12	Blind flange
8	10	4	ENRAF™ 854 ECN-613547 September 8, 1994 (BM CEO-36517 December 11, 1986), (Prior location of Food Instrument Corporation level gauge)
9	110	42	Manhole (below grade)
10	110	42	Manhole (below grade)
11	10	4	Blind flange, in caisson
13	30	12	Saltwell screen and pump
N1	10	4	Spare line V-345
N2	10	4	Inlet line V-346
N3	10	4	Inlet line V-347
N4	10	4	Inlet line V-348
N5	10	4	Cascade outlet to tank 241-BX-108

Notes:

ECN = Engineering Change Notice
CEO = Change Engineering Order

[1]Alstad (1993), Tran (1993), Vitro Engineering Corporation (1988)

Figure A2-1. Riser Configuration for Tank 241-BX-107.



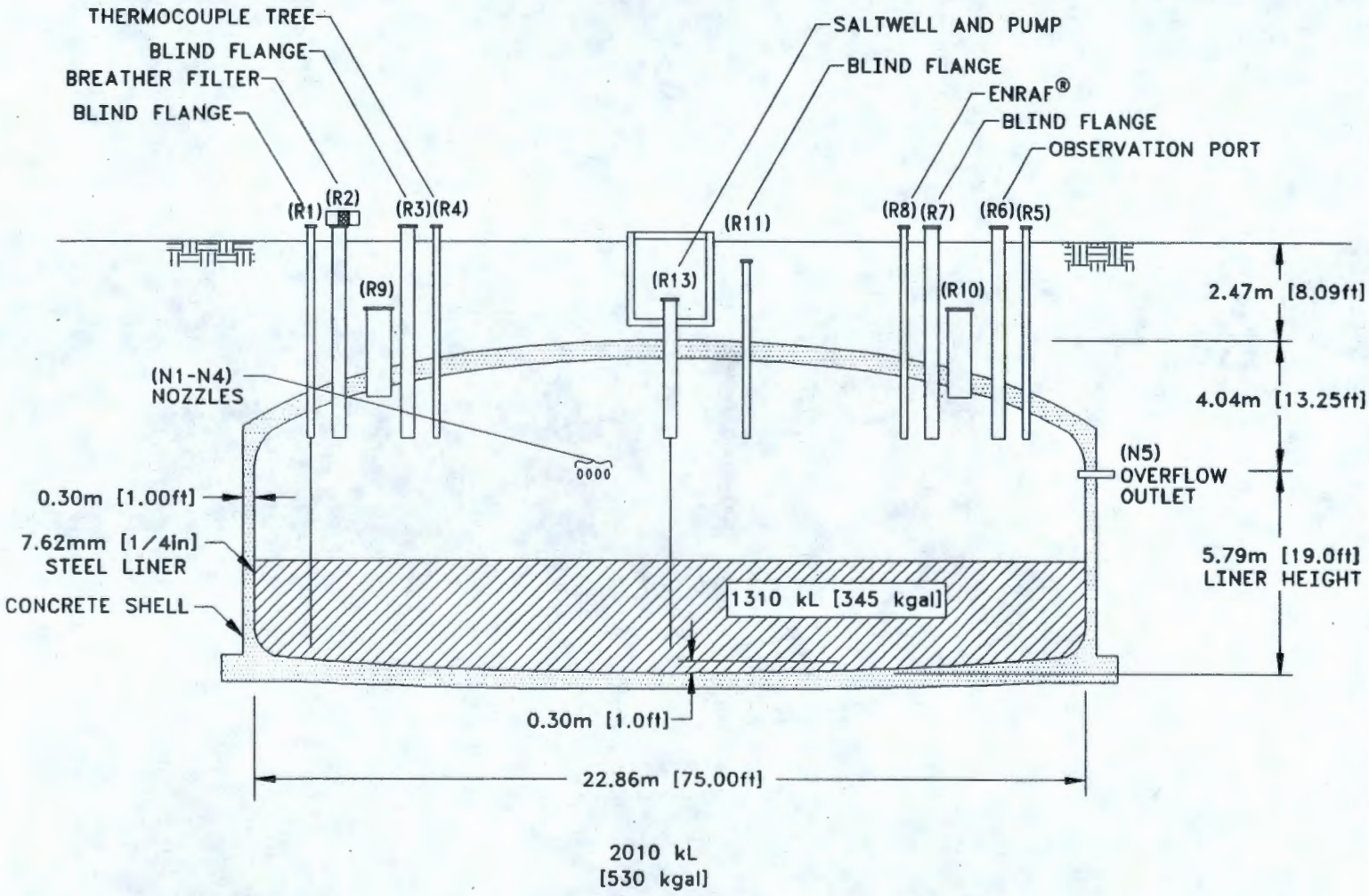


Figure A2-2. Tank 241-BX-107 Cross Section and Schematic.

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A3.0 PROCESS KNOWLEDGE

The following sections 1) provide information about the transfer history of tank 241-BX-107, 2) describe the process wastes that made up the transfers, and 3) give an estimate of the current tank contents based on transfer history.

A3.1 WASTE TRANSFER HISTORY

Table A3-1 summarizes the waste transfer history of tank 241-BX-107. The tank came into service during the third quarter of 1948 and received about 155 kL (41 kgal) of B Plant first cycle decontamination waste (Agnew et al. 1996b). When the tank was filled with 1C waste, the waste cascaded to tank 241-BX-108. This continued until the fourth quarter of 1950 when the last tank in the cascade, tank 241-BX-109, was filled.

At the end of 1952, all supernatant liquid was pumped out of tank 241-BX-107, and1,650 kL (437 kgal) of settled sludge remained in the tank. During the second quarter of 1953, 452 kL (93 kgal) of TBP (or UR) waste was added from U Plant. In the fourth quarter of 1953, waste was transferred from the tank 241-BX-107 to tank 241-BX-108. Between 1953 and 1968, the volume of the sludge remained between 1,620 kL to 1,690 kL (428 to 447 kgal) while liquid volumes fluctuated between 34 and 492 kL (9 to 130 kgal).

In the last quarter of 1968, 598 kL (158 kgal) were transferred to tank 241-BX-106, leaving tank 241-BX-107 with 1,550 kL (409 kgal) of sludge. The last transfer into tank 241-BX-107 was supernate waste from tank 241-BX-104 in the third quarter of 1968. There was a transfer to tank 241-BY-102 in the same quarter. In the third quarter of 1969, tank 241-BX-107 began receiving ion exchange waste (IX). Records show that the sludge volume decreased to 1,420 kL (376 kgal), and the liquid volume increased to 645 kL (165 kgal). Those levels remained approximately constant until 1974 when 250 kL (66 kgal) of tank 241-BX-107 supernatant liquid were transferred to 241-BX-106 for solidification. The remaining 375 kL (99 kgal) of liquid were used as evaporator feed in 1977, leaving the tank with 1,420 kL (376 kgal) of residual sludge from 1977 to 1980.

At various times during the tank 241-BX-107 process history, supernate was removed and sent to tanks 241-B-106, 241-BX-106, or 241-A-102. Saltwell liquid was pumped from the tank 241-BX-107 to tank 241-AN-101 in support of tank stabilization in the second quarter of 1987.

Table A3-1. Summary of Tank 241-BX-107 Major Waste Transfers.

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Volume[1,2]	
				kL	kgal
B Plant	241-BX-107	First-cycle decontamination	1948-1952	6,020	1,590
241-BX-107	241-BX-108	First-cycle decontamination	1949-1950	-4,010	-1,060
241-BX-107	241-B-106	Supernate	1952	-352	-93
U Plant	241-BX-107	Uranium recovery (TBP) waste	1953	2,320	613
241-BX-107	241-BX-108	Uranium recovery (TBP) waste	1953	-1,970	-520
241-BX-107	241-BX-106	Supernate	1968-1974	-848	-224
241-BX-104	241-BX-107	Supernate	1969	625	165
241-BX-107	241-A-102	Supernate	1977	-375	-99
241-BX-107	241-AN-101	Saltwell liquid	1987	-117	-31

Notes:

[1]Agnew et al. (1996b)

[2]Because only major transfers are listed, the sum of these transfers will not equal the current waste volume.

A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS

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

- Waste Status and transaction Record Summary for the Southwest Quadrant of the Hanford 200 East Area (WSTRS) (Agnew et al. 1996a). WSTRS is a tank-by-tank quarterly summary spreadsheet of waste transactions.

- Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 3 (Agnew et al. 1996b). This document contains the Hanford Defined Waste (HDW) list, the Supernatant Mixing Model (SMM), and the Tank Layer Model (TLM).

- Historical Tank Content Estimate for the (Northeast, Northwest, Southeast, Southwest) Quadrant of the Hanford 200 (East or West) Area (HTCE). This set of four documents compiles and summarizes much of the process history, design, and technical information regarding the underground waste storage tanks in the 200 Areas.

- Tank Layer Model (TLM). The TLM defines the sludge and saltcake layers in each tank using waste composition and waste transfer information.

- Supernatant Mixing Model (SMM). This 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 both the WSTRS and the TLM to describe the supernates and concentrates in each tank. Together the WSTRS, TLM, and SMM determine each tank's inventory estimate. These model predictions are considered estimates that require further evaluation using analytical data.

This information is combined in a spreadsheet to produce the HDW Model inventory estimate for each of 177 tanks. These predictions have not been validated and should be used with caution. In some cases, the available data are incomplete thereby reducing the reliability of the transfer data and the modeling results derived from them. These predictions can only be considered estimates that require further evaluation using analytical data.

Based on the Tank Layer Model, the tank contents consists of 4 kL (1 kgal) of supernate and 1,300 kL (344 kgal) of sludge. The sludge layer is further defined as 495 kL (131 kgal) of first cycle decontamination waste (1C2) generated from 1952 to 1956 on top of 806 kL (213 kgal) of first cycle decontamination waste (1C1) generated from 1944 to 1951.

Figure A3-1 is a graphical representation of the estimated waste type and volume. Table A3-2 provides HDW Model estimates of the expected waste constituents and concentrations for tank 241-BX-107.

Figure A3-1. Tank Layer Model for Tank 241-BX-107.

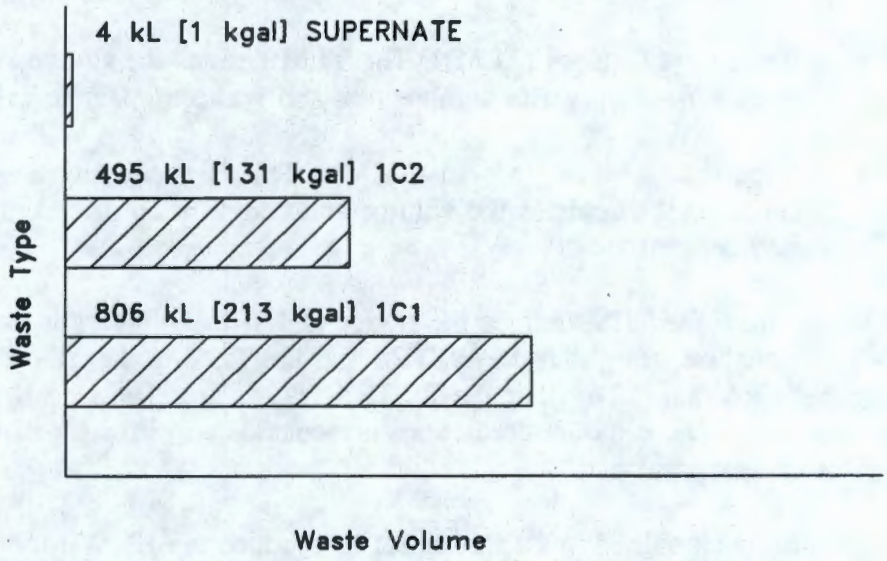


Table A3-2. Tank 241-BX-107 Historical Tank Inventory Estimate.[1] (2 sheets)

Total Inventory Estimate			
Physical Properties			
Total waste	1.65E+06 kg (345 kgal)		
Heat load	117 W (400 Btu/hr)		
Bulk density[2]	1.26 (g/mL)		
Water wt%[2]	72.1		
TOC wt%C (wet)[2]	8.10E-04		
Chemical Constituents	**M**	**ppm**	**kg**
Na^+	4.37	79,500	1.31E+05
Al^{3+}	0.621	13,300	21,900
Fe^{3+} (total Fe)	0.267	11,800	19,500
Cr^{3+}	0.00404	166	274
Bi^{3+}	0.0643	10,600	17,500
La^{3+}	4.75E-12	5.22E-07	8.62E-07
Hg^{2+}	8.72E-05	13.8	22.9
Zr (as $ZrO(OH)_2$)	0.00902	651	1,070
Pb^{2+}	3.60E-07	0.0590	0.0975
Ni^{2+}	0.00123	57.0	94.1
Sr^{2+}	1.58E-12	1.10E-07	1.81E-07
Mn^{4+}	8.00E-06	0.348	0.574
Ca^{2+}	0.0639	2,030	3,340
K^+	0.00311	96.2	159
OH^-	2.83	38,000	62,800
NO_3^-	0.383	18,800	31,000
NO_2^-	0.206	7,510	12,400
CO_3^{2-}	0.0644	3,060	5,050
PO_4^{3-}	1.16	86,900	1.43E+05

Table A3-2. Tank 241-BX-107 Historical Tank Inventory Estimate.[1] (2 sheets)

Total Inventory Estimate			
Chemical Constituents	**M**	**ppm**	**kg**
SO_4^{2-}	0.0474	3,600	5,950
Si (as SiO_3^{2-})	0.0581	1,290	2,130
F^-	0.175	2,630	4,340
Cl^-	0.0143	400	660
$C_6H_5O_7^{3-}$	5.84E-05	8.73	14.4
Chemical Constituents	**M**	**ppm**	**kg**
$EDTA^{4-}$	1.05E-06	0.238	0.394
$HEDTA^{3-}$	2.12E-06	0.459	0.758
$Glycolate^-$	1.34E-05	0.795	1.31
$Acetate^-$	8.84E-09	4.13E-04	6.81E-04
$Oxalate^{2-}$	4.07E-12	2.83E-07	4.67E-07
DBP	3.71E-05	7.80	12.9
Butanol	3.71E-05	2.17	3.59
NH_3	3.74E-04	5.03	8.31
$Fe(CN)_6^{4-}$	0	0	0
Radiological Constituents	**Ci/L**	**μCi/g**	**Ci**
Pu	---	0.0102	0.281 (kg)
U	6.01E-04 (M)	113 (μg/g)	187 (kg)
Cs	0.0187	14.8	24,500
Sr	3.26E-04	0.258	425

Notes:

[1]Agnew et al. (1996a). These estimates have not been validated and should be used with caution.
[2]Volume average for density, mass average water wt%, and TOC wt% C.

A4.0 SURVEILLANCE DATA

Tank 241-BX-107 surveillance data consists of surface level measurements (liquid and solid), temperature monitoring inside the tank (waste and headspace), and leak detection well monitoring for radioactive liquids outside the tank. Surveillance data provide the basis for determining tank integrity.

A4.1 SURFACE LEVEL READINGS

Waste surface level monitoring in tank 241-BX-107 is performed with an ENRAF™ gauge at riser 8. Before December 6, 1995 surface level data was taken by a Food Instrument Corporation gauge. The waste surface level on November 6, 1996, was 339 cm (133.4 in.), which is approximately 1,310 kL (345 kgal). Figure A4-1 shows a graphical representation of the volume measurements.

A4.2 INTERNAL TANK TEMPERATURES

The thermocouple tree, containing 14 thermocouple elements, was declared out of service in April 1983 (Brevick et al. 1996). The thermocouple tree was not repaired until 1994. Temperature data for tank 241-BX-107 are currently recorded for 8 thermocouples (1 through 7 and 11) on one thermocouple tree located in riser 4. The minimum temperature on November 5, 1996, was 19.2 °C (66.6 °F) on thermocouple 3; the maximum temperature on the same date was 21.3 °C (70.3 °F) on thermocouple 11.

Temperature data, available from the Surveillance Analysis Computer System, were recorded from 1975 to 1983 (for all thermocouples) and from 1994 to 1996 (for 8 thermocouples) (Brevick et al. 1996). The average temperature during this period was 19.4 °C (66.9 °F) with a minimum of 12 °C (54 °F) and a maximum of 29 °C (84 °F). Figure A4-2 is a graphical plot of average tank temperature versus time.

A4.3 TANK 241-BX-107 PHOTOGRAPHS

The most recent tank photographs were taken in September 1990 (Hanlon 1996). Overall, the montage shows a relatively heterogeneous top layer composed mainly of gray-brown colored sludge. However, pools of dark yellow liquid can be seen under risers 4, 8, and 13. Dark red material on the waste surface is attributed to spray-on plastic (fabri-form) used to affix contamination on equipment that was to be removed from the tanks. The photographs were taken when the tank was jet pumped and interim stabilized; therefore, the montage may not represent the current tank contents (Brevick et al. 1996).

Figure A4-1. Tank 241-BX-107 Level History.

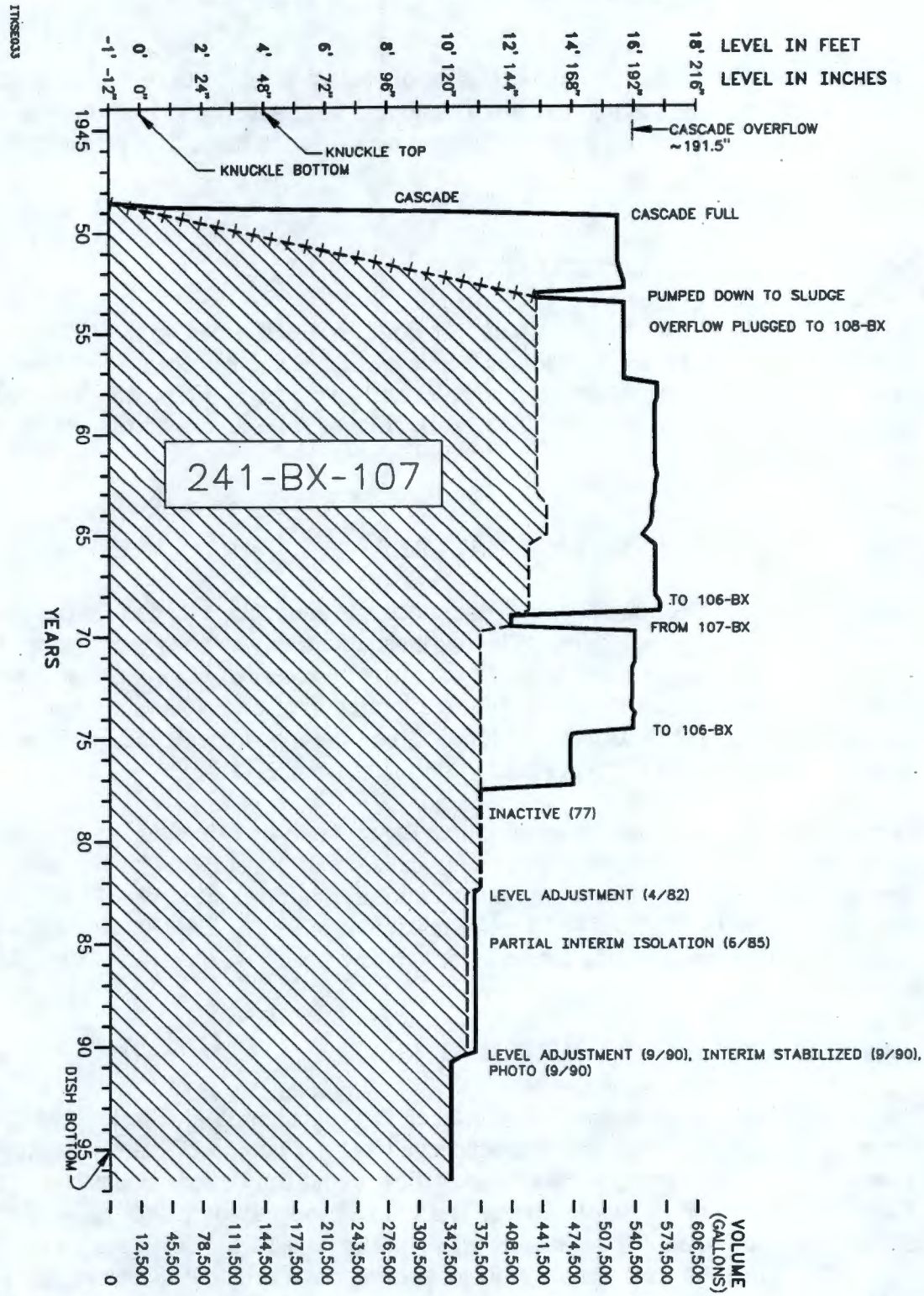
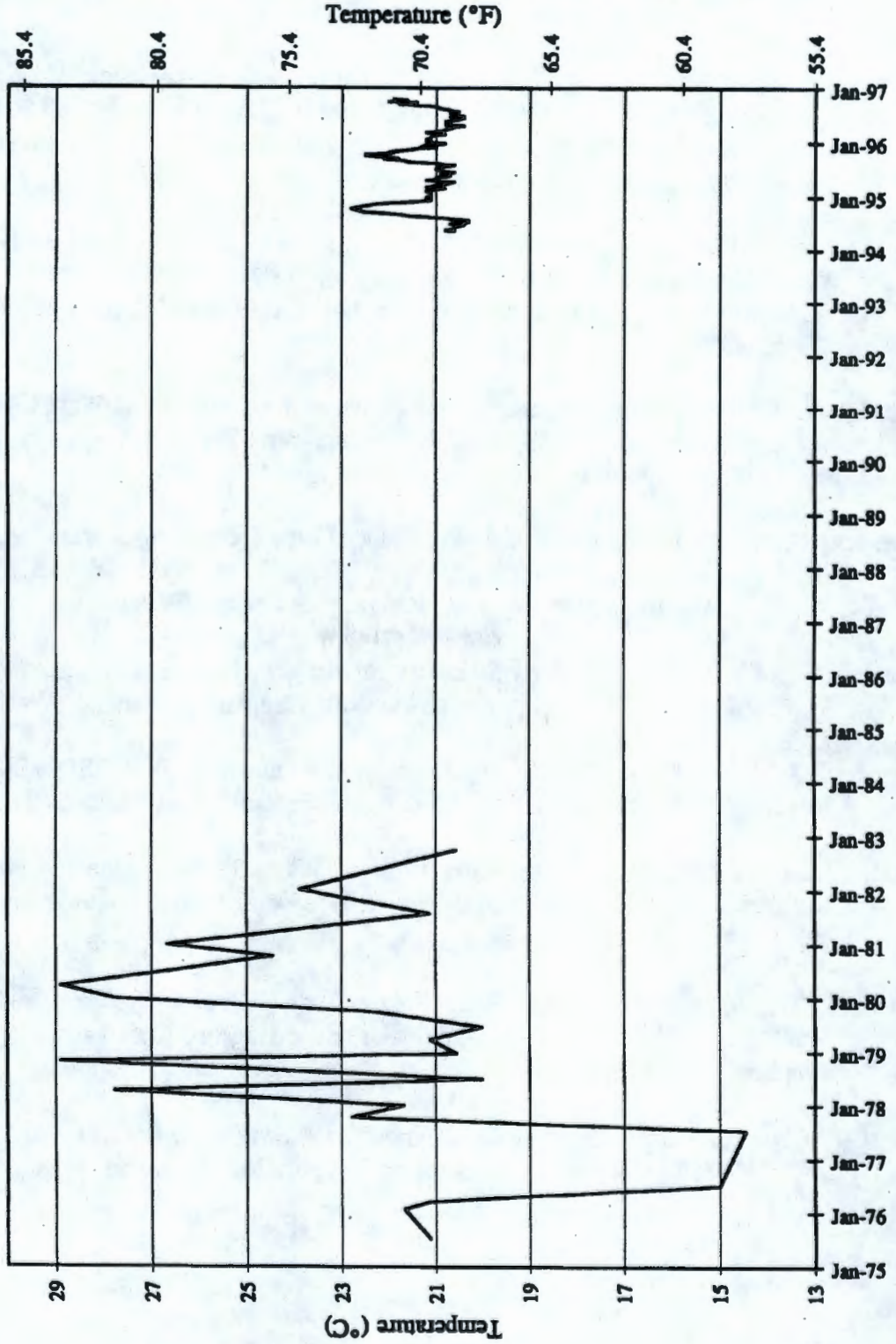


Figure A4-2. Tank 241-BX-107 Weekly High Temperature Plot.



A5.0 APPENDIX A REFERENCES

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Agnew, S. F., P. Baca, R. A. Corbin, T. B. Duran, and K. A. Jurgensen, 1996b, *Waste Status and Transaction Record Summary for the Northeast Quadrant*, WHC-SD-WM-TI-615, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Alstad, A. T., 1993, *Riser Configuration Document for Single-Shell Waste Tanks*, WHC-SD-WM-RE-TI-053, Rev. 9, Westinghouse Hanford Company, Richland, Washington.

Brevick, C. H., R. L. Newell, and J. W. Funk, 1996, *Supporting Document for the Historical Tank Content Estimate for BX Tank Farm*, WHC-SD-WM-ER-311, Rev. 1A, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B. M., 1996, *Waste Tank Summary Report for Month Ending August 31, 1996*, WHC-EP-0182-101, Westinghouse Hanford Company, Richland, Washington.

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

Public Law 101-510, 1990, "Safety Measures for Waste Tanks at Hanford Nuclear Reservation," Section 3137 of *National Defense Authorization Act for Fiscal Year 1991*.

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Vitro Engineering Corporation, 1988, *Piping Waste Tank Isolation 241-BX-107*, Drawing H-2-73318, Rev. 3, Vitro Engineering Corporation, Richland, Washington.

APPENDIX B

SAMPLING OF TANK 241-BX-107

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APPENDIX B

SAMPLING OF TANK 241-BX-107

Appendix B provides sampling and analysis information for each known sampling event for tank 241-BX-107 and assesses the most recent sampling event. It includes the following:

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

Future sampling of tank 241-BX-107 will be appended to the above list.

B1.0 TANK SAMPLING OVERVIEW

This section describes the latest core and vapor sampling of tank 241-BX-107. Core sampling occurred in May/June 1992. Vapor sampling was performed November 14, 1995. Core sampling and analyses were performed in accordance with *Waste Characterization Plan for the Hanford Site Single-Shell Tanks* (Hill et al. 1991). Because the sampling event predated contemporary DQOs, no DQO was applicable. For further discussions of the sampling and analysis procedures, refer to the *Tank Characterization Reference Guide* (De Lorenzo et al. 1994). Vapor sampling was performed in accordance with *Vapor Sampling and Analysis Plan* (Homi 1995). Three sampling events also took place between 1974 and 1990; these sampling events are discussed in Section B1.5.

B1.1 DESCRIPTION OF CORE SAMPLING EVENT

Two core samples were collected from tank 241-BX-107 between May 13 and June 3, 1992. Core 40 was taken from riser 7, and core 41 was taken from riser 3. Samples were received for extrusion at the 222-S Laboratory from June 26 to September 24, 1992.

The push-mode sampling method, which is capable of accommodating liquids, sludge, and soft saltcakes, are used to sample the contents of tank 241-BX-107. The sampler and the drill string assembly were mounted on a rotating platform located on a mobile sampling truck. During the sampling event, the stainless steel sampler was lowered into the material by a hydraulically-powered drill string. The sampler is capable of collecting 0.5-m (19-in.)

long, ~0.02-m (7/8-in.) diameter cylindrical segments. A spring-loaded piston was used to create the negative pressure necessary to fill the sampler. A drill bit was used at the lower end of the drill string to pass through hardened material encountered during penetration. Drill ram hydrostatic fluid pressure was continuously monitored during the sampling operation. Once loaded, a rotary valve at the lower end of the sampler was shut and the sampler was pulled upward to the appropriate position. Then, using remotely controlled mechanical equipment, the sampler was unlatched and loaded into a stainless-steel lined lead-shielded cask for transportation to a laboratory hot cell. A normal paraffin hydrocarbon (NPH) liquid was added as a hydrostatic head during sampler removal from the drill string to prevent waste material from entering the drill string.

The depth of the material in the tank was determined based on the latest level measurements. The number of samples, which could be taken, were calculated starting from the bottom of the tank. Therefore, the first sample taken vertically at the top of the tank might not be a full 0.5 m (19 in.) segment. Following these calculations, the number of samplers were specified.

Although DQOs were not applicable to this sampling event, a comparison of the sampling conditions required by the safety screening DQO was made with the 1992 sampling conditions. The riser locations from the 1992 sampling event were separated radially to the maximum extent possible as required by the DQO. In addition, the full waste depth was sampled. Poor recoveries for some segments may have prevented the acquisition of complete waste profiles. Although this technically does not meet the requirements of the safety screening DQO, it is considered that because the tank was comprised of a limited number of waste types, the sampling recovery was adequate to meet the needs of the DQO.

B1.2 CORE SAMPLE HANDLING

Each core sample consisted of seven segments. Rotary valve mechanical failures were reported for segments 1 and 3 of core 40 and for segments 1, 4, and 5 of core 41. During the extrusion process for the core segments, it was discovered that only about 60 percent of the expected material was obtained (Pool 1993). Two core composite samples were made for each core from homogenized solid segment waste, and a sample was taken from each composite. Table B1-1 gives the segment recovery, sample description, and drill string dose rates.

No notes relative to NPH contamination were found. Moisture loss from the sample during extrusion and homogenization were not addressed.

Table B1-1. Tank 241-BX-107 Segment Recoveries and Sample Descriptions.[1] (2 sheets)

Riser	Core	Segment & Sample Number	Drill String Dose Rate mR/hr	Weight g	Sample Recovery %	Sample Descriptions
7	40	1 92-019	6	0	0	Valve left open.
		2 92-020	140	204.31	100	Segment was gray in color, with a light texture and smooth granular interior. There were visible air pockets.
		3 92-021	3	0	0	Valve left open.
		4 92-022	100	216.57	100	Segment was gray in color, very dry looking with a light texture and granular consistency. There were visible air pockets and the bottom 2 in. were moist.
		5 92-023	35	218.04	100	Segment was gray in color, with the bottom 2/3 a granular consistency and the top 1/3 a thin, runny solid. There were visible air pockets.
		6 92-024	25	215.81	100	Color was not specified for the segment. The waste was a thin, runny solid with a small amount of drainable liquid.
		7 92-025	25	132.45	66	Valve was open. Bottom 2/3 of the segment were white, with a crystal texture and an adhesive consistency.

Table B1-1. Tank 241-BX-107 Segment Recoveries and Sample Descriptions.[1] (2 sheets)

Riser	Core	Segment & Sample Number	Drill String Dose Rate	Weight	Sample Recovery	Sample Descriptions
			mR/hr	g	%	
3	41	1 92-026	50	0	0	Valve left open.
		2 92-027	n/r	186.17	100	Valve was open. Segment was gray in color, with a light texture and much drier than other samples. There were visible air pockets and a little drainable liquid.
		3 92-028	50	185.23	50	Valve was open. Segment was gray in color, with a shiny texture and slick consistency.
		4 92-029	2	0	0	Valve was open.
		5 92-030	n/r	5.53	5	Valve was open. About 4.5 mL of sample on piston.
		6 92-031	2	248.04	100	Segment was gray in color, with a light texture and moist consistency.
		7 92-032	33	250.2	100	Segment was gray/green in color, with a light texture and moist consistency.

Note:

n/r = not reported

[1]Pool (1993)

B1.3 CORE SAMPLE ANALYSIS

All analyses were performed at the Westinghouse Hanford Company 222-S Laboratory and the Pacific Northwest National Laboratory (PNNL) 325 Laboratory.

Prior to homogenization, a small aliquot was removed from the segments for particle size analysis. Samples for volatile organic analysis were taken immediately. Subsamples of the composites and of the core segments were shipped to the Pacific Northwest National Laboratory 325-B hot cell for analysis. Those samples included (1) two core composites from core 40; (2) two core composites from core 41; (3) segments 2, 4, 5, 6, and 7 subsamples of core 40; and (4) segments 2, 3, 5, 6, and 7 subsamples of core 41.

Core 40 (segments 5 and 7) and core 41 (segments 2, 3, 5, 6, and 7) were delivered on July 30, 1993. Core 40 (segments 2, 4, 6 and composites 1 and 2) and core 41 (composites 1 and 2) were transferred from the 222-S Laboratory to Pacific Northwest National Laboratory 325-B hot cell on September 24, 1993. Sample receipt description forms were also completed. Information on the forms includes observations, size and condition of the sample container, sample gross weight, and physical description.

Other composites and segment aliquots were selected for water extraction, acid digestion, fusion, thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and particle size analysis and remained in the 222-S Laboratory.

Table B1-2 shows the analysis scheme for the 1992 core sampling event.

Table B1-2. Analysis Scheme for Cores 40 and 41.

Measurement	Sample portion
Volatiles (PNNL)	Core 40, segments 5 and 7 Core 41, segments 2, 3, 5, 6, 7
Density, % solids, rheology (PNNL) particle size	Core 40, segments 2, 4, 6
Semivolatiles, extractable organic halides (PNNL), TOC (222-S)	Core 40, composites 1 and 2 Core 41, composites 1 and 2
Solids, metals, anions, radionuclides (222-S)	
TGA/DSC (222-S)	All core segments and composites
Toxicity characteristic leaching procedure (TCLP)	Core 40, composite 1
Homogenization tests (ICP, AT, GEA)	Core 41, segments 2 and 6

B1.4 DESCRIPTION VAPOR SAMPLING EVENT

Vapor samples were collected from tank 241-BX-107 on November 14, 1995 according to the specifications of the *Vapor Sampling and Analysis Plan* (Homi 1995). The samples were collected by the Westinghouse Hanford Company using the vapor sampling system (VSS), a truck-based sampling method using a heated probe inserted into the tank headspace. Sampling devices and controls included 11 sorbent trains for selected inorganic analysis (eight sample trains and three field blanks), and five SUMMA[1] canisters for permanent gases and total nonmethane hydrocarbons (three samples and two ambient canisters). Exposed samples and controls were returned to Pacific Northwest National Laboratory on November 20, 1995. Samples and controls were handled, stored and transported using chain-of-custody forms to ensure sample integrity.

Sample analysis was performed by the Vapor Analytical Laboratory at Pacific Northwest National Laboratory. In summary, sorbent traps for inorganic analytes were weighed (for water analysis) or weighed and desorbed with the appropriate aqueous solutions for analyzing inorganic analytes by selective electrode or ion chromatography (IC).

Tank headspace canister samples were analyzed for the following:

- Permanent gases using gas chromatography/thermal conductivity detection.
- Total nonmethane hydrocarbons using cryogenic preconcentration followed by gas chromatography/flame ionization detection.

Analysis details are presented in the *Headspace Vapor Characterization of Hanford Waste Tank 241-BX-107: Results from Samples Collected on 11/17/95* (Evans et al. 1996).

Section B2.7 summarizes analysis results. Analysis concentrations were based on analytical results and, where appropriate, on sample volumes provided by the Westinghouse Hanford Company.

B1.5 DESCRIPTION OF HISTORICAL SAMPLING EVENT

Historical sampling results for tank 241-BX-107 have been obtained for a liquid sample from 1974, a core sample from 1979, and a supernate sample from 1990 (see Section B2.7).

No information was available regarding sample handling for these events. The liquid sample from 1974 was described as clear-yellow with no solids (Wheeler 1974). The core sample was described as yellowish in color with red streaking throughout and had the consistency of soft putty (Horton 1979a, 1979b). No physical descriptions were given for the 1990 supernate sample (Weiss 1990).

[1]SUMMA is a registered trademark of Moletrics, Inc. Cleveland, Ohio.

B2.0 ANALYTICAL RESULTS

B2.1 OVERVIEW

This section summarizes the sampling and analytical results associated with the 1992 sampling and analysis of tank 241-BX-107. Table B2-1 shows the chemical, radiochemical, physical, and organic results associated with this tank. These results are documented in Pool (1993). This section discusses the methods used in analyzing the core samples. Because of the large size of the data set, all discussion of the analytical procedures is first, followed by the data tables.

Table B2-1. Analytical Presentation Tables.

Analysis	Table Number
Summary data for inorganic AA analyses	B2-12 through B2-14
Summary data for inorganic ICP analyses	B2-15 through B2-46
Summary data for inorganic IC analyses	B2-47 through B2-52
Summary data for miscellaneous inorganic analyses	B2-53 through B2-57
Summary data for physical analyses	B2-58 through B2-69
Summary data for radioisotope MS analyses	B2-70 through B2-78
Summary data for radiochemical analyses	B2-79 through B2-99
Summary data for carbon analyses	B2-100 through B2-101
Summary data for SVOA analyses	B2-102 through B2-112
Summary data for VOA analysis	B2-113 through B2-119
Summary data for EOX/TOX analysis	B2-120
Summary of SVOA nondetected analytes	B2-121
Summary of VOA non-detected analytes	B2-122

The four quality control (QC) parameters assessed in conjunction with tank 241-BX-107 samples were standard recoveries, spike recoveries, duplicate analyses, and blanks. The QC criteria applied to the data were 90 to 110 percent recovery for standards, 80 to 120 percent recovery for spikes (75 to 125 percent for metals), and $\leq$ 20 percent for the relative percent difference (RPD) between duplicates. These criteria applied to all analytes. The only QC parameter for which limits are not specified is blank contamination. Section 3.2 provides a

detailed description of sample QC results. 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 limit.
- "b" indicates that the standard recovery was above the QC limit.
- "c" indicates that the spike recovery was below the QC limit.
- "d" indicates that the spike recovery was above the QC limit.
- "e" indicates that the RPD was above the QC limit.
- "f" indicates that there was blank contamination.

Appendix B tables show the analytical results for the 1992 sampling event. All mean results were obtained by calculating an average concentration value from the initial and duplicate results. If an analyte was detected in the original but not in the duplicate, or if both sample results were nondetect, the mean was reported as a nondetect.

B2.2 INORGANIC ANALYSES

The characterization plan (Hill et al. 1991) required that anions and metals be analyzed. Metals were determined following three different sample treatments: (1) water extraction, (2) acid digestion, and (3) potassium hydroxide fusion. Anions were prepared by water extraction.

B2.2.1 Inductively Coupled Plasma Spectroscopy

The following analytes were evaluated by inductively coupled plasma emission spectroscopy (ICP) according to procedure LA-505-151: aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, cerium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, nickel, potassium, phosphorus, selenium, silicon, silver, sodium, strontium, sulfur, tin, zinc, and zirconium. Aluminum, bismuth, iron, phosphorus, and sodium were the most abundant metals in tank 241-BX-107. Tables B2-15 through B2-46 show the results.

B2.2.2 Gaseous Hydride Atomic Absorption Spectroscopy

In addition to ICP, arsenic and selenium were also determined by gaseous hydride atomic absorption (GHAA) spectroscopy according to procedures LA-355-131 and LA-362-131, respectively. Tables B2-12 and B2-13 show the results.

B2.2.3 Cold Vapor Atomic Absorption Spectroscopy

Mercury was analyzed by cold vapor atomic absorption spectroscopy (CVAA) according to procedure LA-325-102. Table B2-14 shows the results.

B2.2.4 Toxicity Characteristic Leaching Procedure

Toxicity characteristic leaching procedure (TCLP), as defined by the Environmental Protection Agency, is a 20:1 extraction procedure using sodium acetate buffer. The 222-S Laboratory procedure, however, was scaled down by a factor of 10 (for radioactive samples). The pH was also adjusted to 2 to test the loss of metals by absorption and/or precipitation in the sample container. Table B2-2 summarizes the TCLP results prior to acidification. For detailed results, refer to the data summary section (Pool 1993).

Table B2-2. Toxicity Characteristic Leaching Procedure Results for Core 40, Composite 1.

Analyte	Dangerous Waste Number	Concentration (mg/L)
Silver	D011	< 0.820
Barium	D005	42.6
Cadmium	D006	0.758
Chromium	D007	8.92
Lead	D008	11.0
Arsenic	D004	< 2.04
Selenium	D010	< 1.63
Mercury	D009	0.02575

B2.2.5 Ion Chromatography

The following anions were determined by ion chromatography (IC) according to procedure LA-533-105: chloride, fluoride, nitrate, nitrite, phosphate, and sulfate. All were present in tank 241-BX-107. Tables B2-47 through B2-52 show the results.

B2.2.6 Kjeldahl

The ammonia analysis was performed by procedure LA-634-103. Table B2-56 shows the results.

B2.2.7 Distillation/Spectrometric Analysis

Cyanide was determined according to procedure LA-695-101. Table B2-53 shows the results.

B2.3 CARBON

Total inorganic carbon (TIC), total organic carbon (TOC), total extractable organic halides (TOX/EOX), and volatile/semivolatile organic constituents were required analytes of the 1992 samples.

B2.3.1 Total Inorganic Carbon

The TIC was determined by coulometry measurements of the CO_2 evolved following sample acidification, as established in procedure LA-344-105. Table B2-101 shows the results.

B2.3.2 Total Organic Carbon

The TOC was determined according to procedure LA-622-102. Table B2-100 shows the results.

B2.3.3 Total Extractable Organic Halides

Total extractable organic halides were determined according to procedure PNL-ALO-320. Table B2-120 shows the results.

B2.3.4 Volatile Organic Compounds

Volatile organic compounds were determined according to procedure PNL-ALO-335. No volatile Environmental Protection Agency target compounds in concentration above the contract required quantification limits were observed in the core samples. However, kerosene constituents, such as decane, undecane, dodecane, and tridecane were observed, and are probably the result of contamination by the NPH solution used during sampling. Tables B2-113 through B2-119 show the results for detected compounds. Table B2-122 summarizes the compounds that were analyzed for but not detected.

B2.3.5 Semivolatile Organic Compounds

Semivolatile organic compounds were determined according to procedure PNL-ALO-345. Compounds consistent with NPH contamination were detected in the core samples, as was tributyl phosphate. Tables B2-102 through B2-112 show the results for detected compounds. Table B2-121 summarizes the compounds that were analyzed for but not detected.

B2.4 RADIOCHEMICAL ANALYSES

B2.4.1 Gamma Energy Analysis

The activities of the following radionuclides were determined by gamma energy analysis according to procedure LA-548-121: ^{241}Am, ^{137}Cs, ^{60}Co, and $^{154/155}$Eu. The activity of ^{129}I was determined by low energy gamma analysis according to procedure LA-378-103. Tables B2-90 through B2-95 show the results of the gamma analyses.

B2.4.2 Alpha Energy Analysis

The following were evaluated by alpha energy analysis according to procedure LA-503-156: ^{241}Am, ^{238}Pu, $^{239/240}$Pu, and ^{237}Np. Tables B2-80 through B2-83 show the sample results.

B2.4.3 Liquid Scintillation

Tritium, ^{14}C, ^{79}Se, and ^{99}Tc were analyzed by liquid scintillation according to procedures LA-218-113, LA-348-104, LA-365-132, and LA-438-101, respectively. Tables B2-89, B2-96, B2-97, and B2-99 show sample results.

B2.4.4 Laser Fluorimetry

Total uranium was determined by laser fluorimetry according to procedure LA-925-106. Table B2-55 shows the sample results.

B2.4.5 Alpha Proportional Counting

Alpha proportional counting was used to determine total alpha activity according to procedure LA-508-101. Tables B2-86 through B2-87 show the results.

B2.4.6 Beta Proportional Counting

Beta proportional counting was used to determine total beta activity and ^{90}Sr activity according to procedures LA-508-101 and LA-220-101, respectively. Tables B2-88 and B2-98 show the results.

B2.5 PHYSICAL ANALYSES

B2.5.1 Density and Physical Measurements

Upon extrusion, a density calculation was made for each segment from both cores by dividing the mass recovered for that segment by its volume. However, this procedural method is considered biased with many of the calculated densities being less than one. These values are reported in Table B2-60 for completeness but will not be used to estimate the density of the waste. The density measurement procedures described below are more accurate and are the basis for the density estimate.

Physical testing was performed on unhomogenized material from three segments of core 40 (segments 2, 4, and 6). The testing included density and settling behavior (centrifuged supernate and solids density, settled solids, volume percent settled solids, weight percent centrifuged solids, weight percent solids, and weight percent undissolved solids). Table B2-3 summarizes the results and Tables B2-63 through B2-69 provide the details.

Table B2-3. Physical and Rheological Results for Core 40 (Segments 2, 4, and 6).

Property	Sample Type	Units	Segment 2	Segment 4	Segment 6	Average
Settled solids	Segment aliquot	Volume %	100	100	98	99
Centrifuged solids	Segment aliquot	Volume %	71.7	76.0	66.0	71.2
		Weight %	77.2	80.6	70.4	76.1
Density	Segment aliquot	g/mL	1.47	1.45	1.40	1.44
	Centrifuged supernate	g/mL	1.18	1.17	1.21	1.19
	Centrifuged solids	g/mL	1.58	1.54	1.49	1.54
Solids	Segment aliquot	Weight %	44.8	45.6	42.0	44.1
Undissolved solids	Segment aliquots	Weight %	38.0	39.6	32.6	36.7
Shear strength	Segment aliquot	Dynes/cm^2	3,000	8,800	4,800	5,533
Viscosity	Diluted aliquots	Centipoise	2	2	2	2

The weight percent water was determined on all segments for both cores and for core composite samples. Two methods were used: gravimetric and thermogravimetric. The gravimetric determination of the weight percent water is measured by the loss of mass in the sample after being held in a drying oven at 105 °C (221 °F) for 24 hours. Table B2-59 shows the results for this analysis. Section B2.6.2 discusses TGA.

B2.5.2 Rheological Properties

Rheological properties measured on segments 2, 4, and 6 of core 40 included shear strength and shear stress as a function of shear rate. These tests were performed on 1:1 and 1:3 water sample dilutions.

Shear strength was measured using a specialized vane viscometer. The sample was placed in a water bath at 32 °C (90 °F) for a minimum of one hour. A shear vane was then placed into the sample and rotated at 0.3 revolutions per minute. The shear stress was recorded as a function of the shear rate generated by the rotating viscometer conical spindle. The viscosity was then calculated by dividing the shear stress by the shear rate. Plots showing shear stress and viscosity as a function of shear rate were generated and are available in the data package (Pool 1993).

B2.5.3 Particle Size Analysis

The particle size distribution was measured on unhomogenized material from each segment of both cores. Particle size analysis was performed at the 222-S Laboratory using scattering laser technology following sonication suspension of the sample aliquots in a deionized water matrix. The results were potentially biased by the dissolution of some soluble salt crystals of the sample in the water dispersant. An assessment of that bias was not reported. For particle number and volume histograms, refer to Pool (1993). Table B2-4 shows sample results.

Table B2-4. Particle Size Distribution for Cores 40 and 41.

Sample	Distribution (%)	Particle Size Range (μm)						
		0.5 - 1	1.5 - 1.5	1.5 - 2	2 - 5	5 - 10	10 - 20	20 - 150
41:7	Number	58.97	18.98	6.54	13.2	2.05	0.21	0.06
	Volume	0.53	0.79	0.74	11.26	11.05	12.17	63.46
41:6	Number	69.11	15.23	5.19	9.31	1.09	0.06	0.01
	Volume	2.91	2.97	2.78	34.18	26.49	13.6	17.06
41:5	Number	59.9	21.01	7.19	10.44	1.23	0.15	0.08
	Volume	0.23	0.38	0.36	3.4	2.98	3.54	89.11
41:3	Number	64.97	20.65	5.99	7.44	0.85	0.08	0.01
	Volume	1.94	2.85	2.27	18.15	15.93	13.89	44.96
41:2	Number	77.07	15.44	3.15	3.76	0.45	0.09	0.03
	Volume	1.53	1.42	0.8	6.1	5.8	12.51	71.85
40:7	Number	67.8	16.27	5.23	9.41	1.22	0.06	0.01
	Volume	2.17	2.41	2.13	26.63	23.21	10.3	33.15
40:6	Number	66.45	17.3	5.63	9.33	1.16	0.13	0.01
	Volume	2.23	2.69	2.4	26.65	23.97	23.15	18.89
40:5	Number	58.94	19.69	7.48	12.48	1.32	0.06	0.02
	Volume	1.1	1.71	1.78	19.56	14.18	6.7	54.97
40:4	Number	68.64	16.77	5.04	8.48	0.99	0.07	0.01
	Volume	2.51	2.84	2.34	27.07	22.2	14.23	28.81
40:2	Number	74.05	15.11	3.93	5.88	0.9	0.1	0.02
	Volume	1.38	1.3	0.93	9.55	10.59	10.46	65.78

The wide percent distribution range exhibited in the volume distribution for particles between 2 to 150 μm is mostly related to the size of the sample used (0.1 grams or less) whereas larger particles can be easily lost or broken into smaller particles. In general, the data reveals that 99 percent of the particles are between 0.5 to 5 μm, and approximately 77 percent of the volume is occupied by particles from 5 to 150 μm.

B2.5.4 pH

The pH of the samples was measured according to procedure PNL-ALO-290. Table B2-57 shows the results.

B2.6 THERMODYNAMIC ANALYSES

B2.6.1 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.

No exothermic reactions were apparent from the DSC analyses for tank 241-BX-107. Therefore, the upper limit of a 95 percent confidence interval of the mean for each sample was not calculated.

B2.6.2 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, 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) is caused by 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 also can often be differentiated by inflection points. Table B2-58 shows TGA results.

B2.7 VAPOR SAMPLE RESULTS

Table B2-5 summarizes the results from the 1995 vapor sampling.

Table B2-5. Summary Results of Samples to Characterize the Headspace of Tank BX-107.[1] (November 17, 1995).

Category	Sample Medium	Analyte	Vapor[2] Concentration	Units
Inorganic analytes[3]	Sorbent traps	NH_3	83 ± 4	ppmv
		NO_2	≤ 0.1	ppmv
		NO	≤ 0.1	ppmv
		H_2O	16.8 ± 0.7	mg/L
Permanent gases	SUMMA™ canister	CO_2	457	ppmv
		CO	3 U	ppmv
		CH_4	4 U	ppmv
		H_2	11 J	ppmv
		N_2O	12 J	ppmv
Total nonmethane hydrocarbons	SUMMA™ canister	Hydrocarbons	2.08	mg/m^3

Notes:

Data Qualifier Flags:
J = Target compound detected above the instrument detection limit but quantitated amount below estimated quantitation limit.
U = Target compound not detected at or above the instrument detection limit.

[1]Evans et al. (1996)
[2]Vapor concentrations were determined using sample volume data provided by Westinghouse Hanford Company and are based on averaged data.
[3]Inorganic analyte concentrations are based on dry tank air at standard temperature and pressure.

B2.8 TANK HEADSPACE FLAMMABILITY SCREENING RESULTS

The flammability of the tank 241-U-102 headspace was monitored with a combustible gas meter before the 1995 vapor sampling event. The safety screening DQO limit for headspace flammability is 25 percent of the LFL (Dukelow et al. 1995). The combustible gas meter reports results as a percent of the LFL. Because the National Fire Protection Association defines the terms lower explosive limit and LFL identically, the two terms may be used interchangeably (NFPA 1995). The reported LFL of 0 percent was well below the limit. Table B2-6 shows the results of the flammability measurement, and the results for oxygen, ammonia, and TOC vapor.

Table B2-6. Headspace Flammability and Vapor Concentrations of Tank 241-BX-107.[1]

Vapor Characteristic Measured	Results	
	Riser	Headspace
Flammability vapor concentration as percent of LFL	0 %	0 %
Volume percent oxygen gas	20.9 %	20.9 %
Concentration of ammonia gas	40 ppm	40 ppm
Concentration of TOC vapor	< 1 ppm	< 1 ppm

Note:
[1]JCS workpackage (1995)

B2.9 HISTORICAL SAMPLE RESULTS

Historical data about tank 241-BX-107 is scarce. Records show two sampling events for the period before 1980 when all single-shell tanks were decommissioned.

B2.9.1 Data Prior to 1980

Table B2-7 summarizes the data in Wheeler (1974), presumably from a sampling event in 1974. Sampling and analytical methods were not specified. The sample analyzed was described as clear and yellow, with no visible solids. Radiation emission was 300 mR/hr. No exotherms below 200 °C were reported. (The sample was also cooled to 5° C with no solids forming after 45 minutes.)

In 1979, a core was sampled and analyzed. While sampling and analytical methods were not discussed, it was reported that the three-segment core yielded a total of 1.27 m (4.17 ft) of waste. The solids were 45 percent water soluble, yellowish in color, had red streaking throughout, and were the consistency of soft putty. Core segment 3 had various sized chunks of a hard material ranging from pea to marble size (Horton 1979b).

Table B2-7. Summary of 1974 Data for Supernatant Sample T-5921.[1]

Analyte	Concentration
Ionic compounds	M
OH^-	0.723
Al^{3+}	0.00153
Na^+	5.29
NO_2^-	1.82
NO_3^-	1.51
PO_4^{3-}	0.0615
F^-	0.0216
CO_3^{2-}	0.674
Physical Properties	
Specific gravity	1.238
Water	75.28 wt %
pH	10.18
Radionuclides	µCi/gal
^{134}Cs	738
^{137}Cs	3.40E+05
	g/gal
Pu	2.67E-04

Note:

[1]Wheeler (1974)

These data have not been validated and should be used with caution.

Tables B2-8 and B2-9 summarize the chemical and radiochemical data reported. No exotherms were reported in any sample. Endotherms were exhibited in all three segments at approximately 105 °C (221 °F) and 290 °C (554 °F). Composite bulk density and percent water were reported at 1.46 g/mL and 54 percent, respectively. Table B2-10 compiles the reported physical properties.

Table B2-8. 1979 Core Chemical Data (Wet Basis).[1]

Analyte	Composite H_2O Soluble Weight %	Composite H_2O Insoluble Weight %
Metals		
Al	n/r	1.64
Bi	< 0.03	1.61
Cd	n/r	0.0015
Metals		
Cr	0.00687	n/r
Fe	n/r	1.4
Hg	n/r	0.01[2]
La	n/r	0.04
Mn	n/r	0.005
Na	6.5	n/r
Ni	< 0.002	0.5
Pb	< 0.03	n/r
Si	n/r	n/r
Anions		
CO_3^{2-}	0.1	n/r
F^-	0.07	0.13
NO_3^-	14	1.3
OH^-	< 0.04	n/r
PO_4^{3-}	1.5	7.1
SO_4^{2-}	0.8	0.12
SiO_4^{2-}	0.02	0.3
Organics		g/g
TOC	n/r	7.3E-04

Notes:

n/r = not reported

[1]Horton (1979a and 1979b)
[2]Possibly attributed to reporting error.
[3]Possibly attributed to KOH fusion in nickel-impregnated crucibles.

These data have not been validated and should be used with caution.

Table B2-9. 1979 Core Radiochemical Data (Wet Basis).[1]

Radionuclides	Segment 1	Segment 2	Segment 3	Composite (water soluble)	Composite (water insoluble)	Units
^{241}Am	n/r	n/r	n/r	n/r	2.7E-09	g/g
^{134}Cs	8.8	3.3	5.2	n/r	n/r	μCi/kg
^{137}Cs	2.01E+05	82,100	1.10E+05	2,740	8,400	μCi/kg
^{154}Eu	24	12	21	n/r	n/r	μCi/kg
^{155}Eu	1,350	68	1010	n/r	n/r	μCi/kg
Pu	n/r	n/r	n/r	8.510E-11	1.75E-06	g/g
$^{89/90}Sr$	n/r	n/r	n/r	0.004	14.2	μCi/g
U	n/r	n/r	n/r	5.5E-07	8E-05	g/g
^{144}Ce	n/r	n/r	n/r	< 0.0254	n/r	μCi/g

Note:

n/r = not reported

[1]Horton (1979a and 1979b)

These data have not been validated and should be used with caution

Table B2-10. 1979 Core Physical Data.[1]

Physical properties	Segment 1	Segment 2	Segment 3	Units
Water content	53.0	55.0	53.0	Wt %
Bulk density	1.42	1.42	1.54	g/mL
Particle density	n/r	n/r	n/r	g/mL

Note:

n/r = not reported

[1]Horton (1979a and 1979b)

These data have not been validated and should be used with caution.

B2.9.2 Data Between 1980 and 1992

Analysis of a supernatant liquid sample from tank 241-BX-107, believed to have been taken in 1990, was reported in Weiss (1990). Tables B2-7 and B2-8 show the results. The total alpha results may have been influenced by significant quantities of cesium present in the sample (Weiss 1990). Weiss also adds that the reported hydroxide concentration was biased by the neutralization of the second phosphate charge present in the sample. Again, sampling or analytical methods were not discussed. No QC information was provided with the results.

Table B2-11. 1990 Supernatant Liquid Profile: Sample Number R6038.[1] (2 sheets)

Analyte	Concentration	
Metals	M	Wt %
Ba	6.53E-05	0
Cr	0.00659	0.03
Cu	7.84E-05	0
Fe	4.64E-04	0
Hg	0	0
K	0.0123	0.04
Mo	6.13E-04	0
Na	4.22	7.94
P	0.17	0.43
Pb	1.64E-04	0
Si	0.00929	0.02
U	0.858 g/L	0.07
Anions		
Cl^-	0.0609	0.18
F^-	< 0.0747	
NO_2^-	0.743	2.8
NO_3^-	2.64	13.41
PO_4^{3-}	0.162	n/r
SO_4^{2-}	0.181	1.42

Table B2-11. 1990 Supernatant Liquid Profile: Sample Number R6038.[1] (2 sheets)

Analyte	Concentration	
OH^-	0.109	n/r
CO_3^{2-}	0.274	1.35
Radionuclides	**µCi/L**	**Wt %**
Total Alpha	29	n/r
Total Beta	28,800	n/r
^{137}Cs	24,900	n/r
$^{89/90}Sr$	57.1	n/r
Radionuclides	**µCi/L**	**Wt %**
$^{239/240}Pu$	4.24	n/r
^{241}Am	0.249	n/r
Organics	**g/L**	**Wt %**
TOC	2.7	n/r
Physical Properties		
Water (wt %)	72	n/a
pH	9.64	n/a

Note:

n/a = not reported

[1]Weiss (1990)

These data have not been validated and should be used with caution.

B2.9.3 Observations Between Historical Supernatant Analytical Results

The following observations can be made about the 1974 and 1990 sampling events:

- There are higher amounts of soluble solids in the 1990 supernatant sample, possibly because of 1) the formation of additional soluble salts and soluble metal oxides, 2) the change in thermodynamic equilibrium state, or 3) the analytical variance based on the sampling location and analytical procedure.

- The pH decrease to 9.64 in 1990, indicating a loss in soluble [OH^-] ions (the conversion of some hydroxides to oxides [or salt + water]), formation (or absorption) of CO_2, or other thermodynamic factors resulting in lower solubility of hydroxide species.

- Lower soluble Na^+ concentration in 1990 could be attributed to 1) analytical variance, 2) a decrease in solubility because of alteration in the thermodynamic equilibrium, or 3) the incorporation of Na^+ ions into a less soluble matrix.

- Lower soluble NO_2^- and higher soluble NO_3^- concentrations were possibly because of the oxidation of nitrite to nitrate.

- Increase in PO_4^{3-} concentration in 1990 was possibly because of analytical variance or a change in the medium's thermodynamic conditions, for example, the formation of additional soluble phosphate compounds (by ion- exchange, substitution, and other mechanisms such as the ones supporting Le Chatelier's principle).

- Lower soluble CO_3^{2-} concentration in 1990 was possibly because of the reduction of carbonate to carbon dioxide, or the incorporation of carbonates into a less soluble matrix.

- Lower cesium concentration in 1990 can be attributed to cesium decay, to barium, or possibly analytical variance.

All analytes reported correspond to water soluble compounds present in the supernatant liquid. Unfortunately, the data available is not sufficient to determine any chemical changes that took place in tank 241-BX-107 residues between 1974 and 1990.

B2.10 ANALYTICAL DATA TABLES

Table B2-12. Tank 241-BX-107 Analytical Results: Arsenic (GHAA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
924-8795	Core 40	Solid composite	0.462	0.402	0.432[QC:b]
926-8795		Solid composite	0.433	0.353	0.393[QC:b,e]
925-8795	Core 41	Solid composite	0.319	0.403	0.361[QC:e]
927-8795		Solid composite	0.517	0.554	0.536[QC:b]
Solids: TCLP			µg/mL	µg/mL	µg/mL
994-8795	Core 40	Solid composite	< 2.04		< 2.04[QC:b,d]
Solids: TCLP and acid digest			µg/mL	µg/mL	µg/mL
987-8795	Core 40	Solid composite	< 0.05	0.0527	< 0.051[QC:b,d]

Table B2-13. Tank 241-BX-107 Analytical Results: Selenium (GHAA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
924-8795	Core 40	Solid composite	1.52	1.48	1.5
926-8796		Solid composite	1.76	2.07	1.915
925-8795	Core 41	Solid composite	2.01	2.03	2.02
927-8795		Solid composite	0.596	0.704	0.65[QC:a]
Solids: TCLP			µg/mL	µg/mL	µg/mL
994-8796	Core 40	Solid composite	< 1.63		< 1.63
Solids: TCLP and acid digest			µg/mL	µg/mL	µg/mL
987-8796	Core 40	Solid composite	< 0.0025	< 0.0025	< 0.0025[QC:c]

Table B2-14. Tank 241-BX-107 Analytical Results: Mercury (CVAA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			**µg/g**	**µg/g**	**µg/g**
924-8795	Core 40	Solid composite	0.56	0.661	0.6105
926-8796		Solid composite	0.366	0.383	0.3745
925-5798	Core 41	Solid composite	0.539	0.723	0.631[QC:e]
927-5798		Solid composite	0.627	0.657	0.642
Solids: TCLP			**µg/mL**	**µg/mL**	**µg/mL**
987-5797	Core 40	Solid composite	0.0264	0.0251	0.0258
Solids: TCLP and acid digest			**µg/mL**	**µg/mL**	**µg/mL**
995-5797	Core 40	Solid composite	< 0.0497		< 0.0497[QC:d]

Table B2-15. Tank 241-BX-107 Analytical Results: Aluminum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	16,200	16,000	16,100[QC:b,c]
837-8755		Homogenized test 2	16,600	16,200	16,400[QC:b,c]
814-8755	41: 6	Homogenized test 1	17,100	17,200	17,150[QC:b,d]
815-8755		Homogenized test 2	17,000	16,700	16,850[QC:b]
924-8755	Core 40	Solid composite	12,300	11,400	11,850[QC:b,c]
926-8750		Solid composite	12,500	12,200	12,350[QC:b]
925-8755	Core 41	Solid composite	16,200	16,200	16,200[QC:b,d]
927-8755		Solid composite	16,600	16,500	16,550[QC:b]
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	13,400	14,300	13,850
926-6755		Solid composite	11,200	12,800	12,000
925-6755	Core 41	Solid composite	17,200	17,300	17,250
927-6755		Solid composite	13,300	14,900	14,100
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	115	95.7	105.35
926-7755		Solid composite	80	80.7	80.35
925-7755	Core 41	Solid composite	73.3	69.9	71.6[QC:c]
927-6755		Solid composite	350	209	279.5[QC:e]

Table B2-16. Tank 241-BX-107 Analytical Results: Antimony (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	< 34.4	< 36.0	< 35.2[QC:d]
837-8755		Homogenized test 2	< 35.5	< 35.1	< 35.3[QC:d]
814-8755	41: 6	Homogenized test 1	< 34.9	< 34.6	< 34.75
815-8755		Homogenized test 2	< 33.6	< 33.9	< 33.75
924-8755	Core 40	Solid composite	< 34.8	< 33.5	< 34.15[QC:a]
926-8750		Solid composite	< 34.5	< 35.2	< 34.85[QC:a]
925-8755	Core 41	Solid composite	< 34.7	< 35.6	< 35.15[QC:a,c]
927-8755		Solid composite	< 33.5	< 34.1	< 33.8[QC:b]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	< 183	< 183	< 183
926-6755		Solid composite	< 183	< 183	< 183
925-6755	Core 41	Solid composite	< 182	< 182	< 182
927-6755		Solid composite	< 183	< 183	< 183
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	37.3	37.3	37.3
926-7755		Solid composite	37.3	37.3	37.3
925-7755	Core 41	Solid composite	36.3	36.2	36.25
927-6755		Solid composite	37.2	37.2	37.2

Table B2-17. Tank 241-BX-107 Analytical Results: Arsenic (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	7.53	6.07	6.80[QC:e]
837-8755		Homogenized test 2	6.32	6.12	6.22
814-8755	41: 6	Homogenized test 1	< 3.04	< 3.02	< 3.03
815-8755		Homogenized test 2	< 2.92	< 2.96	< 2.94
924-8755	Core 40	Solid composite	< 2.85	< 2.74	< 2.795
926-8750		Solid composite	< 2.83	< 2.88	< 2.855
925-8755	Core 41	Solid composite	3.13	< 2.92	< 3.025
927-8755		Solid composite	< 2.74	< 2.8	< 2.77
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	< 15	< 15	< 15
926-6755		Solid composite	< 15	< 15	< 15
925-6755	Core 41	Solid composite	< 14.9	< 14.9	< 14.9
927-6755		Solid composite	< 15	< 15	< 15
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	< 3.06	< 3.05	< 3.055
926-7755		Solid composite	< 3.05	< 3.06	< 3.055
925-7755	Core 41	Solid composite	< 3.16	< 3.16	< 3.16
927-6755		Solid composite	< 3.05	< 3.05	< 3.05

Table B2-18. Tank 241-BX-107 Analytical Results: Barium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	16.23	16.42	16.32
837-8755		Homogenized test 2	16.56	16.01	16.29
814-8755	41: 6	Homogenized test 1	8.38	8.77	8.575
815-8755		Homogenized test 2	8.48	8.42	8.45
924-8755	Core 40	Solid composite	7.28	6.22	6.75
926-8750		Solid composite	6.33	6.42	6.375
925-8755	Core 41	Solid composite	10.1	10.5	10.3
927-8755		Solid composite	9.34	9.27	9.305
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	4.17	7.97	6.07[QC:e]
926-6755		Solid composite	8.35	7.78	8.065
925-6755	Core 41	Solid composite	12	11.6	11.8
927-6755		Solid composite	10.6	10.5	10.55
Solids: TCLP			**µg/mL**	**µg/mL**	**µg/mL**
987-8750	Core 40	Solid composite	49	36.2	42.6[QC:e]
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	0.452	0.305	0.3785[QC:e]
926-7755		Solid composite	0.389	0.674	0.5315[QC:e]
925-7755	Core 41	Solid composite	< 0.306	< 0.305	< 0.3055
927-6755		Solid composite	0.636	0.469	0.5525[QC:e]

Table B2-19. Tank 241-BX-107 Analytical Results: Beryllium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	< 0.2817	< 0.2953	< 0.2885[QC:a]
837-8755		Homogenized test 2	< 0.2913	< 0.2874	< 0.28935[QC:a]
814-8755	41: 6	Homogenized test 1	< 0.294	< 0.292	< 0.293
815-8755		Homogenized test 2	< 0.283	< 0.286	< 0.2845
924-8755	Core 40	Solid composite	< 0.285	< 0.274	< 0.2795
926-8750		Solid composite	< 0.283	< 0.288	< 0.2855
925-8755	Core 41	Solid composite	< 0.285	< 0.292	< 0.2885
927-8755		Solid composite	< 0.274	< 0.28	< 0.277
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	< 1.5	< 1.5	< 1.5
926-6755		Solid composite	< 1.5	< 1.5	< 1.5
925-6755	Core 41	Solid composite	< 1.49	< 1.49	< 1.49
927-6755		Solid composite	< 1.5	< 1.5	< 1.5
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	< 0.306	< 0.305	< 0.3055
926-7755		Solid composite	< 0.305	< 0.306	< 0.3055
925-7755	Core 41	Solid composite	< 0.306	< 0.305	< 0.3055
927-6755		Solid composite	< 0.305	< 0.305	< 0.305

Table B2-20. Tank 241-BX-107 Analytical Results: Bismuth (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	31,000	30,500	30,800[QC:a,c]
837-8755		Homogenized test 2	32,000	30,900	31,500[QC:a,c]
814-8755	41: 6	Homogenized test 1	28,200	28,200	28,200[QC:a,d]
815-8755		Homogenized test 2	27,900	27,500	27,700[QC:a]
924-8755	Core 40	Solid composite	21,900	20,500	21,200[QC:a,c]
926-8750		Solid composite	22,200	22,000	22,100[QC:a]
925-8755	Core 41	Solid composite	27,300	27,000	27,150[QC:a,c]
927-8755		Solid composite	26,400	26,000	26,200[QC:a]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	21,300	22,500	21,900[QC:c]
926-6755		Solid composite	19,300	21,900	20,600
925-6755	Core 41	Solid composite	28,200	28,000	28,100
927-6755		Solid composite	18,900	18,300	18,600
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	99.6	113	106.3[QC:c]
926-7755		Solid composite	78.3	82.1	80.2[QC:c]
925-7755	Core 41	Solid composite	116	111	113.5[QC:c]
927-6755		Solid composite	839	431	635[QC:c]

Table B2-21. Tank 241-BX-107 Analytical Results: Boron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	31.9	39.1	35.5[QC:b,c,e]
837-8755		Homogenized test 2	25.7	18.1	21.9[QC:b,c,e]
814-8755	41: 6	Homogenized test 1	25.6	31.7	28.65[QC:b,e]
815-8755		Homogenized test 2	24.2	22.3	23.25[QC:b]
924-8755	Core 40	Solid composite	47	52.5	49.75[QC:b]
926-8750		Solid composite	68.5	56.1	62.3[QC:b]
925-8755	Core 41	Solid composite	57.6	44	50.8[QC:b,e]
927-8755		Solid composite	21.2	29.5	25.35[QC:b,e]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	16.1	20.6	18.35[QC:e]
926-6755		Solid composite	20.1	17.5	18.8
925-6755	Core 41	Solid composite	8.32	4.98	6.65[QC:e]
927-6755		Solid composite	18.8	13.5	16.15[QC:e]
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	27.9	27.8	27.85
926-7755		Solid composite	28.9	28.5	28.7
925-7755	Core 41	Solid composite	20.5	20.9	20.7
927-6755		Solid composite	23.2	22.5	22.85

Table B2-22. Tank 241-BX-107 Analytical Results: Cadmium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	3.76	3.85	3.81
837-8755		Homogenized test 2	4.03	3.49	3.76
814-8755	41: 6	Homogenized test 1	2.59	2.17	2.38[QC:a]
815-8755		Homogenized test 2	2.47	2.27	2.37[QC:a]
924-8755	Core 40	Solid composite	2.04	1.67	1.855
926-8750		Solid composite	2.03	1.83	1.93
925-8755	Core 41	Solid composite	2.7	2.77	2.735
927-8755		Solid composite	2.69	2.43	2.56
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	< 3.49	3.87	< 3.68
926-6755		Solid composite	< 3.49	3.53	< 3.51
925-6755	Core 41	Solid composite	< 4.73	< 3.96	< 4.345
927-6755		Solid composite	4.3	6.22	5.26[QC:e]
Solids: TCLP			µg/mL	µg/mL	µg/mL
987-8750	Core 40	Solid composite	0.763	0.752	0.7575
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	0.714	0.713	0.7135
926-7755		Solid composite	0.713	0.714	0.7135
925-7755	Core 41	Solid composite	< 0.714	< 0.713	< 0.7135
927-6755		Solid composite	< 0.711	< 0.711	< 0.711

Table B2-23. Tank 241-BX-107 Analytical Results: Calcium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	371	388	380[QC:b,c]
837-8755		Homogenized test 2	366	348	357[QC:b,c]
814-8755	41: 6	Homogenized test 1	277	303	290[QC:b]
815-8755		Homogenized test 2	276	269	272.5[QC:b]
924-8755	Core 40	Solid composite	3,500	786	2,143[QC:b,c,e]
926-8750		Solid composite	365	730	547.5[QC:b,e]
925-8755	Core 41	Solid composite	416	1,920	1,168[QC:b,d,e]
927-8755		Solid composite	306	286	296[QC:b]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	343	377	360
926-6755		Solid composite	303	310	306.5
925-6755	Core 41	Solid composite	365	372	368.5
927-6755		Solid composite	520	578	549
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	1,130	371	750.5[QC:c,e]
926-7755		Solid composite	947	480	713.5[QC:c,e]
925-7755	Core 41	Solid composite	141	154	147.5[QC:c]
927-6755		Solid composite	136	105	120.5[QC:e]

Table B2-24. Tank 241-BX-107 Analytical Results: Cerium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	253	267	260[QC:d]
837-8755		Homogenized test 2	261	258	259[QC:d]
814-8755	41: 6	Homogenized test 1	194	190	192
815-8755		Homogenized test 2	193	186	189.5
924-8755	Core 40	Solid composite	154	147	150.5[QC:a,d]
926-8750		Solid composite	169	169	169[QC:a]
925-8755	Core 41	Solid composite	192	190	191[QC:a,d]
927-8755		Solid composite	205	201	203
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	< 48.9	135	< 91.95[QC:e]
926-6755		Solid composite	211	144	177.5[QC:e]
925-6755	Core 41	Solid composite	230	172	201[QC:e]
927-6755		Solid composite	252	206	229[QC:e]
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	< 10	< 9.98	< 9.99
926-7755		Solid composite	< 9.98	< 10	< 9.99
925-7755	Core 41	Solid composite	< 8.77	< 8.75	< 8.76
927-6755		Solid composite	< 9.96	< 9.96	< 9.96

Table B2-25. Tank 241-BX-107 Analytical Results: Chromium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	1,220	1,170	1,190[QC:c]
837-8755		Homogenized test 2	1,250	1,190	1,220[QC:c]
814-8755	41: 6	Homogenized test 1	1,040	1,020	1,030
815-8755		Homogenized test 2	1,030	1,010	1,020
924-8755	Core 40	Solid composite	889	820	854.5[QC:c]
926-8750		Solid composite	877	877	877
925-8755	Core 41	Solid composite	1,070	1,070	1,070[QC:c]
927-8755		Solid composite	1,040	1,020	1,030
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	954	990	972
926-6755		Solid composite	787	889	838
925-6755	Core 41	Solid composite	1,080	1,080	1,080
927-6755		Solid composite	958	1,010	984
Solids: TCLP			**µg/mL**	**µg/mL**	**µg/mL**
987-8750	Core 40	Solid composite	9.08	8.76	8.92
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	158	157	157.5
926-7755		Solid composite	131	135	133
925-7755	Core 41	Solid composite	154	158	156[QC:c]
927-6755		Solid composite	171	148	159.5

Table B2-26. Tank 241-BX-107 Analytical Results: Cobalt (ICP)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	1.35	1.53	1.44
837-8755		Homogenized test 2	< 0.971	1.713	< 1.342[QC:e]
814-8755	41: 6	Homogenized test 1	1.88	< 1.17	< 1.525[QC:a,e]
815-8755		Homogenized test 2	1.68	< 1.14	< 1.41[QC:a,e]
924-8755	Core 40	Solid composite	2.22	1.94	2.08
926-8750		Solid composite	1.64	1.75	1.695
925-8755	Core 41	Solid composite	2.09	2.55	2.32
927-8755		Solid composite	< 0.914	< 0.988	< 0.951
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	< 4.99	< 4.99	< 4.99
926-6755		Solid composite	< 4.99	< 5	< 4.995
925-6755	Core 41	Solid composite	< 4.98	< 4.98	< 4.98
927-6755		Solid composite	9.68	15.9	12.79[QC:e]
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	< 1.02	< 1.02	< 1.02
926-7755		Solid composite	< 1.02	< 1.02	< 1.02
925-7755	Core 41	Solid composite	< 1.22	< 1.22	< 1.22
927-6755		Solid composite	1.17	1.02	1.095

Table B2-27. Tank 241-BX-107 Analytical Results: Copper (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	22.1	22.5	22.3
837-8755		Homogenized test 2	22.4	21.7	22.0
814-8755	41: 6	Homogenized test 1	18.3	18.3	18.3
815-8755		Homogenized test 2	18.6	18	18.3
924-8755	Core 40	Solid composite	65.1	60.4	62.75
926-8750		Solid composite	72.4	72.7	72.55
925-8755	Core 41	Solid composite	18.6	18.9	18.75[QC:d]
927-8755		Solid composite	17.2	16.7	16.95
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	61	73.6	67.3
926-6755		Solid composite	72.7	70.5	71.6
925-6755	Core 41	Solid composite	25.9	27.1	26.5
927-6755		Solid composite	53.3	29.1	41.2[QC:e]
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	0.687	0.766	0.7265
926-7755		Solid composite	0.772	0.78	0.776
925-7755	Core 41	Solid composite	< 0.612	< 0.611	< 0.6115
927-6755		Solid composite	1.07	0.67	0.87[QC:e]

Table B2-28. Tank 241-BX-107 Analytical Results: Iron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	17,400	16,700	17,100[QC:c]
837-8755		Homogenized test 2	17,800	17,000	17,400[QC:c]
814-8755	41: 6	Homogenized test 1	12,200	12,100	12,150[QC:d]
815-8755		Homogenized test 2	12,200	11,800	12,000
924-8755	Core 40	Solid composite	9,860	9,040	9,450[QC:c]
926-8750		Solid composite	9,430	9,420	9,425
925-8755	Core 41	Solid composite	12,800	12,900	12,850[QC:c]
927-8755		Solid composite	12,500	12,100	12,300[QC:b]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	10,700	11,300	11,000
926-6755		Solid composite	8,350	9,390	8,870
925-6755	Core 41	Solid composite	13,400	13,200	13,300
927-6755		Solid composite	10,500	11,700	11,100
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	51.6	57.8	54.7
926-7755		Solid composite	42.7	41.2	41.95
925-7755	Core 41	Solid composite	61.5	55.2	58.35[QC:c]
927-6755		Solid composite	422	214	318[QC:e]

Table B2-29. Tank 241-BX-107 Analytical Results: Lanthanum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	< 1.50	< 1.57	< 1.54
837-8755		Homogenized test 2	< 1.55	< 1.53	< 1.54
814-8755	41: 6	Homogenized test 1	< 2.06	< 2.04	< 2.05
815-8755		Homogenized test 2	< 1.98	< 2	< 1.99
924-8755	Core 40	Solid composite	< 1.52	< 1.46	< 1.49[QC:c]
926-8750		Solid composite	< 1.51	< 1.54	< 1.525
925-8755	Core 41	Solid composite	< 1.52	< 1.56	< 1.54[QC:c]
927-8755		Solid composite	< 1.46	< 1.49	< 1.475
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	< 7.98	< 7.98	< 7.98
926-6755		Solid composite	< 7.98	< 8	< 7.99
925-6755	Core 41	Solid composite	< 7.97	< 7.97	< 7.97
927-6755		Solid composite	< 8	< 7.98	< 7.99
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	1.63	1.63	1.63
926-7755		Solid composite	1.63	1.63	1.63
925-7755	Core 41	Solid composite	< 2.14	< 2.14	< 2.14
927-6755		Solid composite	< 1.63	< 1.63	< 1.63

Table B2-30. Tank 241-BX-107 Analytical Results: Lead (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	92.3	94.5	93.4
837-8755		Homogenized test 2	101.7	94.3	98.0
814-8755	41: 6	Homogenized test 1	64.8	67.7	66.25
815-8755		Homogenized test 2	60.6	69	64.8
924-8755	Core 40	Solid composite	55.5	53	54.25
926-8750		Solid composite	54.9	46.1	50.5
925-8755	Core 41	Solid composite	77.5	76.7	77.1[QC:d]
927-8755		Solid composite	69.2	69.4	69.3
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	< 35.4	54.5	< 44.95[QC:e]
926-6755		Solid composite	65.6	64.8	65.2
925-6755	Core 41	Solid composite	123	75.8	99.4[QC:e]
927-6755		Solid composite	101	75.1	88.05[QC:e]
Solids: TCLP			**µg/mL**	**µg/mL**	**µg/mL**
987-8750	Core 40	Solid composite	12.8	9.11	10.955[QC:e]
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	< 7.24	< 7.23	< 7.235
926-7755		Solid composite	< 7.23	< 7.24	< 7.235
925-7755	Core 41	Solid composite	< 8.67	< 8.65	< 8.66
927-6755		Solid composite	7.49	8.04	7.765

Table B2-31. Tank 241-BX-107 Analytical Results: Magnesium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	158	178	168[QC:c]
837-8755		Homogenized test 2	163	148	155[QC:c]
814-8755	41: 6	Homogenized test 1	138	145	141.5
815-8755		Homogenized test 2	136	130	133
924-8755	Core 40	Solid composite	202	137	169.5[QC:b,c,e]
926-8750		Solid composite	156	143	149.5[QC:b]
925-8755	Core 41	Solid composite	162	216	189[QC:b,e]
927-8755		Solid composite	125	127	126[QC:b]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	108	114	111
926-6755		Solid composite	85.5	94	89.75
925-6755	Core 41	Solid composite	131	132	131.5
927-6755		Solid composite	107	124	115.5
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	24.3	8.72	16.51[QC:e]
926-7755		Solid composite	44.1	24.7	34.4[QC:e]
925-7755	Core 41	Solid composite	6.59	6.43	6.51
927-6755		Solid composite	9.57	7.25	8.41[QC:e]

Table B2-32. Tank 241-BX-107 Analytical Results: Manganese (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	70.6	67.9	69.2
837-8755		Homogenized test 2	71.5	68.3	69.9
814-8755	41: 6	Homogenized test 1	40.1	40.2	40.15[QC:a]
815-8755		Homogenized test 2	40.4	39.3	39.85[QC:a]
924-8755	Core 40	Solid composite	37.8	33	35.4
926-8750		Solid composite	33.2	33.5	33.35
925-8755	Core 41	Solid composite	46.2	48.2	47.2
927-8755		Solid composite	43.9	42.3	43.1
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	65.1	60.5	62.8
926-6755		Solid composite	49.9	58.9	54.4
925-6755	Core 41	Solid composite	65.2	81.6	73.4[QC:e]
927-6755		Solid composite	66	69.2	67.6
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	1.53	0.631	1.0805[QC:e]
926-7755		Solid composite	1.58	0.912	1.246[QC:e]
925-7755	Core 41	Solid composite	< 0.306	< 0.305	< 0.3055
927-6755		Solid composite	1.72	0.888	1.304[QC:a,e]

Table B2-33. Tank 241-BX-107 Analytical Results: Nickel (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	16.6	16.5	16.6
837-8755		Homogenized test 2	16.2	16.1	16.2
814-8755	41: 6	Homogenized test 1	12.4	13	12.7
815-8755		Homogenized test 2	12.3	12.1	12.2
924-8755	Core 40	Solid composite	11.6	10.3	10.95
926-8750		Solid composite	10.8	9.93	10.365
925-8755	Core 41	Solid composite	13.6	14.3	13.95[QC:d]
927-8755		Solid composite	13.9	13.3	13.6
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	1.43	1.43	1.43
926-7755		Solid composite	1.43	1.43	1.43
925-7755	Core 41	Solid composite	< 1.84	< 1.83	< 1.835
927-6755		Solid composite	< 1.42	< 1.42	< 1.42

Table B2-34. Tank 241-BX-107 Analytical Results: Phosphorus (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	26,300	26,200	26,200[QC:b,d]
837-8755		Homogenized test 2	26,700	27,300	27,000[QC:b,d]
814-8755	41: 6	Homogenized test 1	25,900	25,500	25,700[QC:d]
815-8755		Homogenized test 2	25,300	25,000	25,150
924-8755	Core 40	Solid composite	19,500	20,000	19,750[QC:b,d]
926-8750		Solid composite	22,100	20,600	21,350[QC:b]
925-8755	Core 41	Solid composite	24,400	23,500	23,950[QC:b,d]
927-8755		Solid composite	26,900	27,500	27,200
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	23,900	24,400	24,150
926-6755		Solid composite	19,400	22,100	20,750[QC:d]
925-6755	Core 41	Solid composite	25,900	28,800	27,350[QC:d]
927-6755		Solid composite	20,900	22,000	21,450
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	4,770	4,740	4,755[QC:b]
926-7755		Solid composite	5,260	4,740	5,000[QC:b]
925-7755	Core 41	Solid composite	4,560	4,650	4,605[QC:c]
927-6755		Solid composite	4,810	4,810	4,810

Table B2-35. Tank 241-BX-107 Analytical Results: Potassium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	549	568	559
837-8755		Homogenized test 2	573	561	567
814-8755	41: 6	Homogenized test 1	94.7	98.6	96.65
815-8755		Homogenized test 2	113	104	108.5
924-8755	Core 40	Solid composite	273	256	264.5[QC:a]
926-8750		Solid composite	199	199	199[QC:a]
925-8755	Core 41	Solid composite	299	313	306[QC:a,d]
927-8755		Solid composite	278	286	282[QC:b]
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	170	164	167
926-7755		Solid composite	131	143	137
925-7755	Core 41	Solid composite	151	161	156[QC:c]
927-6755		Solid composite	128	131	129.5

Table B2-36. Tank 241-BX-107 Analytical Results: Selenium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	378	372	375[QC:b]
837-8755		Homogenized test 2	399	391	395[QC:b]
814-8755	41: 6	Homogenized test 1	14.3	21.9	18.1[QC:e]
815-8755		Homogenized test 2	26.1	32.6	29.35[QC:e]
924-8755	Core 40	Solid composite	326	299	312.5[QC:b,c]
926-8750		Solid composite	290	301	295.5[QC:b]
925-8755	Core 41	Solid composite	366	372	369[QC:b,d]
927-8755		Solid composite	< 7.59	< 7.74	< 7.665[QC:b]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	< 41.4	< 41.4	< 41.4
926-6755		Solid composite	< 41.4	< 41.5	< 41.45
925-6755	Core 41	Solid composite	< 41.3	< 41.3	< 41.3
927-6755		Solid composite	316	345	330.5
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	< 8.47	< 8.45	< 8.46
926-7755		Solid composite	< 8.45	< 8.47	< 8.46
925-7755	Core 41	Solid composite	< 13.4	< 13.3	< 13.35
927-6755		Solid composite	74.5	62	68.25

Table B2-37. Tank 241-BX-107 Analytical Results: Silicon (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	2,280	2,170	2,220[QC:b,d]
837-8755		Homogenized test 2	2,190	2,330	2,260[QC:b,d]
814-8755	41: 6	Homogenized test 1	1,610	1,670	1,640[QC:b,d]
815-8755		Homogenized test 2	1,150	1,540	1,345[QC:b,e]
924-8755	Core 40	Solid composite	1,660	1,410	1,535[QC:b,d]
926-8750		Solid composite	1,630	1,810	1,720[QC:b]
925-8755	Core 41	Solid composite	1,630	1,860	1,745[QC:b,d]
927-8755		Solid composite	1,770	1,540	1,655[QC:b]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	6,430	6,770	6,600
926-6755		Solid composite	5,630	6,370	6,000
925-6755	Core 41	Solid composite	7,980	7,990	7,985
927-6755		Solid composite	6,100	6,970	6,535
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	524	303	413.5[QC:d,e]
926-7755		Solid composite	368	361	364.5[QC:d]
925-7755	Core 41	Solid composite	133	139	136[QC:c]
927-6755		Solid composite	271	253	262

Table B2-38. Tank 241-BX-107 Analytical Results: Silver (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	< 0.939	1.22	< 1.08[QC:a,c]
837-8755		Homogenized test 2	< 0.97	< 0.96	< 0.96[QC:a,c]
814-8755	41: 6	Homogenized test 1	< 0.98	< 0.973	< 0.9765[QC:a,c]
815-8755		Homogenized test 2	< 0.943	< 0.953	< 0.948[QC:a]
924-8755	Core 40	Solid composite	< 0.95	< 0.914	< 0.932[QC:a,c]
926-8750		Solid composite	< 0.943	< 0.962	< 0.9525[QC:a]
925-8755	Core 41	Solid composite	< 0.949	< 0.973	< 0.961[QC:a,c]
927-8755		Solid composite	< 0.914	< 0.933	< 0.9235[QC:a]
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	< 4.99	< 4.99	< 4.99
926-6755		Solid composite	8.48	5.57	7.025[QC:c]
925-6755	Core 41	Solid composite	< 7.59	< 4.98	< 6.285[QC:c]
927-6755		Solid composite	5.92	< 4.99	< 5.455
Solids: TCLP			**µg/mL**	**µg/mL**	**µg/mL**
987-8750	Core 40	Solid composite	< 0.964	0.675	< 0.8195[QC:a,c,]
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	< 1.02	< 1.02	< 1.02
926-7755		Solid composite	< 1.02	< 1.02	< 1.02
925-7755	Core 41	Solid composite	< 1.02	< 1.02	< 1.02
927-6755		Solid composite	< 1.02	< 1.02	< 1.02

Table B2-39. Tank 241-BX-107 Analytical Results: Sodium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	95,900	97,100	96,500[QC:b,d]
837-8755		Homogenized test 2	98,800	96,700	97,700[QC:b,d]
814-8755	41: 6	Homogenized test 1	101,000	101,000	101,000[QC:b,c]
815-8755		Homogenized test 2	98,200	95,900	97,050[QC:b]
924-8755	Core 40	Solid composite	102,000	98,500	100,300[QC:b,c]
926-8750		Solid composite	103,000	102,000	102,500[QC:b]
925-8755	Core 41	Solid composite	104,000	103,000	103.500[QC:b,c]
927-8755		Solid composite	100,000	100,000	100,000[QC:b]
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	102,000	106,000	104,000
926-6755		Solid composite	99,700	102,000	100,900[QC:d]
925-6755	Core 41	Solid composite	101,000	103,000	102,000[QC:d]
927-6755		Solid composite	94,500	95,600	95,050
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	26,300	80,300	53,300[QC:d,e]
926-7755		Solid composite	52,900	81,100	67,000[QC:d,e]
925-7755	Core 41	Solid composite	79,400	80,800	80,100[QC:c]
927-6755		Solid composite	72,600	71,400	72,000

Table B2-40. Tank 241-BX-107 Analytical Results: Strontium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	217.5	215.6	216.6
837-8755		Homogenized test 2	225.3	216.6	220.9
814-8755	41: 6	Homogenized test 1	174	173	173.5
815-8755		Homogenized test 2	174	169	171.5
924-8755	Core 40	Solid composite	161	147	154
926-8750		Solid composite	158	157	157.5
925-8755	Core 41	Solid composite	185	185	185
927-8755		Solid composite	172	168	170
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	164	177	170.5
926-6755		Solid composite	165	155	160
925-6755	Core 41	Solid composite	188	188	188
927-6755		Solid composite	144	166	155
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	1.99	1.41	1.7[QC:e]
926-7755		Solid composite	1.9	1.43	1.665[QC:e]
925-7755	Core 41	Solid composite	1.48	1.44	1.46
927-6755		Solid composite	6.5	3.51	5.005[QC:e]

Table B2-41. Tank 241-BX-107 Analytical Results: Sulfur (ICP)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	4,250	4,260	4,250[QC:b,d]
837-8755		Homogenized test 2	4,430	4,320	4,370[QC:b,d]
814-8755	41: 6	Homogenized test 1	4,050	3,920	3,985
815-8755		Homogenized test 2	4,130	3,990	4,060
924-8755	Core 40	Solid composite	4,760	4,760	4,760[QC:b,d]
926-8750		Solid composite	5,070	4,940	5,005[QC:b]
925-8755	Core 41	Solid composite	4,520	4,430	4,475[QC:b,c]
927-8755		Solid composite	4,030	4,030	4,030[QC:b]
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	4,790	4,870	4,830
926-6755		Solid composite	4,650	4,650	4,650
925-6755	Core 41	Solid composite	4,030	4,260	4,145
927-6755		Solid composite	4,200	4,060	4,130
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	4,540	4,570	4,555
926-7755		Solid composite	4,690	4,570	4,630
925-7755	Core 41	Solid composite	4,350	4,440	4,395[QC:c]
927-6755		Solid composite	4,170	4,130	4,150

Table B2-42. Tank 241-BX-107 Analytical Results: Tin (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	9.43	9.77	9.60
837-8755		Homogenized test 2	11.06	9.59	10.32
814-8755	41: 6	Homogenized test 1	9.41	8.25	8.83
815-8755		Homogenized test 2	7.51	8.87	8.19
924-8755	Core 40	Solid composite	3.34	3.23	3.285
926-8750		Solid composite	< 2.17	10.4	< 6.285[QC:e]
925-8755	Core 41	Solid composite	5.34	9.04	7.19[QC:e]
927-8755		Solid composite	10.7	11.7	11.2
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	< 11.5	< 11.5	< 11.5
926-6755		Solid composite	< 11.5	< 11.5	< 11.5
925-6755	Core 41	Solid composite	< 11.5	< 11.5	< 11.5
927-6755		Solid composite	< 11.5	< 11.5	< 11.5
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	< 2.35	< 2.34	< 2.345
926-7755		Solid composite	< 2.34	< 2.35	< 2.345
925-7755	Core 41	Solid composite	< 1.63	< 1.63	< 1.63
927-6755		Solid composite	< 2.34	< 2.34	< 2.34

Table B2-43. Tank 241-BX-107 Analytical Results: Titanium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
836-8755	41: 2	Homogenized test 1	5.47	6.00	5.74
837-8755		Homogenized test 2	5.84	5.69	5.77
814-8755	41: 6	Homogenized test 1	4.12	4.18	4.15
815-8755		Homogenized test 2	4.3	4.23	4.265
924-8755	Core 40	Solid composite	3.18	3.18	3.18
926-8750		Solid composite	3.72	3.47	3.595
925-8755	Core 41	Solid composite	4.23	4.94	4.585
927-8755		Solid composite	4.08	4.05	4.065
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
924-6755	Core 40	Solid composite	< 2	4.51	< 3.255[QC:e]
926-6755		Solid composite	6.35	5.26	5.805
925-6755	Core 41	Solid composite	8.14	6.4	7.27[QC:e]
927-6755		Solid composite	6.89	11.2	9.045[QC:e]
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
924-7755	Core 40	Solid composite	< 0.408	< 0.407	< 0.4075
926-7755		Solid composite	< 0.407	< 0.408	< 0.4075
925-7755	Core 41	Solid composite	< 0.51	< 0.509	< 0.5095
927-6755		Solid composite	< 0.406	< 0.406	< 0.406

Table B2-44. Tank 241-BX-107 Analytical Results: Vanadium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	5.88	4.64	5.26[QC:e]
837-8755		Homogenized test 2	5.99	5.49	5.74
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	23.6	13	18.3[QC:e]
926-6755		Solid composite	7.33	8.3	7.815
925-6755	Core 41	Solid composite	10.5	10.4	10.45
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	0.816	0.814	0.815
926-7755		Solid composite	0.814	0.816	0.815

Table B2-45. Tank 241-BX-107 Analytical Results: Zinc (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	120	118	119
837-8755		Homogenized test 2	126	120	123
814-8755	41: 6	Homogenized test 1	44.5	43.9	44.2
815-8755		Homogenized test 2	43.9	43.5	43.7
924-8755	Core 40	Solid composite	75	37.2	56.1[QC:e]
926-8750		Solid composite	31.3	39.7	35.5[QC:e]
925-8755	Core 41	Solid composite	77.1	85	81.05[QC:d]
927-8755		Solid composite	66.5	64.5	65.5[QC:b]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	78.1	72.5	75.3
926-6755		Solid composite	51.3	44.9	48.1
925-6755	Core 41	Solid composite	92.8	83.5	88.15
927-6755		Solid composite	111	133	122

Table B2-45. Tank 241-BX-107 Analytical Results: Zinc (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	43.3	7.94	25.62[QC:e]
926-7755		Solid composite	33.1	14.6	23.85[QC:e]
925-7755	Core 41	Solid composite	< 2.55	< 2.54	< 2.545
927-6755		Solid composite	5.28	4.95	5.115

Table B2-46. Tank 241-BX-107 Analytical Results: Zirconium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
836-8755	41: 2	Homogenized test 1	146	134	140[QC:d]
837-8755		Homogenized test 2	137	165	151[QC:d]
814-8755	41: 6	Homogenized test 1	108	89.7	98.85[QC:c]
815-8755		Homogenized test 2	76.6	101	88.8[QC:e]
924-8755	Core 40	Solid composite	112	77.2	94.6[QC:c,e]
926-8750		Solid composite	87.2	97.1	92.15
925-8755	Core 41	Solid composite	86.4	89.5	87.95[QC:c]
927-8755		Solid composite	115	105	110[QC:b]
Solids: fusion			µg/g	µg/g	µg/g
924-6755	Core 40	Solid composite	181	197	189
926-6755		Solid composite	79	53.4	66.2[QC:b,e]
925-6755	Core 41	Solid composite	173	69.2	121.1[QC:b,e]
927-6755		Solid composite	135	197	166[QC:e]
Solids: water digest			µg/g	µg/g	µg/g
924-7755	Core 40	Solid composite	1.49	1.6	1.545[QC:b]
926-7755		Solid composite	< 0.814	1.4	< 1.107[QC:b,e]
925-7755	Core 41	Solid composite	< 1.12	1.3	< 1.21
927-6755		Solid composite	7.85	4.33	6.09[QC:e]

Table B2-47. Tank 241-BX-107 Analytical Results: Chloride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7771	Core 40	Solid composite	1,170	1,140	1,155
926-7771		Solid composite	1,140	1,210	1,175
925-7771	Core 41	Solid composite	1,020	1,060	1,040
927-7771		Solid composite	1,200	1,150	1,175

Table B2-48. Tank 241-BX-107 Analytical Results: Fluoride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7771	Core 40	Solid composite	8,910	8,110	8,510[QC:d]
926-7771		Solid composite	8,500	8,330	8,415[QC:d]
925-7771	Core 41	Solid composite	9,040	8,720	8,880
927-7771		Solid composite	10,900	11,000	10,950

Table B2-49. Tank 241-BX-107 Analytical Results: Nitrate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7771	Core 40	Solid composite	145,000	139,000	142,000[QC:d]
926-7771		Solid composite	146,000	153,000	149,500[QC:d]
925-7771	Core 41	Solid composite	123,000	129,000	126,000
927-7771		Solid composite	128,000	131,000	129,500

Table B2-50. Tank 241-BX-107 Analytical Results: Nitrite (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7771	Core 40	Solid composite	10,200	9,170	9,685
926-7771		Solid composite	9,120	9,190	9,155
925-7771	Core 41	Solid composite	12,500	12,400	12,450
927-7771		Solid composite	1,210	1,180	1,195

Table B2-51. Tank 241-BX-107 Analytical Results: Phosphate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7771	Core 40	Solid composite	14,500	14,300	14,400
926-7771		Solid composite	14,800	15,100	14,950
925-7771	Core 41	Solid composite	13,400	13,400	13,400
927-7771		Solid composite	14,300	14,100	14,200

Table B2-52. Tank 241-BX-107 Analytical Results: Sulfate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7771	Core 40	Solid composite	14,100	14,000	14,050
926-7771		Solid composite	14,100	14,200	14,150
925-7771	Core 41	Solid composite	12,800	13,200	13,000
927-7771		Solid composite	12,200	12,300	12,250

Table B2-53. Tank 241-BX-107 Analytical Results: Cyanide (Spectrometric [CN]).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
924-5778	Core 40	Solid composite	3.14	3.08	3.11
926-5778		Solid composite	< 1.79	< 1.06	< 1.425[QC:e]
925-5778	Core 41	Solid composite	2.88	3.1	2.99
927-5778		Solid composite	2.07	2.78	2.425[QC:e]

Table B2-54. Tank 241-BX-107 Analytical Results: Nitrite (Spectrophotometric)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7779	Core 40	Solid composite	13,100	13,200	13,150
926-7779		Solid composite	10,000	10,600	10,300
925-7779	Core 41	Solid composite	13,900	12,600	13,250
927-7779		Solid composite	12,400	12,500	12,450

Table B2-55. Tank 241-BX-107 Analytical Results: Total Uranium (Laser Florimetry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	1,810	1,810	1,810
92-11297		Solid composite	1,730	1,680	1,705
924-6740		Solid composite	1,560	2,070	1,815[QC:e]
926-6740		Solid composite	1,860	2,180	2,020
92-11298	Core 41	Solid composite	2,290	2,230	2,260
92-11299		Solid composite	2,210	2,240	2,225
925-6740		Solid composite	2,820	2,820	2,820
927-6740		Solid composite	22,900	25,200	24,050

Table B2-56. Tank 241-BX-107 Analytical Results: Ammonium (Distillation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7728	Core 40	Solid composite	< 4,500	< 4,500	< 4,500
926-7728		Solid composite	< 4,500	< 4,500	< 4,500
925-7728	Core 41	Solid composite	< 4,500	< 4,500	< 4,500
927-7728		Solid composite	< 4,500	< 4,500	< 4,500

Table B2-57. Tank 241-BX-107 Analytical Results: pH Measurement (pH).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			unitless	unitless	unitless
924-5715	Core 40	Solid composite	9.59	9.66	9.625
926-5715		Solid composite	9.77	9.58	9.675
925-5715	Core 41	Solid composite	9.95	9.69	9.82
927-5715		Solid composite	9.71	9.72	9.715

Table B2-58. Tank 241-BX-107 Analytical Results: Percent Water (TGA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
897-5712	40: 2	Whole	45	43.7	44.35
895-5712	40: 4	Whole	51.2	51.4	51.3
893-5712	40: 5	Whole	54.9	50.8	52.85
892-5712	40: 6	Whole	46.2	46	46.1
890-5712	40: 7	Whole	50.4	48.8	49.6
888-5712	41: 2	Whole	49.1	39.6	44.35[QC:e]
887-5712	41: 3	Whole	52.5	54.1	53.3
884-5712	41: 5	Whole	39.4	36.4	37.9
883-5712	41: 6	Whole	38.4	44	41.2
882-5712	41: 7	Whole	35.2	34	34.6

Table B2-58. Tank 241-BX-107 Analytical Results: Percent Water (TGA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
'924-5712	Core 40	Solid composite	56.4	56.5	56.45
926-5712		Solid composite	63.3	63.7	63.5
925-5712	Core 41	Solid composite	66.3	61.8	64.05
927-5712		Solid composite	50.7	54.3	52.5

Table B2-59. Tank 241-BX-107 Analytical Results: Percent Water (Gravimetric).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
907-5710	40: 2	Whole	55.2	54.7	54.95
907-5710		Whole	55.15	54.68	54.915
878-5710	40: 4	Whole	50.8		50.8
902-5710		Whole	53.4	52.9	53.15
900-5710	40: 5	Whole	57.7	56.6	57.15
854-5710	40: 6	Whole	56.2	56.3	56.25
854-5719		Whole	56.2	56.3	56.25
851-5710	40: 7	Whole	44.3	43	43.65
851-5710		Whole	44.3	43	43.65
829-5710	41: 3	Whole	56.89	56.8	56.845
869-5710	41: 5	Whole	27.9		27.9
809-5710	41: 6	Whole	48.72	50.16	49.44
806-5710	41: 7	Whole	50.34	48.7	49.52
931-5710	Core 40	Solid composite	57.5	58	57.75
933-5710		Solid composite	57.3	56.9	57.1
935-5710	Core 41	Solid composite	56	56.3	56.15
937-5710		Solid composite	55.9	56	55.95

Table B2-60. Tank 241-BX-107 Analytical Results: Density (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			g/mL	g/mL	g/mL
92-020	40: 2	Whole	1.0926		1.0926
92-11293		Whole	1.47		1.47
92-022	40: 4	Whole	1.1581		1.1581
92-11294		Whole	1.45		1.45
92-023	40: 5	Whole	1.166		1.166
92-024	40: 6	Whole	1.1541		1.1541
92-11295		Whole	1.4		1.4
92-025	40: 7	Whole	0.7083		0.7083
92-027	41: 2	Whole	0.9956		0.9956
92-028	41: 3	Whole	1.9917		1.9917
92-030	41: 5	Whole	0.5914		0.5914
92-031	41: 6	Whole	1.3264		1.3264
92-032	41: 7	Whole	1.338		1.338

Table B2-61. Tank 241-BX-107 Analytical Results: Volume (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			mL	mL	mL
92-020	40: 2	Whole	187		187
92-022	40: 4	Whole	187		187
92-023	40: 5	Whole	187		187
92-024	40: 6	Whole	187		187
92-025	40: 7	Whole	187		187
92-027	41: 2	Whole	187		187
92-028	41: 3	Whole	93		93
92-030	41: 5	Whole	9.35		9.35
92-031	41: 6	Whole	187		187
92-032	41: 7	Whole	187		187

Table B2-62. Tank 241-BX-107 Analytical Results: Mass (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			g	g	g
92-020	40: 2	Whole	204.31		204.31
92-022	40: 4	Whole	216.57		216.57
92-023	40: 5	Whole	218.04		218.04
92-024	40: 6	Whole	215.81		215.81
92-025	40: 7	Whole	132.45		132.45
92-027	41: 2	Whole	186.17		186.17
92-028	41: 3	Whole	185.23		185.23
92-030	41: 5	Whole	5.53		5.53
92-031	41: 6	Whole	248.04		248.04
92-032	41: 7	Whole	250.2		250.2

Table B2-63. Tank 241-BX-107 Analytical Results: Centrifuged Solids Density (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			g/mL	g/mL	g/mL
92-11293	40: 2	Whole	1.58		1.58
92-11294	40: 4	Whole	1.54		1.54
92-11295	40: 6	Whole	1.49		1.49

Table B2-64. Tank 241-BX-107 Analytical Results: Centrifuged Supernate Density (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			g/mL	g/mL	g/mL
92-11293	40: 2	Whole	1.18		1.18
92-11294	40: 4	Whole	1.17		1.17
92-11295	40: 6	Whole	1.21		1.21

Table B2-65. Tank 241-BX-107 Analytical Results: Settled solids (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
92-11293	40: 2	Whole	100		100
92-11294	40: 4	Whole	100		100
92-11295	40: 6	Whole	97.8		97.8

Table B2-66. Tank 241-BX-107 Analytical Results: Volume Percent Settled Solids (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
92-11293	40: 2	Whole	71.7		71.7
92-11294	40: 4	Whole	76		76
92-11295	40: 6	Whole	66		66

Table B2-67. Tank 241-BX-107 Analytical Results: Weight Percent Centrifuged Solids (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
92-11293	40: 2	Whole	77.2		77.2
92-11294	40: 4	Whole	80.6		80.6
92-11295	40: 6	Whole	70.4		70.4

Table B2-68. Tank 241-BX-107 Analytical Results: Weight percent solids (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
92-11293	40: 2	Whole	44.8		44.8
92-11294	40: 4	Whole	45.6		45.6
92-11295	40: 6	Whole	42		42

Table B2-69. Tank 241-BX-107 Analytical Results: Weight Percent Undissolved Solids (Physical Properties).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
92-11293	40: 2	Whole	38		38
92-11294	40: 4	Whole	39.6		39.6
92-11295	40: 6	Whole	32.6		32.6

Table B2-70. Tank 241-BX-107 Analytical Results: Pu238 to Pu ratio (Mass Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
92-11296	Core 40	Solid composite	0.0036	0.0041	0.00385
92-11297		Solid composite	0.004	0.0043	0.00415
92-11298	Core 41	Solid composite	0.004	0.0041	0.00405
92-11299		Solid composite	0.004	0.0042	0.0041

Table B2-71. Tank 241-BX-107 Analytical Results: Pu239 to Pu ratio (Mass Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
92-11296	Core 40	Solid composite	96.9751	96.9698	96.9725
92-11297		Solid composite	96.995	96.8142	96.9046
92-11298	Core 41	Solid composite	97.114	97.0968	97.1054
92-11299		Solid composite	97.1357	97.082	97.1088

Table B2-72. Tank 241-BX-107 Analytical Results: Pu240 to Pu ratio (Mass Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
92-11296	Core 40	Solid composite	2.9457	2.9681	2.9569
92-11297		Solid composite	2.98	2.9916	2.9858
92-11298	Core 41	Solid composite	2.8511	2.8514	2.85125
92-11299		Solid composite	2.8367	2.8523	2.8445

Table B2-73. Tank 241-BX-107 Analytical Results: Pu241 to Pu ratio (Mass Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
92-11296	Core 40	Solid composite	0.0575	0.041	0.04925[QC:e]
92-11297		Solid composite	0.0347	0.1301	0.0824[QC:e]
92-11298	Core 41	Solid composite	0.0216	0.0442	0.0329[QC:e]
92-11299		Solid composite	0.0193	0.0346	0.02695[QC:e]

Table B2-74. Tank 241-BX-107 Analytical Results: Pu242 to Pu ratio (Mass Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
92-11296	Core 40	Solid composite	0.0181	0.0171	0.0176
92-11297		Solid composite	0.0062	0.0598	0.033[QC:e]
92-11298	Core 41	Solid composite	0.0094	0.0035	0.00645[QC:e]
92-11299		Solid composite	0.0044	0.0271	0.01575[QC:e]

Table B2-75. Tank 241-BX-107 Analytical Results: U234 to U ratio (Mass Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
92-11296	Core 40	Solid composite	0.0058	0.0051	0.00545
92-11297		Solid composite	0.0054	0.0068	0.0061[QC:e]
92-11298	Core 41	Solid composite	0.0065	0.0058	0.00615
92-11299		Solid composite	0.0055	0.0077	0.0066[QC:e]

Table B2-76. Tank 241-BX-107 Analytical Results: U235 to U ratio (Mass Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
92-11296	Core 40	Solid composite	0.6779	0.7003	0.6891
92-11297		Solid composite	0.6753	0.6792	0.67725
92-11298	Core 41	Solid composite	0.6834	0.6776	0.6805
92-11299		Solid composite	0.6738	0.6799	0.67685

Table B2-77. Tank 241-BX-107 Analytical Results: U236 to U ratio (Mass Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
92-11296	Core 40	Solid composite	0.0055	0.0103	0.0079[QC:e]
92-11297		Solid composite	0.0061	0.0083	0.0072[QC:e]
92-11298	Core 41	Solid composite	0.0067	0.0056	0.00615
92-11299		Solid composite	0.0054	0.0077	0.00655[QC:e]

Table B2-78. Tank 241-BX-107 Analytical Results: U238 to U ratio (Mass Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
92-11296	Core 40	Solid composite	99.3109	99.2843	99.2976
92-11297		Solid composite	99.3133	99.3056	99.3094
92-11298	Core 41	Solid composite	99.3034	99.311	99.3072
92-11299		Solid composite	99.3154	99.3046	99.31

Table B2-79. Tank 241-BX-107 Analytical Results: Total Alpha (Alpha Radiation Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
836-8725	41: 2	Homogenized test 1	0.142	0.155	0.1485
837-8725		Homogenized test 2	0.171	0.155	0.163
814-8725	41: 6	Homogenized test 1	0.141	0.14	0.1405[QC:a,c]
815-8725		Homogenized test 2	0.145	0.144	0.1445[QC:a]

Table B2-80. Tank 241-BX-107 Analytical Results: Americium-241 (Alpha Radiation Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6782	Core 40	Solid composite	0.00805	0.0123	0.010175[QC:c,e]
926-6781		Solid composite	0.0141	0.0138	0.01395[QC:c]
925-6781	Core 41	Solid composite	0.0128	0.0162	0.0145[QC:e]
927-6781		Solid composite	0.0131	0.0134	0.01325[QC:c]

Table B2-81. Tank 241-BX-107 Analytical Results: Plutonium-238 (Alpha Radiation Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6782	Core 40	Solid composite	< 0.00449	< 0.00449	< 0.00449[QC:c]
926-6781		Solid composite	< 0.0045	< 0.0045	< 0.0045[QC:c]
927-6781	Core 41	Solid composite	< 0.0045	< 0.0045	< 0.0045

Table B2-82. Tank 241-BX-107 Analytical Results: Plutonium-239/40 (Alpha Radiation Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6782	Core 40	Solid composite	0.0349	0.0533	0.0441[QC:c,e]
926-6781		Solid composite	0.0834	0.0757	0.07955[QC:c]
925-6781	Core 41	Solid composite	0.0549	0.0564	0.05565
927-6781		Solid composite	0.0449	0.0541	0.0495[QC:c]

Table B2-83. Tank 241-BX-107 Analytical Results: Neptunium-237 (Alpha Radiation Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6783	Core 40	Solid composite	< 0.0216	< 0.0108	< 0.0162[QC:a,c]
926-6783		Solid composite	< 0.0216	< 0.0108	< 0.0162[QC:a,c]
925-6783	Core 41	Solid composite	< 0.0189	< 0.0189	< 0.0189[QC:a]
927-6783		Solid composite	< 0.00324	< 0.0324	< 0.01782[QC:a,c]

Table B2-84. Tank 241-BX-107 Analytical Results: Ratio of Total Alpha to Plutonium + Americium (Alpha).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			unitless	unitless	unitless
924-6725	Core 40	Solid composite	1.84	1.44	1.64[QC:e]
926-6725		Solid composite	0.735	0.813	0.774
925-6725	Core 41	Solid composite	1.82	1.56	1.69
927-6725		Solid composite	1.98	1.5	1.74[QC:e]

Table B2-85. Tank 241-BX-107 Analytical Results: Ratio of total beta to Cesium + Strontium (Alpha).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			unitless	unitless	unitless
924-6725	Core 40	Solid composite	1.05	1.02	1.035
926-6725		Solid composite	1.01	0.771	0.8905[QC:e]
925-6725	Core 41	Solid composite	0.822	0.807	0.8145
927-6725		Solid composite	0.745	0.774	0.7595

Table B2-86. Tank 241-BX-107 Analytical Results: Total alpha Pu (Alpha).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
92-11296	Core 40	Solid composite	0.0741	0.0938	0.08395[QC:e]
92-11297		Solid composite	0.0968	0.0976	0.0972
92-11298	Core 41	Solid composite	0.124	0.143	0.1335
92-11299		Solid composite	0.134	0.13	0.132

Table B2-87. Tank 241-BX-107 Analytical Results: Total Alpha (Alpha).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6725	Core 40	Solid composite	0.0789	0.0947	0.0868
926-6725		Solid composite	0.0717	0.0728	0.07225
925-6725	Core 41	Solid composite	0.123	0.113	0.118
927-6725		Solid composite	0.115	0.101	0.108

Table B2-88. Tank 241-BX-107 Analytical Results: Total Beta (Beta).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6725	Core 40	Solid composite	50.3	50.2	50.25
926-6725		Solid composite	38.8	32.8	35.8
925-6725	Core 41	Solid composite	52.4	52.3	52.35
927-6725		Solid composite	45.8	51.2	48.5

Table B2-89. Tank 241-BX-107 Analytical Results: Carbon-14 (Liquid Scintillation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µCi/g	µCi/g	µCi/g
924-7788	Core 40	Solid composite	30,600	13,300	21,950[QC:a,c]
926-7788		Solid composite	18,200	42,100	30,150[QC:a,c]
925-7788	Core 41	Solid composite	34,900	28,900	31,900[QC:a]
927-7788		Solid composite	< 22,400	< 29,900	< 26,150[QC:c]

Table B2-90. Tank 241-BX-107 Analytical Results: Americium-241 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
836-8730	41: 2	Homogenized test 1	< 0.13	< 0.13	< 0.13
837-8730		Homogenized test 2	< 0.13	< 0.13	< 0.13
814-8730	41: 6	Homogenized test 1	< 0.024	< 0.024	< 0.024
815-8730		Homogenized test 2	< 0.0235	< 0.022	< 0.02275
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6730	Core 40	Solid composite	< 0.0748	< 0.0747	< 0.07475
926-6730		Solid composite	< 0.0689	< 0.0719	< 0.0704
925-6730	Core 41	Solid composite	< 0.0896	< 0.0912	< 0.0904
927-6730		Solid composite	< 0.097	< 0.098	< 0.0975

Table B2-91. Tank 241-BX-107 Analytical Results: Cesium-137 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
836-8730	41: 2	Homogenized test 1	45.7	45.9	45.8
837-8730		Homogenized test 2	47.1	47.2	47.15
814-8730	41: 6	Homogenized test 1	7.26	7.31	7.285
815-8730		Homogenized test 2	7.2	7.34	7.27
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6730	Core 40	Solid composite	13.5	13.4	13.45
926-6730		Solid composite	10.9	11.6	11.25
925-6730	Core 41	Solid composite	20	20.4	20.2
927-6730		Solid composite	24.3	25.1	24.7

Table B2-92. Tank 241-BX-107 Analytical Results: Cobalt-60 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
836-8730	41: 2	Homogenized test 1	< 0.0065	< 0.0061	< 0.0063
837-8730		Homogenized test 2	< 0.0058	< 0.0054	< 0.0056
814-8730	41: 6	Homogenized test 1	< 0.00126	< 0.00094	< 0.0011[QC:e]
815-8730		Homogenized test 2	< 0.0012	< 0.001	< 0.0011
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6730	Core 40	Solid composite	< 0.00683	< 0.00573	< 0.00628
926-6730		Solid composite	< 0.00654	< 0.00664	< 0.00659
925-6730	Core 41	Solid composite	< 0.00682	< 0.00598	< 0.0064
927-6730		Solid composite	< 0.0066	< 0.0075	< 0.00705

Table B2-93. Tank 241-BX-107 Analytical Results: Europium-154 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
836-8730	41: 2	Homogenized test 1	< 0.017	< 0.019	< 0.018
837-8730		Homogenized test 2	< 0.018	< 0.0195	< 0.01875
814-8730	41: 6	Homogenized test 1	< 0.0037	< 0.004	< 0.00385
815-8730		Homogenized test 2	< 0.0038	< 0.0027	< 0.00325[QC:e]
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6730	Core 40	Solid composite	< 0.0185	< 0.0222	< 0.02035
926-6730		Solid composite	< 0.00181	< 0.0194	< 0.010605[QC:e]
925-6730	Core 41	Solid composite	< 0.0159	< 0.0198	< 0.01785[QC:e]
927-6730		Solid composite	< 0.021	< 0.021	< 0.021

Table B2-94. Tank 241-BX-107 Analytical Results: Europium-155 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
836-8730	41: 2	Homogenized test 1	< 0.052	< 0.054	< 0.053
837-8730		Homogenized test 2	< 0.054	< 0.054	< 0.054
814-8730	41: 6	Homogenized test 1	< 0.01	< 0.0099	< 0.00995
815-8730		Homogenized test 2	< 0.0098	< 0.0092	< 0.0095
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6730	Core 40	Solid composite	< 0.0311	< 0.0319	< 0.0315
926-6730		Solid composite	< 0.029	< 0.0302	< 0.0296
925-6730	Core 41	Solid composite	< 0.0376	< 0.0377	< 0.03765
927-6730		Solid composite	< 0.039	< 0.041	< 0.04

Table B2-95. Tank 241-BX-107 Analytical Results: Iodine-129 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6785	Core 40	Solid composite	< 0.0139	< 0.0145	< 0.0142[QC:c]
926-6785		Solid composite	< 0.00954	< 0.0123	< 0.01092[QC:c]
925-6785	Core 41	Solid composite	< 0.0183	< 0.0123	< 0.0153[QC:c,e]
927-6785		Solid composite	< 0.0504	< 0.0674	< 0.0589[QC:a,c,]

Table B2-96. Tank 241-BX-107 Analytical Results: Tritium (Liquid Scintillation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µCi/g	µCi/g	µCi/g
924-7787	Core 40	Solid composite	3.890E-04	4.020E-04	3.955E-04
926-7787		Solid composite	7.790E-04	4.830E-04	6.310E-04[QC:e]
925-7787	Core 41	Solid composite	4.200E-04	3.660E-04	3.930E-04
927-7787		Solid composite	6.970E-04	0.00108	8.885E-04[QC:a,e]

Table B2-97. Tank 241-BX-107 Analytical Results: Selenium-79 (Liquid Scintillation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µCi/g	µCi/g	µCi/g
924-6789	Core 40	Solid composite	< 0.000125	< 0.000122	< .0.000124
926-6789		Solid composite	< 0.000123	< 0.000122	< 0.000123
925-6789	Core 41	Solid composite	< 0.000126	< 0.000125	< 0.000126
927-6789		Solid composite	< 0.000147	< 0.000144	< 0.000146

Table B2-98. Tank 241-BX-107 Analytical Results: Strontium-90 (Beta).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6786	Core 40	Solid composite	9.76	10.2	9.98
926-6786		Solid composite	7.71	8.79	8.25
925-6786	Core 41	Solid composite	11.8	12	11.9
927-6786		Solid composite	8.74	9.96	9.35

Table B2-99. Tank 241-BX-107 Analytical Results: Technetium-99 (Liquid Scintillation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
924-6784	Core 40	Solid composite	0.0356	0.0406	0.0381[QC:c]
926-6784		Solid composite	0.0283	0.0296	0.02895[QC:c]
925-6784	Core 41	Solid composite	0.0492	0.0423	0.04575[QC:c]
927-6784		Solid composite	0.0374	0.0324	0.0349[QC:c]

Table B2-100. Tank 241-BX-107 Analytical Results: Total organic carbon (Furnace Oxidation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7726	Core 40	Solid composite	700	700	700
926-7726		Solid composite	< 0.58	< 550	< 275.29[QC:c]
925-7726	Core 41	Solid composite	< 500	< 550	< 525
927-7726		Solid composite	796	997	896.5[QC:c]

Table B2-101. Tank 241-BX-107 Analytical Results: Carbonate (TIC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
924-7727	Core 40	Solid composite	1,100	1,200	1,150
926-7727		Solid composite	1,600	699	1,149.5[QC:c]
925-7727	Core 41	Solid composite	1,390	1,100	1,245[QC:c,e]
927-7727		Solid composite	1,100	1,100	1,100[QC:c]

Table B2-102. Tank 241-BX-107 Analytical Results: 2-Chlorophenol (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	< 11	< 10	< 10.5
92-11297		Solid composite	5.3	< 9.9	< 7.6[QC:e]
92-11298	Core 41	Solid composite	< 12	< 11	< 11.5
92-11299		Solid composite	< 11	< 10	< 10.5

Table B2-103. Tank 241-BX-107 Analytical Results: 4-Chloro-3-methylphenol (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	< 11	< 10	< 10.5
92-11297		Solid composite	2.7	< 9.9	< 6.3[QC:e]
92-11298	Core 41	Solid composite	< 12	< 11	< 11.5
92-11299		Solid composite	< 11	< 10	< 10.5

Table B2-104. Tank 241-BX-107 Analytical Results: Acenaphthene (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	< 11	< 10	< 10.5
92-11297		Solid composite	2	< 9.9	< 5.95[QC:e]
92-11298	Core 41	Solid composite	< 12	< 11	< 11.5
92-11299		Solid composite	< 11	< 10	< 10.5

Table B2-105. Tank 241-BX-107 Analytical Results: Bis(2-ethylhexyl) phthalate (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	< 2.1	< 1.7	< 1.9[QC:e]
92-11297		Solid composite	2	1.8	1.9
92-11298	Core 41	Solid composite	4.9	4.8	4.85
92-11299		Solid composite	3.9	4.5	4.2

Table B2-106. Tank 241-BX-107 Analytical Results: Dodecane (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	610	490	550[QC:e]
92-11297		Solid composite	670	610	640
92-11298	Core 41	Solid composite	680	600	640
92-11299		Solid composite	530	610	570

Table B2-107. Tank 241-BX-107 Analytical Results: Pentadecane (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	42	35	38.5
92-11297		Solid composite	49	42	45.5
92-11298	Core 41	Solid composite	55	51	53
92-11299		Solid composite	46	52	49

Table B2-108. Tank 241-BX-107 Analytical Results: Pyrene (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	< 11	< 10	< 10.5
92-11297		Solid composite	2.6	< 9.9	< 6.25[QC:e]
92-11298	Core 41	Solid composite	< 12	< 11	< 11.5
92-11299		Solid composite	< 11	< 10	< 10.5

Table B2-109. Tank 241-BX-107 Analytical Results: TBP (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	9.5	6.9	8.2[QC:e]
92-11297		Solid composite	11	7.8	9.4[QC:e]
92-11298	Core 41	Solid composite	7.1	6.6	6.85
92-11299		Solid composite	5.5	2	3.75[QC:e]

Table B2-110. Tank 241-BX-107 Analytical Results: Tetradecane (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	1,300	1,100	1,200
92-11297		Solid composite	1,300	1,200	1,250
92-11298	Core 41	Solid composite	1,200	1,100	1,150
92-11299		Solid composite	1,000	1,100	1,050

Table B2-111. Tank 241-BX-107 Analytical Results: Tridecane (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	1,800	1,400	1,600[QC:e]
92-11297		Solid composite	1,900	1,600	1,750
92-11298	Core 41	Solid composite	1,500	1,400	1,450
92-11299		Solid composite	1,300	1,400	1,350

Table B2-112. Tank 241-BX-107 Analytical Results: Undecane (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40	Solid composite	11	9.1	10.05
92-11297		Solid composite	12	11	11.5
92-11298	Core 41	Solid composite	16	13	14.5[QC:e]
92-11299		Solid composite	11	15	13[QC:e]

Table B2-113. Tank 241-BX-107 Analytical Results: 2-butanone (VOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-09439	40: 5	Whole	< 6.7	< 6.1	< 6.4
92-09438	40: 7	Whole	< 5.9	< 6.7	< 6.3
92-09440	41: 2	Whole	< 6.6	1.8	< 4.2[QC:e]
92-09441	41: 3	Whole	< 6.2	< 6.3	< 6.25
92-09442	41: 5	Whole	< 6.3	1.8	< 4.05[QC:e]
92-09443	41: 6	Whole	< 6.2	< 5.9	< 6.05
92-09444	41: 7	Whole	< 6.4	< 6	< 6.2

Table B2-114. Tank 241-BX-107 Analytical Results: Acetone (VOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-09439	40: 5	Whole	< 6.7	< 6.1	< 6.4
92-09438	40: 7	Whole	< 5.9	< 6.7	< 6.3
92-09440	41: 2	Whole	< 6.6	< 5.9	< 6.25
92-09441	41: 3	Whole	< 6.2	< 6.3	< 6.25
92-09442	41: 5	Whole	< 26	27	< 26.5
92-09443	41: 6	Whole	< 6.2	< 5.9	< 6.05
92-09444	41: 7	Whole	< 6.4	2.1	< 4.25[QC:e]

Table B2-115. Tank 241-BX-107 Analytical Results: Decane (VOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-09439	40: 5	Whole	1.9	2.2	2.05
92-09438	40: 7	Whole	2.2	2.2	2.2
92-09440	41: 2	Whole	1.9	1.3	1.6[QC:e]
92-09441	41: 3	Whole	2.5	2	2.25[QC:e]
92-09442	41: 5	Whole	6.9	7	6.95

Table B2-116. Tank 241-BX-107 Analytical Results: Dodecane (VOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-09439	40: 5	Whole	21	32	26.5[QC:e]
92-09438	40: 7	Whole	21	25	23
92-09440	41: 2	Whole	29	29	29
92-09441	41: 3	Whole	47	36	41.5[QC:e]
92-09442	41: 5	Whole	77	63	70
92-09443	41: 6	Whole	< 15	14	< 14.5
92-09444	41: 7	Whole	32	28	30

Table B2-117. Tank 241-BX-107 Analytical Results: Tetradecane (VOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-09439	40: 5	Whole	2	2.1	2.05
92-09438	40: 7	Whole	1.3	3	2.15[QC:e]
92-09440	41: 2	Whole	3.2	5.6	4.4[QC:e]
92-09441	41: 3	Whole	12	7.9	9.95[QC:e]
92-09442	41: 5	Whole	21	17	19[QC:e]
92-09443	41: 6	Whole	< 6	5.8	< 5.9
92-09444	41: 7	Whole	13	12	12.5

Table B2-118. Tank 241-BX-107 Analytical Results: Tridecane (VOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-09439	40: 5	Whole	8.1	15	11.55[QC:e]
92-09438	40: 7	Whole	7.5	13	10.25[QC:e]
92-09440	41: 2	Whole	19	22	20.5
92-09441	41: 3	Whole	37	26	31.5[QC:e]
92-09442	41: 5	Whole	69	48	58.5[QC:e]
92-09443	41: 6	Whole	< 15	16	< 15.5
92-09444	41: 7	Whole	42	38	40

Table B2-119. Tank 241-BX-107 Analytical Results: Undecane (VOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-09439	40: 5	Whole	2.1	2.6	2.35[QC:e]
92-09438	40: 7	Whole	1.9	2.1	2
92-09440	41: 2	Whole	2.2	1.9	2.05
92-09441	41: 3	Whole	3.5	3.2	3.35
92-09442	41: 5	Whole	5.1	5.1	5.1

Table B2-120. Tank 241-BX-107 Analytical Results: Total Extractable Organic Halides (TOX/EOX).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
92-11296	Core 40 Composite	Whole	8.0	9.0	8.5
92-11297		Whole	Not detected	Not detected	---
92-11298	Core 41 Composite	Whole	Not detected	Not deducted	---
92-11299		Whole	Not detected	Not deducted	---

Table B2-121. Tank 241-BX-107 Analytical Results: SVOA Target Analyte CRQLs[1]. (3 sheets)

Target Compound	Greatest CRQL[2] (µg/g)
Acenaphthene	< 12
Acenaphthylene	< 12
Anthracene	< 12
Benzo(a)anthracene	< 12
Benzo(b)fluoranthene	< 12
Benzo(k)fluoranthene	< 12
Benzoic acid	< 58
Benzo(ghi)perylene	< 12
Benzo(a)pyrene	< 12
Benzyl alcohol	< 12
Bis(2-chloroethoxy)methane	< 12
Bis(2-chloroethyl) ether	< 12
Bis(2-chloroisopropyl) ether	< 12
4-Bromophenylphenyl ether	< 12
Butylbenzylphthalate	< 12
4-Chloroaniline	< 12
4-Chloro-3-methylphenol	< 12
2-Chloronaphthalene	< 12

Table B2-121. Tank 241-BX-107 Analytical Results: SVOA Target Analyte CRQLs[1]. (3 sheets)

Target Compound	Greatest CRQL[2] (µg/g)
2-Chlorophenol	< 12
4-Chlorophenylphenyl ether	< 12
Chrysene	< 12
Dibenz[a,h]anthracene	< 12
Dibenzofuran	< 12
Di-n-butylphthalate	< 12
1,2-Dichlorobenzene	< 12
1,3-Dichlorobenzene	< 12
1,4-Dichlorobenzene	< 12
3,3-Dichlorobenzidine	< 23
2,4-Dichlorophenol	< 12
Diethylphthalate	< 12
2,4-Dimethylphenol	< 12
Dimethyl phthalate	< 12
4,6-Dinitro-o-cresol	< 58
2,4-Dinitrophenol	< 58
2,4-Dinitrotoluene	< 12
2,6-Dinitrotoluene	< 12
Di-n-octylphthalate	< 12
Fluoranthene	< 12
Fluorene	< 12
Hexachlorobenzene	< 12
Hexachlorobutadiene	< 12
Hexachlorocyclopentadiene	< 12
Hexachloroethane	< 12
Indeno(1,2,3-cd)pyrene	< 12
Isophorone	< 12
2-Methylphenol	< 12
4-Methylphenol	< 12
Naphthalene	< 12

Table B2-121. Tank 241-BX-107 Analytical Results: SVOA Target Analyte CRQLs[1]. (3 sheets)

Target Compound	Greatest CRQL[2] (µg/g)
2-Nitroaniline	< 58
3-Nitroaniline	< 58
4-Nitroaniline	< 58
Nitrobenzene	< 12
2-Nitrophenol	< 12
4-Nitrophenol	< 58
N-Nitroso-di-n-dipropylamine	< 12
N-Nitrosodiphenylamine	< 12
Pentachlorophenol	< 58
Phenanthrene	< 12
Phenol	< 12
Pyrene	< 12
1,2,4-Trichlorobenzene	< 12
2,4,5-Trichlorophenol	< 58
2,4,6-Trichlorophenol	< 12

Notes:

SVOA = semivolatile organic analysis
CRQL = (USEPA) contract-required quantitation limit

[1]This table lists the target compounds that were analyzed for under the U.S. Environmental Protection Agency's Contract Laboratory Program (CLP) protocol for semivolatile organic compounds. The CLP protocol specifies a minimum Contract Required Quantitation Limit (CRQL). The CRQL is typically greater than the actual method detection limit for the SVOA. However, when a given analyte was not detected above the actual method detection limit, the analyte was reported as being present at less than the CRQL rather than less than the smaller method detection limit. Actual method detection limits for the target analytes were not reported.

[2]The largest CRQL for any given subsample is listed in this column. The less than sign indicates that the target analyte was not detected above the method detection limit; the CRQL value was reported instead of the actual method detection limit.

Table B2-122. Tank 241-BX-107 Analytical Results: VOA Target Analyte CRQLs[1]. (2 sheets)

Target Compound	Greatest CRQL[2] (µg/g)
Acetone	< 26
Benzene	< 3.4
Bromodichloromethane	< 3.4
Bromoform	< 3.4
Bromomethane	< 6.7
2-butanone	< 6.7
Carbon disulfide	< 3.4
Carbon tetrachloride	< 3.4
Chlorobenzene	< 3.4
Chloroethane	< 6.7
Chloroform	< 3.4
Chloromethane	< 6.7
Dibromochloromethane	< 3.4
1,1-Dichloroethane	< 3.4
1,2-Dichloroethane	< 3.4
1,1-Dichloroethene	< 3.4
1,2-Dichloroethylene	< 3.4
1,2-Dichloropropane	< 3.4
cis-1,3-Dichloropropene	< 3.4
trans-1,3-Dichloropropene	< 3.4
Ethylbenzene	< 3.4
2-Hexanone	< 6.7
Hexone	< 6.7
Methylenechloride	< 3.4
Styrene	< 3.4
1,1,2,2-Tetrachloroethane	< 3.4

Table B2-122. Tank 241-BX-107 Analytical Results: VOA Target Analyte CRQLs[1]. (2 sheets)

Target Compound	Greatest CRQL[2] (μg/g)
Tetrachloroethene	< 3.4
Toluene	< 3.4
1,1,1-Trichloroethane	< 3.4
1,1,2-Trichloroethane	< 3.4
Trichloroethene	< 3.4
Vinyl acetate	< 6.7
Vinyl chloride	< 6.7
Xylenes (total)	< 3.4

Notes:

VOA = volatile organic analysis
CRQL = (USEPA) contract-required quantitation limit

[1]This table lists the target compounds that were analyzed for under the U.S. Environmental Protection Agency's Contract Laboratory Program (CLP) protocol for volatile organic compounds. The CLP protocol specifies a minimum Contract Required Quantitation Limit (CRQL). The CRQL is typically greater than the actual method detection limit for the SVOA. However, when a given analyte was not detected above the actual method detection limit, the analyte was reported as being present at less than the CRQL rather than less than the smaller method detection limit. Actual method detection limits for the target analytes were not reported.

[2]The largest CRQL for any given subsample is listed in this column. The less than sign indicates that the target analyte was not detected above the method detection limit; the CRQL value was reported instead of the actual method detection limit.

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS

The purpose of this section is to discuss the overall quality and consistency of the current sampling results for tank 241-BX-107 and to present the results of the calculation of an analytical-based inventory.

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

B3.1 FIELD OBSERVATIONS

Sample recovery was much less than expected because of mechanical failure of the sampler rotary valve during the collection of 5 of 14 segments. However, no segment was resampled, and for the most part, the analyses were performed on composite samples created from the two cores.

B3.2 QUALITY CONTROL ASSESSMENT

The usual QC 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 pertinent quality control tests were conducted on the 1992 core samples, enabling a full assessment regarding the accuracy and precision of the data. The specific criteria for all QC checks are in Hill et al. (1991). Sample and duplicate pairs with one or more QC results outside the specified criteria were identified by subscripts in the data summary tables.

B3.2.1 Assessment of Accuracy

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.

A number of spike recoveries were outside the target level for ^{3}H, ^{14}C, ^{99}Tc, ^{129}I, $^{238,239/240}Pu$, ^{241}Am, and total alpha. The total alpha recovery problems may have been caused by a high dissolved solids content on the sample mount and subsequent self-shielding. Reruns were deemed unnecessary as the sample results were far below the action limit. For the anions, only nitrate and fluoride had recoveries outside the limits. Nearly every metal analyte had at least one standard and/or spike recovery outside the limit. Poor recoveries of iron, manganese, and calcium accompany high preparation blank values. Silver recoveries are commonly low because of AgCl precipitation following addition of HCl. Spike failures for

major elements are frequently caused by a high element concentration in the sample; when the added spike concentration is insignificant compared to the concentration of the element present in the sample, a failure generally occurs.

The ICP analysis following water extraction showed good standard recovery values. Although spike percent recovery results were better than with acid digestion, they still showed anomalies relative to chromium, sodium, phosphorus, sulfur, silicon, calcium, and bismuth. No spike recovery was reported for core 41, composite 2. The ICP analysis following sample fusion showed good standard percent recoveries.

In summary, the majority of the standard recovery and spike recovery QC results were within the specified boundaries. The discrepancies mentioned here and footnoted in the data summary tables should not impact data validity or use.

B3.2.2 Assessment of Precision

The precision is estimated by the RPD, which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times 100. In three of four composites, nearly every metal analyte had at least one RPD outside the limit. For the ICP analysis following water extraction, sample and duplicate readings showed a large concentration span for elements such as barium, calcium, sodium, zinc, and zirconium. For the fusion digest ICP data, sample and duplicate readings showed a large span for 1) cadmium, lead, selenium, and titanium in composite 1 of core 40; 2) cadmium, silver, and zirconium in composite 2 of core 40; and 3) silver in composite 2 of core 40. No data were reported for composite 1 of core 41.

The low fusion concentration results exhibited by calcium are attributed to possible spectral interferences or highly insoluble precipitate/matrix formation. High nickel concentration results following fusion are attributed to sample contamination resulting from the use of nickel-impregnated crucibles.

There was one RPD result outside the limit for TGA. Cyanide and TIC each had two RPDs outside the limit.

The results of all blank analyses were below the detection limits except as follows: at least one analysis from the sample or duplicate were found to be slightly above the detection limit for the following experiments; TOC, TB, IC(F, Cl, NO_3), Cs-137, and ICP (Ca, K, Na, B, Si). However, no blank corrections were needed.

In summary, the majority of precision QC results were within the specified boundaries. The discrepancies mentioned here and footnoted in the data summary tables should not impact data validity or use.

B3.2.3 Analytical Data Validation

The validation of the analytical results from tank 241-BX-107 was performed by Los Alamos Technical Associates, according to standard procedures described in *Sample Management and Administration* (WHC-CM-5-3), Section 2.0 to 2.2. Quality assurance procedures described in Appendix D of Hill et al. (1991) were also applied.

The main objective of the data validation effort is to assess the usefulness and defensibility of the data generated. As mentioned in the narrative section of the tank 241-BX-107 data package, this was accomplished by a detailed examination of the data package to recreate the analytical process and to verify that proper and acceptable analytical techniques were applied. The data package was checked for correct submission of required deliverables, correct data transcriptions from the raw data to the summary forms, and the proper calculation of various parameters.

Data summary tables, including data qualifiers showing data usefulness (unusable, estimate) were consecutively generated. The following major factors were used in the data qualification process:

- Chain-of-custody records
- Holding times
- Instrument calibration
- Calibration verifications
- Analytical blanks
- Preparation blanks
- Interference check sample
- Laboratory control sample
- Duplicate analysis
- Matrix spike or post digestion spike
- Retention time
- Contract required detection limit standard
- Serial dilution
- Surrogate recoveries.

For a validation summary of the analytical results, refer to Addendum 1 of Pool (1993).

Most reported data was qualified as an estimate (UJ or J) or as unreliable (R). The following flaws were found:

- Typical ICP analysis problems, such as elemental and matrix interferences, were encountered. Preparation blank contaminations were reported. Some analyses lacked calibration records.

- Total alpha results were qualified as unreliable because of the lack of a matrix spike (was not required when analysis was performed).

- Americium-241 data was classified unreliable because no energy counts were found for tracer recoveries below the program goal of 50 percent.

- 222-S Laboratory plutonium analysis reports were missing some documentation; therefore, results were classified as estimates.

- Iodine results were classified unreliable because of poor carrier recovery.

- Carbon-14 results were classified as estimates because duplicate RPDs exceeded acceptance criteria.

- 222-S Laboratory uranium analysis results were classified as estimates because of poor precision and missing documentation for internal standard traceability.

For most analyses the analytical chemist was not required to perform additional reruns if the original quality control failure remained after the first rerun.

Discrepancies in the data package results included incorrect reports of exotherms for segment 6 of core 40. Scans for DSC were also missing for the core 41 segments.

B3.3 DATA CONSISTENCY CHECKS

Comparing different analytical methods can help to assess data consistency and quality. Several comparisons were possible with the data set provided by the two core samples. Comparisons were made between total alpha and the sum of the alpha emitters, total beta and the sum of the beta emitters, phosphorus by ICP and phosphate by IC, and sulfur by ICP and sulfate by IC. In addition, mass and charge balances were calculated to help assess 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. Close agreement between the two methods strengthens the credibility of both results, whereas poor agreement brings the reliability of the data into question. Table B3-5 shows all analytical mean results.

The analytical phosphorus mean of samples prepared by fusion digestion and analyzed by ICP was 23,400 μg/g, which represents total phosphorus. This amount of phosphorus converts to 71,700 μg/g of phosphate. In a check of soluble phosphate, samples prepared by water digestion and analyzed by ICP produced a phosphorus mean of 4,790 μg/g, which converts to 14,700 μg/g of phosphate. The water digest ICP result agrees well with the IC phosphate result of 14,200 μg/g. The ICP results indicate there is substantially more insoluble phosphate than soluble phosphate.

The analytical sulfur mean result as determined from ICP water digestion data was 4,430 μg/g, which converts to 13,300 μg/g of sulfate. The ICP result compared well to the IC sulfate mean result of 13,400 μg/g.

Total alpha and total beta were compared to the sum of the alpha and beta emitters in Table B3-1. As shown, the sum of all analyzed alpha emitters accounts for 72.9 percent of the total alpha result, and the sum of beta emitters accounts for 110 percent of the total beta result. Note that the ^{90}Sr activity must be multiplied by 2 to account for its daughter product, ^{90}Y, and the calibration efficiency must be compensated for. These results indicate that the alpha and beta analysis are consistent, and the unreliable validation tag may be unjustified.

Table B3-1. Comparison of Alpha and Beta Emitters with Total Alpha and Total Beta Results.

Analytes for Alpha Comparison	Mean μCi/g	Analytes for Beta Comparison	Mean μCi/g
$^{239/240}$Pu	0.0572	^{137}Cs x 1.51	26.3
^{241}Am	0.013	^{99}Tc	0.0369
---	---	2 x ^{90}Sr x 1.42	28.0
Sum of alpha emitters	0.0702	Sum of beta emitters	51.3
Total alpha activity	0.0963	Total beta activity	46.7

B3.3.2 Mass and Charge Balances

The principle objective in performing mass and charge balances is to determine whether the measurements are self-consistent. In calculating the balances, only Section B3.4 analytes detected at a concentration of 2,000 μg/g or greater were considered.

Table B3-2 shows the cation mass and charge data. Based on ICP water digest data, all aluminum and silicon was assumed to be insoluble and present as $Al_2O_3 \bullet SiO_2$ and AlO(OH). Based on the ICP phosphorus and IC phosphate comparison (see Section B3.3.1), it was determined that approximately 80 percent of the phosphorus existed in an insoluble form. Phosphorus was assumed to be present as the following insoluble compounds: $BiPO_4$, $FePO_4 \bullet 2H_2O$, and Na_3PO_4. The assumption that all aluminum, bismuth, iron, and silicon are present as insoluble compounds was supported by the water digest results. Because precipitates are neutral species, all positive charge was attributed to the sodium portion

existing in soluble form. The anionic analytes listed in Table B3-3 were assumed to be present as sodium salts and were expected to balance the positive charge. The concentrations of cationic species in Table B3-2, the anionic species in Table B3-3, and the percent water were ultimately used to calculate the mass balance in Table B3-4.

Table B3-2. Cation Mass and Charge Data.

Analyte	Concentration	Assumed Species	Concentration of Assumed Species	Charge
	µg/g		µg/g	µeq/g
Aluminum	14,300	AlO(OH)	2,890	0
		$Al_2O_3 \cdot SiO_2$	39,100	
Bismuth	24,200	$BiPO_4$	35,200	0
Iron	11,100	$FePO_4 \cdot 2H_2O$	37,100	0
Sodium	100,000	Na^+	79,900	3,470
		Na_3PO_4	47,900	0
Phosphorus	23,400	Na_3PO_4	See above	0
		$FePO_4 \cdot 2H_2O$		
		$BiPO_4$		
Silicon	6,780	$Al_2O_3 \cdot SiO_2$	See above	0
Total			242,000	3,470

Table B3-3. Cation Mass and Charge Data.

Analyte	Concentration	Assumed Species	Concentration of Assumed Species	Charge
	µg/g		µg/g	µeq/g
Fluoride	9,190	F^-	9,190	484
Nitrate	137,000	NO_3^-	137,000	2,210
Nitrite	8,120	NO_2^-	8,120	177
Phosphate	14,200	PO_4^{3-}	14,200	448
Sulfate	13,400	SO_4^{2-}	13,400	279
Total			182,000	3,600

Table B3-4. Mass Balance Totals.

Totals	Concentrations	
	Mass $\mu g/g$	Charge $\mu eg/g$
Total from Table B3-2	242,000	3,470
Total from Table B3-3	182,000	-3,600
Water %	591,000	0
Grand Total	1,020,000	-130 net charge

The mass balance was calculated from the formula below. The factor of 0.0001 is the conversion factor from $\mu g/g$ to weight percent.

Mass balance = percent Water + 0.0001 x {Total Analyte Concentration}
= percent Water + 0.0001 x $\{AlO(OH) + Al_2O_3 \bullet SiO_2 + BiPO_4 + FePO_4 \bullet 2H_2O + Na_3PO_4 + Na^+ + F^- + NO_3^- + NO_2^- + PO_4^{3-} + SO_4^{2-}\}$

The total analyte concentrations from the above equation is 424,000 $\mu g/g$ (wet weight). The mean weight percent water obtained from thermogravimetric analysis was 59.1 percent, or 591,000 $\mu g/g$. The mass balance resulting from adding the percent water to the total analyte concentration is 102 percent (see Table B3-4).

The following equations demonstrate the derivation of total cations and total anions, and the charge balance is the ratio of these two values. To derive the results shown in the equations, all concentrations must first be converted to a $\mu g/g$ basis.

Total cations ($\mu eq/g$) = $[Na^+]/23.0$ = 3,470 $\mu eq/g$

Total anions ($\mu eq/g$) = $[F^-]/19.0 + [NO_3^-]/62.0 + [NO_2^-]/46.0 + [PO_4^{3-}]/31.7 + [SO_4^{2-}]/48.0$ = 3,600 $\mu eq/g$

The charge balance obtained by dividing the sum of the positive charge by the sum of the negative charge was 0.96.

In summary, the above calculations yield reasonable (close to 1.00 for charge balance and 100 percent for mass balance) mass and charge balance values, indicating the analytical results are generally consistent.

B3.4 MEAN CONCENTRATIONS AND CONFIDENCE INTERVALS

B3.4.1 Mean Concentration Estimates

The statistics in this section were calculated using analytical data from the most recent sampling event of tank 241-BX-107. Analysis of variance (ANOVA) techniques were used to estimate the mean and calculate confidence limits on the mean for all analytes with all values above the detection limit.

The results below are ANOVA estimates based on the data from cores 40 and 41 of tank 241-BX-107. In the laboratory, two core composite samples were formed from homogenized segment samples. For analytes with all values above the detection limit, an estimate of the mean concentration and confidence interval on the mean concentration were calculated.

Table B3-5 gives the upper and lower limits to the 95 percent confidence intervals for analytes detected in tank 241-BX-107. Some analytes had a lower confidence limit less than zero. Because an actual inventory value of less than zero is not possible, the lower limit is reported as zero whenever this occurred.

There was incomplete core recovery from the two core samples (cores 40 and 41) taken from tank 241-BX-107 (see Table B1-1). The average recovery for core 40 and core 41 was 67 percent and 51 percent, respectively.

The incomplete core recovery introduces a potential for a bias in the results given in Table B3-5. If the material recovered is assumed to be a random sample of the waste, then the reported mean analyte concentration values are unbiased estimates of the true concentrations. In addition, the confidence intervals incorporate the "error" caused by incomplete recovery. If the material recovered is not a random sample of the waste, then the results given here are biased. The magnitude of the bias is unknown.

Table B3-5. Tank Concentration From Composite Samples (Units in μg/g Except Radionuclides [μCi/g]). (4 sheets)

Analyte	$\bar{y}$	$\hat{\sigma}(\bar{y})$	df	95% LL	95% UL
AA.As	0.43	0.038	1	0	0.912
AA.Se	1.52	0.752	1	0	1.48
CVAA.Hg	0.565	0.072	1	0	1.48
ICP.a.Al	14,200	2,138	1	0	41,400
ICP.a.B	47.1	8.98	1	0	161
ICP.a.Ba	8.18	1.62	1	0	28.8
ICP.a.Bi	24,200	2,512	1	0	56,100
ICP.a.Ca	1,040	411	1	0	6,260
ICP.a.Ce	178	18.6	1	0	415
ICP.a.Cr	958	92.1	1	0	2,130
ICP.a.Cu	42.8	24.9	1	0	359
ICP.a.Fe	11,000	1,568	1	0	30,900
ICP.a.K	263	31.1	1	0	658
ICP.a.Mg	159	13.5	1	0	330
ICP.a.Mn	39.8	5.4	1	0	108
ICP.a.Na	1.02E+05	856	1	90,700	112,000
ICP.a.Ni[1]	12.2	1.6	1	0	32
ICP.a.P	23,100	2,512	1	0	55,000
ICP.a.Pb[1]	62.8	10.4	1	0	195
ICP.a.S	4,570	315	1	565	8,570
ICP.a.Se[1,2]	336	32.2	1	0	746
ICP.a.Si	1,660	52.3	1	999	2,330
ICP.a.Sn	7.97	1.82	1	0	31.1
ICP.a.Sr	167	10.9	1	28.4	305
ICP.a.Ti [1]	3.86	0.469	1	0	9.81
ICP.a.Zn	59.5	13.7	1	0	234

Table B3-5. Tank Concentration From Composite Samples (Units in μg/g Except Radionuclides [μCi/g]). (4 sheets)

Analyte	$\bar{y}$	$\hat{\sigma}(\bar{y})$	df	95% LL	95% UL
ICP.a.Zr	96.2	4.81	1	35.1	157
ICP.w.Al	134	48.9	1	0	756
ICP.w.B	25	3.27	1	0	66.5
ICP.w.Bi	234	140	1	0	2,020
ICP.w.Ca	434	299	1	0	4,240
ICP.w.Cr	151	6.24	1	72.2	231
ICP.w.Fe	118	70.0	1	0	1,010
ICP.w.K	147	8.59	1	38.3	257
ICP.w.Mg	16.5	8.99	1	0	131
ICP.w.Na	68,100	7,956	1	0	169,000
ICP.w.P	4,790	84.0	1	3,730	5,860
ICP.w.S	4,430	160	1	2,400	6,470
ICP.w.Si	294	95.0	1	0	1,500
ICP.w.Sr[1,2]	2.46	0.851	1	0	13.3
ICP.w.Zn[1,2]	14.3	10.4	1	0	147
ICP.f.Al	14,300	1,371	1	0	31,700
ICP.f.Bi	22,300	2,047	1	0	48,300
ICP.f.Ca[1,2]	396	62.8	1	0	1,190
ICP.f.Cr	968	63.2	1	166	1,770
ICP.f.Cu	51.6	17.8	1	0	278
ICP.f.Fe	11,100	1,122	1	0	25,300
ICP.f.Mg	112	11.5	1	0	259
ICP.f.Mn	64.6	6.0	1	0	140
ICP.f.Na	1.00E+05	1,926	1	75,900	125,000
ICP.f.P	23,400	1,500	1	4,360	42,500
ICP.f.S	4,440	299.83	1	630	8,250

Table B3-5. Tank Concentration From Composite Samples (Units in μg/g Except Radionuclides [μCi/g]). (4 sheets)

Analyte	$\bar{y}$	$\hat{\sigma}(\bar{y})$	df	95% LL	95% UL
ICP.f.Si	6,780	480.62	1	680	12,900
ICP.f.Sr	168	7.20	1	77	260
ICP.f.Va	12.2	3.15	1	0	52.2
ICP.f.Zn [1,2]	83.3	21.6	1	0	358
ICP.f.Zr	136	27.1	1	0	480
Dir.%TGA	59.1	2.81	1	23.5	94.8
Dir.%Water	56.7	0.700	1	47.8	65.6
Dir.CN	2.49	0.385	1	0	7.37
IC.w.F	9,190	726	1	0	18,400
IC.w.Cl	1,140	32.4	1	724	1,550
IC.w.NO3	1.37E+05	9,000	1	22,400	251,000
IC.w.NO2	8,120	2,419	1	0	38,900
IC.w.PO4	14,200	437	1	8,680	19,800
IC.w.SO4	13,400	738	1	3,990	22,700
Spec.w.NO2	12,300	686	1	3,570	21,000
pH	9.71	0.059	1	8.96	10.5
TOC.furnace	798	98.3	1	0	2047
TIC.w.CO3[1,2]	1,160	92.1	1	0	2,330
Fluor.U[1]	4,838	3,075	1	0	43,900
RAD.f.AT.Pu	0.112	2.11E-02	1	0	0.380
RAD.f.AT	0.0963	0.0167	1	0	0.309
RAD.f.TB	46.7	3.73	1	0	94.1
GEA.Cs-137	17.4	5.05	1	0	81.6
Pu-239/240	0.0572	7.82E-03	1	0	0.156
Am-241	0.013	9.66E-04	1	7.00E-04	0.0252
Tc-99	0.0369	3.49E-03	1	0	0.0814

Table B3-5. Tank Concentration From Composite Samples (Units in μg/g Except Radionuclides [μCi/g]). (4 sheets)

Analyte	$\bar{y}$	$\hat{\sigma}(\bar{y})$	df	95% LL	95% UL
Sr-90	9.87	0.766	1	0.146	19.6
H-3 [1,2]	5.80E-04	1.18E-04	1	0	0.00207
C-14 [1,2]	2.60E-04	n/a	1	n/a	n/a

Notes:

LL = lower limit
n/a = not applicable
UL = upper limit

[1]Analytes with a portion of the data below 10 times the detection limit.

[2]Analytes with a portion of the data below 3 times the detection limit.

B3.4.2 ANOVA Model

The statistical model that describes the structure of the core composite data is

$$y_{ijk} = \mu + S_i + C_{ij} + A_{ijk},$$
$$i = 1,\ldots a,\ j = 1,\ldots b_i,\ k = 1,\ldots n_{ij},$$

where

y_{ijk} = laboratory results from the kth duplicate of the jth composite of the ith core from the tank,

μ = the grand mean of all the data,

S_i = the effect of the ith core (spatial effect),

C_{ij} = the effect of the jth composite sample from the ith core,

A_{ijk} = the analytical error associated with the kth duplicate in the jth composite from the ith core,

a = the number of cores,

b_i = the number of composite samples in the ith core, and

n_{ij} = the number of analytical results from the jth composite sample in the ith core.

For cores 40 and 41, there are two core composite samples (that is, $b_i = 2$).

The variables S_i and C_{ij} are random effects. It is assumed that S_i, C_{ij}, and A_{ijk} are each distributed normally with mean zero and variances of $\sigma^2(S)$, $\sigma^2(C)$, and $\sigma^2(A)$, respectively. Estimates of $\sigma^2(S)$, $\sigma^2(C)$, and $\sigma^2(A)$ were obtained using Restricted Maximum Likelihood Estimation (REML). This method, as applied to variance component estimation, is described by Harville (1977).

The mean concentration for each analyte of interest in the tank was calculated using the following equation.

where

$$\bar{y} = \frac{1}{a}\sum_{i=1}^{a}\bar{y}_{i++} = \frac{1}{a}\sum_{i=1}^{a}\frac{\sum_{j=1}^{b_i}\sum_{k=1}^{n_{ij}} y_{ijk}}{n_{i+}} = \frac{1}{a}\sum_{i=1}^{a}$$

This mean gives the results from each core the same weight regardless of the unbalance that may exist for a particular analyte. The variance of $\bar{y}$ is

$$V(\bar{y}) = C_1\sigma^2(S) + C_2\sigma^2(C) + C_3\sigma^2(A)$$

where

$$\bar{y}_{i++} = \frac{\sum_{j=1}^{b_i}\sum_{k=1}^{n_{ij}} y_{ijk}}{n_{i+}} \quad \text{and} \quad n_{i+} = \sum_{j=1}^{b_i} n_{ij}.$$

and

$$C_1 = \frac{1}{a}, \quad C_2 = \frac{1}{a^2}\sum_{i=1}^{a}\left(\frac{1}{n_{i+}}\right)^2\left(\sum_{j=1}^{b_i} n_{ij}^2\right), \quad C_3 = \frac{1}{a^2}\sum_{i=1}^{a}\left(\frac{1}{n_{i+}}\right).$$

Using $\hat{\sigma}^2(S)$, $\hat{\sigma}^2(C)$, and $\hat{\sigma}^2(A)$ (REML variance component estimates), an estimated variance of $\bar{y}$ is

$$\hat{\sigma}^2(\bar{y}) = C_1\hat{\sigma}^2(S) + C_2\hat{\sigma}^2(C) + C_3\hat{\sigma}^2(A).$$

The approximate degrees of freedom used for $\hat{\sigma}^2(\bar{y})$ is the number of cores with data minus one.

The lower and upper 95 percent limits (95 percent LL and 95 percent UL respectively) on the mean concentration are

$$95\%\ LL = \bar{y} - t_{.025}\sqrt{\hat{\sigma}^2(\bar{y})} \quad \text{and} \quad 95\%\ UL = \bar{y} + t_{.025}\sqrt{\hat{\sigma}^2(\bar{y})}$$

where

$t_{0.025}$ is the 0.025 quantile from Student's t-distribution with one degree of freedom ($t_{0.025}=12.706$).

B3.4.2 Inventory Estimates

The total inventory of each analyte based on the core composite data can be calculated using an average density of 1.44 g/mL and a waste volume of 1,310 kL (345 kgal). The calculation is performed by multiplying the concentration estimates given in Table B3-5 by the density and the waste volume, then dividing by 1,000. Radionuclide inventories can be calculated similarly.

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

In Appendix C, the data investigations required for the applicable DQOs for tank 241-BX-107 are documented including statistical and other numerical manipulation. Because the 1992 sampling of tank 241-BX-107 predated DQOs, no DQO was applicable to the sampling event. An effort has been made to apply the current safety screening DQO requirements to the 1992 data set. This requires the computation of a 95 percent confidence interval on the mean for exothermic reactions and total alpha. The UL of a 95 percent confidence interval on the mean for total alpha activity was calculated and compared to the safety screening limit of 42.7 μCi/g. Total alpha activity was measured on two separate core composite samples created from each core. The total alpha activity mean was 0.0963 μCi/g, and the UL of the one-sided 95 percent confidence interval on the mean was 0.202 μCi/g. Because there were no exothermic reactions, calculation of a confidence interval is not necessary.

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BX-107

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BX-107

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various tank waste management activities (Kupfer et al. 1995). As part of this effort, an evaluation of the chemical information for tank 241-BX-107 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Appendix B of this TCR provides characterization results from the most recent sampling event for this tank. Two core samples were obtained and analyzed. Component inventories can be calculated by multiplying the concentration of an analyte by the current tank volume and by the density of the waste. Sample-based inventories and tank content estimates listed in Tables D2-1 and D2-2 of this report are from Appendix B data and the HDW model. The HDW model document (Agnew et al. 1996) provides tank content estimates in terms of component concentrations and inventories. The HDW model and this evaluation use the same waste volume reported by Hanlon (1996).

D2.0 EVALUATION OF COMPONENT INVENTORY VALUES

Sample-based inventories, derived from analytical concentration data, and HDW model inventories, are compared in Tables D2-1, D2-2 and D2-3. The tank volume used to generate these inventories is 1,300 kL (344 kgal) sludge (Hanlon 1996). Hanlon also includes 4 kL (1 kgal) of supernate which was not treated separately in these calculations. The amount that may be in the supernate is not significant in determining the tank inventories. The mean sludge density, that which includes interstitial liquid, used to calculate the sample-based component inventories is 1.44 g/mL from analytical analysis (see Table B2-3). The HDW model density for the sludge and total waste is estimated to be 1.25 g/mL (approximately 13 percent less than the measured density). Note the significant differences between the sample-based and HDW model inventories for several of the bulk components, for example, bismuth, fluoride, sodium, nitrate, sulfate, and silicon.

Table D2-1 Summary of 1992 Analytical Data and Method Comparison.
(2 sheets)

ICP RESULTS				Representative Value (μg/g)
	Preparation Method			
Analyte	Acid	Water	Fusion	
Al	14,200	134	14,300	14,300
B	47.1	25		47.1
Ba	8.18			8.18
Bi	24,200	234	22,300	22,300
Ca	1,040	434	396	396
Ce	178			178
Cr	958	151	968	968
Cu	42.8		51.6	51.6
Fe	11,000	118	11,100	11,100
K	263	147		263
Mg	159	16.5	112	159
Mn	39.8		64.6	64.6
Na	1.02E+05	68,100	1.00E+05	102,000
Ni	12.2			12.2
P	23,100	4,790	23,400	23,400
Pb[1]	62.8			62.8
S	4,570	4,430	4,440	4,570
Sb		37		37
Se	336			336
Si	1,660	294	6,780	6,780
Sn	7.96			7.96
Sr	167	2.46	168	168
Ti	3.86			3.86
Va			12.2	12.2
Zn	59.5	14.3	83.3	83.3
Zr	96.2		136	136

Table D2-1 Summary of 1992 Analytical Data and Method Comparison.
(2 sheets)

ICP RESULTS	Representative Value (μg/g)
Analyte	
GHAA.As	0.43
CVAA.Hg	0.565
GHAA.Se	1.52
CN	2.49
IC.F	9,190
IC.Cl	1,140
IC.NO3	137,000
IC.NO2	8,120
IC.PO4	14,200
IC.SO4	13,400
Spec.NO2	12,300
TOC	798
TIC.CO3[1,2]	1,160
Fluor.U[1]	4,838
Radionuclides	μCi/g
RAD.f.AT	0.0963
RAD.f.TB	46.7
GEA.Cs-137	17.4
Pu-239/240	0.0572
Am-241	0.013
Tc-99	0.0369
Sr-90	9.87
H-3 [1,2]	5.80E-04
C-14 [1,2]	2.60E-04
%TGA	59.1
%Water	56.7

Table D2-2. Sample-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components.

Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)	Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)
Al	26,900	21,900	Mg	299	n/r
Ag	12	n/r	Mn	121	.57
As	0.8	n/r	Na	192,000	131,000
Ba	15	n/r	NH_4	n/r	8.3
Be	3	n/r	Ni	23	94
Bi	41,900	17,500	NO_2	15,300	12,400
Ca	745	3,340	NO_3	258,000	31,000
Ce	335	n/r	OH	n/r	62,800
Cd	8	n/r	oxalate	n/r	5.00E-04
Cl	2,140	660	Pb	118	9.80E-02
Co	13	n/r	P as PO_4	135,000	143,000
Cr	1,820	n/r	Si	12,800	2,130
Cr^{+3}	n/r	274	S as SO_4	25,000	5,950
Cr^{+6}	n/r	n/r	Sr	316	2.00E-04
Cs	n/r	n/r	TIC as CO_3	2,180	5,050
Cu	97	n/r	TOC	1,500	n/r
F	17,300[3]	4,340	U_{TOTAL}	9,100	187
Fe	20,900	19,500	Zr	256	1,070
Hg	1	22.9	H_2O (Wt%)	56	72.1
K	495	159	density (kg/L)	1.44	1.25
La	15	9.00E-04			

Notes:

n/r = not reported

[1]Appendix B.
[2]Agnew et al. (1996)
[3]Fluoride based on water soluble portion only

Table D2-3. Sampling and Predicted Inventory Estimates for Radioactive Components.

Analyte	Sampling[a] Inventory Estimate (Ci)	HDW[b] Inventory Estimate (Ci)	Analyte	Sampling[a] Inventory Estimate (Ci)	HDW[b] Inventory Estimate (Ci)
^{14}C	0.489	n/r	$^{239/240}Pu$	108	17.1
^{90}Sr	18,600	24,500	^{241}Am	24.4	n/r
^{99}Tc	69.4	425	^{137}Cs	32,700	24,500

Notes:

n/r = not reported

[1]See Appendix B
[2]Agnew et al. (1996)

D2.1 CONTRIBUTING WASTE TYPES

Appendix A Section 3.0 contains a process history of tank 241-BX-107. The following indicates the information sources and expected waste types derived from the process history.

Waste volumes (kgal) (Agnew et al. 1996): 1C1 and 1C2 344 kgal
(Hill et al. 1995): 1C, TBP, CW and IX

In the bismuth phosphate process, the 1C waste stream was neutralized with aluminum cladding waste. This neutralized waste stream, which contains approximately seven percent cladding waste, also is commonly referred to as 1C. The tank also received a TBP (or UR) waste stream and ion exchange waste. The ion exchange waste does not seem to provide much of the waste inventory and is not included in the calculations. The waste transfer records show that tank 241-BX-107 was the first tank in a cascade that received neutralized TBP waste directly from the processing plant. Because it was the first tank to receive the waste after the processing plant, it is logical to expect that the precipitated components from the TBP waste stream would settle out in 241-BX-107. Analytical uranium results show a tank average of 4,838 μg/g. One composite sample analysis contributed significantly to this average. This one sample (primary, duplicate pair) had an average of 24,050 μg/g. The tank average would have been approximately 2,130 μg/g if this sample would have had results similar to the others. The uranium analytical results seem to support this assumption and agree with the designation in Hill et al. (1995) that TBP is a secondary waste type in this tank.

D2.2 EXPECTED WASTE COMPOSITION

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.

Table D2-4 provides technical flowsheet information for 1C/cladding waste and TBP streams. The comparative Los Alamos National Laboratory defined waste streams also are in this table.

Table D2-4. Technical Flowsheet and Hanford Defined Waste Streams.

Analyte	Flowsheet 1C/CW[1] (*M*)	Flowsheet TBP[1] (*M*)	HDW[2] 1C/CW (*M*)	HDW[2] TBP (*M*)
Al	0.0826	n/r	0.233	n/r
Bi	0.0115	n/r	0.014	n/r
Fe	0.0315	0.03	0.046	0.046
Cr	0.00306	n/r	0.0052	0.0032
F	0.170	n/r	0.228	n/r
Si	0.0312	n/r	0.038	0.1416
U	9.63E-04	0.0061	7.67E-04	0.0078
Zr	2.96E-04	n/r	0.004	n/r
Na	2.17	8.87	2.24	4.50678
NO_3	1.44	7.35	0.588	3.40208
PO_4	0.258	0.3	0.326	0.13
SO_4	0.0631	0.31	0.0616	0.1416
NO_2	0.0577	n/r	0.174	n/r

Notes:

n/r = not reported

[1]Hill et al. (1995) for TBP and Appendix C of Kupfer et al. (1996) for 1C/cladding waste
[2]Agnew et al. (1996)

D2.2.1 Assumptions for Reconciling Waste Inventories

Reference inventories for certain components in tank 241-BX-107 were estimated using an engineering assessment that is based on a set of simplified assumptions. The inventories were compared to tank 241-BX-107 sample-based inventories and HDW model inventories. The assumptions and observations for the engineering assessment were based on best technical judgment pertaining to parameters that can significantly influence tank inventories. These parameters include: 1) correct prediction of contributing waste type and correct relative proportions of the waste types, 2) accurate description of model flowsheet conditions, fuel processed, and waste volumes, 3) accurate description of partitioning of components, 4) accurate predictions of physical parameters such as density, percent solids, void fraction (porosity), etc. By using this evaluation the assumptions can be modified to provide a basis for identifying potential errors and/or missing information that could influence the sampling and model based inventories. The following are the simplified assumptions and observations that were used for the evaluation.

1. In addition to the analytical data for tank 241-BX-107, tank 241-T-104 which contains only the 1C waste type, helped provide the analytical basis for estimating the inventory in tank 241-BX-107.

2. Components listed in the technical flowsheets that summarized in Appendix C and Table D2-4 report were used for the evaluation.

3. Tank waste mass is calculated using the tank volume listed in Hanlon (1996). Both the analytical based and the model-based inventories use equivalent volumes of 1,302 kL (344 kgal) solids and 3.8 kL (1 kgal) supernatant. As a result, inventory comparisons are made on the same volume basis.

4. All Bi, Fe, Si, Ce, and U precipitate as water insoluble components. These assumptions are based on the known chemistry of the components in alkaline solutions. Chromium was assumed to precipitate because it was added as CrIII in the $BiPO_4$ process and would be expected to precipitate as $Cr(OH)_3$ or $Cr_2O_3 \bullet XH_2O$ in alkaline media. The HDW model predicts varying solubilities for these components.

5. Na, NO_3, NO_2, SO_4, Al, and F are assumed to partition between the liquid and solid phases based on known chemical solubilities and properties of compounds in alkaline solutions.

6. No radiolysis of NO_3 to NO_2 and no additions of NO_2 to the waste for corrosion purposes are factored into this independent assessment.

D2.2.2 Solids Concentration Factor and Partition Factors for First Cycle Bismuth Phosphate and TBP Waste in Tank 241-BX-107

One method for estimating a component inventory for a particular waste type in a tank (for example, 1C waste) is to derive a concentration factor (CF) for the individual component. This approach was used to estimate inventories in tank 241-BX-107. The CF is derived by dividing the concentration of a component found in tank samples by the concentration of that component in the neutralized process waste stream (that is, flowsheet concentrations in Table D2-4). The CF for components of a defined waste are best determined if the tank contains only one waste type (for example, only 1C waste in tank 241-T-104). The approach also works best when abundant representative analytical data are available.

Components that are expected to precipitate 100 percent based on chemical knowledge and are expected to be fully retained in the waste should exhibit nearly the same CFs. If this is the case, it generally can be concluded the sample data are consistent with the flowsheet basis and are quite representative of the tank contents. Because the intank concentration of a component for a given waste type should be consistent in different tanks, the concentration from a tank that has been shown to be that same waste type can be used to estimate the inventory for a tank for which samples have not been taken.

It was noted in assumption 4 that this evaluation assumes Bi as well as Fe, Si, U, Ce, Zr, and Cr precipitate nearly 100 percent from the neutralized waste. The assumption for Bi is based on sludge and supernatant analysis performed on typical Hanford Site tank wastes and is consistent with known chemistry for $BiPO_4$ and for Bi in alkaline solutions. The procedure below is used to calculate the CF for Bi in tank 241-BX-107. Because Bi appears in the 1C/cladding waste flowsheet and not the TBP, it gives a CF for the 1C waste. Based on the average concentration of 22,300 μg/g (see Table D3-5), the analytical based inventory for Bi is 41,800 kg. Given that the flowsheet concentration for Bi in 1C waste is 0.0115 moles/L (see Table D2-4) and assuming that all 1,310 kL (345 kgal) solids are 1C waste.

$$0.0115 \text{ moles Bi/L}_{1C} \times 345 \text{ kgal} \times 3{,}785 \text{ L/kgal} \times 209 \text{ g Bi/mole} \times \text{kg} / 1.0\text{E}+03 \text{ g} \times \text{CF} = 41{,}900 \text{ kg}$$

$$\text{or } 3{,}139 \text{ kg} \times \text{CF} = 41{,}900 \text{ kg}$$

$$\text{CF} = 13.4$$

A comparable calculation for Bi in tank 241-T-104, which contains only 1C waste, results in a CF of 9.5. With the exception of Fe and U, the CFs for other components expected to fully precipitate from 1C waste are approximately 9 to 12 for tanks 241-T-104 and 241-BX-112. These variations may be attributed to differences between B Plant and T Plant waste. Table D2-5 shows the CFs calculated for 241-BX-107 assuming all the waste is 1C waste.

Table D2-5. Concentration Factors for 241-BX-107 Assuming All the Waste is 1C Waste.

Analyte	Concentration Factor	Analyte	Concentration Factor
Al	9	Zr	7
Bi	13	Na	3
Fe	9	NO3	2
Cr	9	PO4	4
F	4	SO4	3
Si	11	NO2	4
U	30		

The variation for precipitated components is 9 to 30. With the exception of Fe and especially U these agree with 241-T-104 and 241-BX-112. The high CF for Fe and U both components of the TBP waste stream indicate TBP waste is present in the tank as suggested from the transfer records.

Difficulty arises when attempting to determine the amount of TBP waste. Silicon is a component that is expected to precipitate 100 percent and is only shown in the 1C flowsheet. Using the Bi CF of 13 and the sample based inventory for silicon, the volume of 1C waste can be calculated to be 1124 kL (297 kgal), indicating 178 kL (47 kgal) of TBP waste is also present.

If Cr or Zr are used, smaller volumes of 1C waste are estimated. A CF for TBP waste for U and Fe can be calculated from the data for tank 241-TY-105 (Colton 1995) which is believed to contain only TBP waste. The CFs are 5.7 for U and 19.1 for Fe indicating that the uranium does not fully precipitate in TBP wastes.

If it is assumed that tank 241-T-104 represents 1C waste and that the 1C waste layer in tank 241-BX-107 has the same concentrations of Fe and U, the CFs for the 1C and TBP layers in tank 241-BX-107 can be calculated. This is done by base calculating a TBP layer volume. The uranium inventory of the 1C layer is then calculated and subtracted from the tank uranium inventory. The remaining uranium is used to calculate a CF.

The volume of the TBP layer is adjusted until the CF for the uranium is approximately the same as the uranium CF for tank 241-TY-105. The concentration factors for iron for the two layers are calculated using the volumes of the respective layers and the Fe concentration for the 1C layer from tank 241-T-104. The resulting CFs for the 1C layer for U and Fe are 5.6 and 7.2 respectively. These values agree well with those determined for U and Fe in tanks 241-T-104 and 241-BX-112. The CF for Fe in the TBP layer is calculated to be 14.3,

and this agrees with the CF of 19.1 calculated for the TBP in tank 241-TY-105. This analysis further indicates the presence of TBP waste in tank 241-BX-107. However, performing this analysis results in a concentration factor for Bi in the 1C layer of 19 which does not agree with tanks 241-T-104 and 241-BX-112.

Once the CFs for fully precipitated components for a waste type are determined, the sample analysis can be used to establish how components such as SO_4 or PO_4 partition between solids and supernatants. For example, if the CF for Bi is determined to be 9.5, and the CF for PO_4 is 3.2, it can then be concluded that 34 percent of the PO_4 in the neutralized process waste partitions to the waste solids (that is,the PF is 0.34).

Because it is not possible to unambiguously separate the 1C and TBP layers, it is not possible to calculate partition factors (PF) for the two types of waste in tank 241-BX-107. If it is assumed that the tank has only 1C waste and the CF is 13, then the estimated PFs for 1C components based on tank 241-BX-107 are as follows:

Na: 0.23, Al: 0.71 SO_4: 0.25 PO_4: 0.33 F: 0.32
NO_3: 0.17 NO_2: 0.34

In general, these PFs are comparable to those found in tank 241-T-104 and tank 241-BX-112. It is again observed that both Fe and U apparently partition between solids and supernatant.

This is substantiated by the following:

- CFs for components in tank 241-BX-107 that are expected to fully precipitate are consistent and indicate that the sample probably represents a waste that is mostly 1C with some TBP. Comparable CFs were obtained from tanks 241-T-104, 241-BX-112, and 241-TY-105.

- PFs for components expected to partition are generally comparable to those obtained for tanks 241-T-104 and 241-BX-112.

- The PFs indicate partitioning of components based on experience and knowledge of the typical chemical behavior of components in alkaline media.

D2.2.3 Inventory of Components Assumed to Precipitate 100 Percent

The following calculations provide rounded estimates of tank 241-BX-107 inventories for components assumed to precipitate 100 percent based on a Bi CF of 13 and assuming 1C waste is in the tank.

Fe: 0.032 moles Fe/L_{1C} x $13_{CF(1C)}$ x 345 kgal x 3,785 L/gal x 55.85 g/mole Fe x kg/1E+03 g = 30,800 kg

Similarly

Si: 15,300 kg
Zr: 472 kg
U: 4,010 kg
Cr: 2,780 kg

Estimated inventories from this evaluation for components assumed to fully precipitate are compared with sample and HDW model based inventories in Table D2-5. Observations regarding these inventories are provided by component in the following text. Sample-based and HDW model inventories for other components assumed to partition are compared in Table D2-5. Observations regarding these inventories are also provided.

Table D2-6. Comparison of Selected Component Inventory Estimates for Tank 241-BX-107 Waste.

Component	This Evaluation (kg)[1]	Sample-Based (kg)	HDW Estimated (kg)
Bi	42,100	41,900	17,500
Cr	2,780	1,820	274
Si	15,300	12,000	2,130
Fe	30,800	20,900	19,500
U	4,010	9,100	187
Zr	472	256	1,070

Note:
[1]Based on assumptions defined in Section 1.0 and calculations in Section D2.2.1.

Bismuth. The Bi inventory based on core sample data exceeds by two times that predicted by the HDW model. The 1C defined waste from the HDW model does not differ significantly from the 1C flowsheet basis in Table D2-4. Although the HDW model assumes only 73 percent of the Bi in the 1C waste stream precipitates, this does not account for all the discrepancy. The CFs for other components that are expected to fully precipitate are consistent with that for Bi, which indicates that the sample represents the waste produced by the $BiPO_4$ process 1C flowsheet. The sample based inventory is considered the best basis for Bi.

Chromium. This inventory assessment predicts the total Cr content to be close to that based on sample analysis. However, these values are approximately seven times higher than that predicted by the HDW model. The HDW model assumes that none of the Cr precipitated in the 1C stream (that is, the only Cr contribution to the solids is from the interstitial liquids associated with the solids). Additionally, because the Cr was added primarily as CrIII in the Bi PO_4 process, it is expected the majority of the Cr will precipitate as $Cr(OH)_3$ or $Cr_2O_3 \bullet XH_2O$.

Iron. The Fe inventory predicted by this assessment is approximately 45 percent higher than the sample-based inventory. This assessment assumed Fe would fully precipitate; however, some partitioning is likely by loss as fine particles or (less likely) approximately 30 percent of the Fe is soluble. The sample-based inventory is therefore considered the best basis. The HDW model inventory is approximately the same as that for the sample-based inventory. The HDW assumes that approximately 96 percent of Fe precipitates.

Aluminum. The sample-based inventory and HDW model estimates are comparable. The sample-based inventory for tank 241-BX-112 indicates that all the Al partitions to the solids. The HDW model also assumes that all the Al precipitates. It is not surprising that most Al in 1C waste would partition to the solids. Historical evidence suggests that wastes from the $BiPO_4$ process were made alkaline to an approximate pH of only 9 which would promote precipitation of the metal hydroxide. If the waste was neutralized to a higher pH (for example, 12), the dissolution of the hydroxide with conversion to soluble sodium aluminate would be significant.

Sodium. Based on the sample analysis of tank 241-BX-107, approximately 23 percent of the Na partitions to the solids. This is somewhat higher than observed for tank 241-T-104 which also contains 1C waste.

Silicon. The Si inventory predicted by this assessment is slightly more than the sample-based inventory. The Si inventory was estimated based on the CF for Bi. As previously mentioned, the CFs for components expected to fully precipitate should be approximately the same if the samples represent the waste results from the 1C $BiPO_4$ process. It is concluded in the assessment that the sample-based inventory is close to the predicted inventory. The HDW model-based inventory is significantly lower than the sample-based inventory. The apparent explanation is that this assessment assumes all Si precipitates, and the HDW model assumes that approximately 10 percent of the Si precipitates.

Fluoride. The sample-based inventory for F is approximately four times higher than the HDW model inventory. The analytical data show that a major portion of the F is partitioned to the solids. This is consistent with analyses for tank 241-T-104. The HDW model assumes that no F precipitates with the solids although some remains with the interstitial liquid associated with the solids.

Uranium. The U inventory predicted by this assessment is considerably lower than the sample based inventory. As stated previously, it is concluded that some of the U is from TBP waste that was added to this tank. The sample-based inventory is approximately 49 times higher than the HDW model based inventory. The HDW model assumes that no TBP waste is in 241-BX-107 and that no U precipitates but that some is associated with the solids in the interstitial liquid.

Nitrate. The sample-based inventory is approximately 8 times higher than that predicted by the HDW model. The sample analysis for tank 241-BX-107 shows the same fraction of Na and NO^3 partitioning to the waste solids as tank 241-BX-112 but are larger than tank 241-T-104 which also contains 1C waste. For tank 241-BX-112, this was concluded to indicate that some B saltcake is present in tank 241-BX-112 as predicted by the HDW model. However, waste transfer records do not indicate saltcake additions. Perhaps this indicates ion exchange waste which may have passed through tank 241-BX-107. It is surprising that the analytical-based inventory for NO_3 is eight times higher than predicted by the HDW model.

Nitrite. The sample-based inventory for NO_2 is slightly higher than that predicted by the HDW model. The sample-based inventory indicates about 34 percent of the NO_2 added in the 1C $BiPO_4$ process partitioned to the solids. This is expected based on the high solubility of NO_2 in the alkaline solutions. However, it does not agree with tank 241-BX-112 data for 1C waste.

Phosphate. The sample-based inventory for PO_4 is within 10 percent of that predicted by the HDW model. Analytical data indicate that some PO_4 is 1C waste which partitions to the solids. The HDW model assumes that much of the PO_4 partitions.

Sulfate. The HDW model-based inventory is smaller than that based on the samples. The sample-based inventory for SO_4 indicates that some SO_4 is 1C waste which partitions to the solids. The HDW model predicts that all SO_4 will remain soluble and will be present only in the interstitial liquids associated with the solids.

D3.0 BEST-BASIS COMPONENT INVENTORIES

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessments 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, processes, 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 the results of sample

analyses, 2) component inventories are predicted 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 the standard characterization for waste management activities. As part of this effort, an evaluation of available chemical information for 241-BX-107 was performed, including the following:

- Data from two push mode 1992 core samples (Appendix B)
- An inventory estimate generated by the HDW model (Agnew et al. 1996)
- Evaluation of the 1C/cladding and TBP flowsheets (Schneider 1951).

Based on this evaluation, a best-basis inventory was developed. In general, the sample-based analytical results were preferred because they were reasonable and consistent with other results. The sample-based inventory was determined using the tank volume, a density of 1.44, and the mean concentration values given in Table B3-5. The Hg content came from values in Table B2-3, La from Table B2-28, and TOC from Table B2-99.

The best-basis inventory for tank 241-BX-107 is presented in Tables D3-1 and D3-2.

Table D3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BX-107. (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	26,900	S	
Ag	12	S	
As	.8	S	
Ba	15	S	
Be	3	S	
Bi	41,900	S	
Ca	745	S	
Ce	335	S	
Cd	8	S	
Cl	2,140	S	
Co	13	S	

Table D3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BX-107. (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
TIC as CO_3	2,180	S	
Cr	1,820	S	
Cu	97	S	
F	17,300	S	
Fe	20,900	S	
Hg	1.0	S	
K	495	S	
La	15	S	
Mg	299	S	
Mn	121	S	
Na	192,000	S	
Ni	23	S	
NO_2	15,300	S	
NO_3	258,000	S	
OH	n/r		
Pb	118	S	
P as PO_4	135,000	S	
Si	12,800	S	
S as SO_4	25,000	S	
Sr	316	S	
TOC	1,500	S	
U_{TOTAL}	9,100	S	
Zr	256	S	

Note:

n/r = not reported

[1]S = Based on 1992 core sample data (see Appendix B), M = HDW model-based, E = Engineering assessment-based

Table D3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BX-107.

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	1.09	S	
^{14}C	0.489	S	
^{90}Sr	18,600	S	
^{99}Tc	69.4	S	
^{137}Cs	32,700	S	
^{238}U	1.4	S	
^{239}Pu	108	S	
^{241}Am	24.4	S	

Note:

[1]S = Based on 1992 core sample data (see Appendix B), M = HDW model-based, E = Engineering assessment-based

D4.0 APPENDIX D REFERENCES

Agnew, S. F., J. Boyer, R. Corbin, T. Duran, J. FitzPatrick, K. Jurgensen, T. Ortiz, and B. Young, 1996, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 3*, Draft, March 5, 1996, Los Alamos National Laboratory, Los Alamos, New Mexico.

Colton, N. G., 1995, *Sludge Pretreatment Chemistry Evaluation: Enhanced Sludge Washing Separation Factors*, PNL-10512, Pacifica Nothwest Laboratory, Richland, Washington.

Hanlon, B. M., 1996, *Waste Tank Summary Report for Month Ending August 31, 1996*, WHC-EP-0182-101, Westinghouse Hanford Company, Richland, Washington.

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.

Kupfer, M. J., M. D. LeClair, W. W. Schulz, and L. W. Shelton, 1995, *Work Plan for Defining a Standard Inventory Estimate for Wastes Stored in Hanford Site Underground Tanks*, WHC-SD-WM-WP-311, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Kupfer, M. J., et al., July 1, 1996, *Interim Report: Best-Basis Inventories of Chemicals and Radionuclides in Hanford Site Tank Waste*, WHC-SD-WM-TI-740, Rev. D-Draft, Westinghouse Hanford Company, Richland, Washington.

Schneider, K. J., 1951, *Flow Sheets and Flow Diagrams of Precipitation Separation Processes*, HW-23043, General Electric Company, Richland, Washington.

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-BX-107

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-BX-107

Appendix E is a bibliography that supports the characterization of tank 241-BX-107. This bibliography represents an in-depth literature search of all known information sources that provide sampling, analysis, surveillance, and modeling information, and processing occurrences associated with tank 241-BX-107 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

- IIa. Sampling of Tank 241-BX-107 Waste and Waste Types
- IIb. Sampling and Analysis of 1C/TBP Waste

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

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

This bibliography is broken into appropriate sections of material, with an annotation at the end of each reference describing the information source. Where possible, a reference is provided for information sources. A majority of the information listed below is in the Lockheed Martin Hanford Corporation Tank Characterization 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, 1990, Westinghouse Hanford Company, Richland, Washington.

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

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

- Provides a model based on process knowledge and radioactive decay estimations using ORIGEN for different compositions of process waste streams assembled for total, solution, and solids compositions by tank. Also provides assumptions about waste/waste types and solubility parameters/constraints.

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

- Contains compositions of process stream waste before its transfer to 200 Area waste tanks.

Ib. Fill History/Waste Transfer Records

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1996, *Waste Status and Transaction Record Summary for the Northeast Quadrant*, WHC-SD-WM-TI-615, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Contains spreadsheets showing data on tank additions/transfers for the Northeast quadrant.

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

- Contains single-shell tank fill history 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-RE-TI-053, Rev. 9, Westinghouse Hanford Company, Richland, Washington.

- Shows tank riser locations in relation to tank aerial view and a description of 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.

- Assesses riser locations for each tank; however not all tanks are included/completed. Also includes an estimate of which risers are available for sampling.

Leach, C. E. and S. M. Stahl, 1993, *Hanford Site Tank Farm Facilities Interim Safety Basis Volume I and II*, WHC-SD-WM-ISB-001, Rev. 0-L, Westinghouse Hanford Company, Richland, Washington.

- Provides a ready reference to the tank farms safety envelope.

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

- Compiles information on thermocouples and status for Hanford Site waste tanks.

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

- Describes the nature, scope, and frequency of surveillance employed for waste storage tanks, states action criteria for response to data deviations, and provides tank data reviews between June 15, 1973, and June 15, 1988.

Id. Sample Planning/Tank Prioritization

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

- Summarizes the technical basis for characterizing tank waste and assigns a priority number to each tank.

Defense Operations Division, 1990, *Sample Management and Administration*, WHC-CM-5-3, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Provides guidelines for performing data validation of samples in accordance with the *Resource Conservation and Recovery Act* requirements.

Hill, J. G., W. I. Winters, B. C. Simpson, J. W. Buck, P. J. Chamberlain, and V. L. Hunter, September 1991, *Waste Characterization Plan for the Hanford Site Single-Shell Tanks*, WHC-EP-0210, Rev. 3, Westinghouse Hanford Company, Richland, Washington.

- Characterization planning document. Includes test plan for sampling and analysis of tank 241-BX-107, etc.

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

- Characterization planning document. Provides sampling and analysis plans for tank characterization.

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 determines whether tanks are under safe operating conditions.

Kupfer, M. J., W. W. Schultz, G. L. Borsheim, S. J. Eberlein, B. C. Simpson, and J. T. Slankas, 1994, *Strategy for Sampling Hanford Site Tank Wastes for Development of Disposal Technology*, WHC-SD-WM-TA-154, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Provides basis for selecting tanks for disposal needs.

II. ANALYTICAL DATA

IIa. Sampling of Tank Waste and Waste Types

Bratzel, D. R., 1980, *Evaluation of Waste Storage Tank and Chemical Characterization Data*, (internal memo 65453-80-255 to F. M. Jungfleisch, September 18), Rockwell Hanford Operations, Richland, Washington.

- Summarizes data on 12 tanks including tank 241-BX-107.

Evans, J. C., B. L. Thomas, K. N. Pool, K. B. Olsen, J. S. Fruchter, and K. L. Silvers, 1996, *Headspace Vapor Characterization of Hanford Waste Tank 241-BX-107: Results from Samples Collected on 11/17/95*, PNNL-11158, Pacific Northwest National Laboratory, Richland, Washington.

- Provides results of vapor sample analysis.

Hill, L. R., 1979, *Statistical Analysis of 107-BX Core Segments*, (internal memo 65440-79-132 to D. J. Flesher, May 15), Rockwell Hanford Operations, Richland, Washington.

- Provides radiological data on three core segments to find consistent relationship.

Horton, J. E., 1979, *Chemical and Physical Characterization of Tank 107-BX*, (internal letter 65120-79-115J to D. J. Flesher, July 25) Rockwell Hanford Operations, Richland, Washington.

- Reports analytical data of sludge samples from the 1979 core sampling event.

Horton, J. E., 1979, *Status of Core Segments from Tank 107-BX*, (internal memo 65120-79-080J to G. W. Grimes, May 2) Rockwell Hanford Operations, Richland, Washington.

- Provides results of early core analysis.

Keele, R. H., 1992, *The Radiological Characterization of BX-107 & C-110 Core Segments*, (internal memo 12240-SAS92-059 to B. C. Simpson, August 11), Westinghouse Hanford Company, Richland, Washington.

- Provides information about the gamma scanning experiment.

Pool, K. N., 1994, *Single-Shell Tank Waste Characterization 241-BX-107 Cores 40 and 41*, WHC-SD-WM-DP-028, Rev. 0-C, Westinghouse Hanford Company, Richland, Washington.

- Summarizes information on the historical uses, status, and the sampling and analysis results of waste stored in this tank.

Remund, K. P., and L. Jensen, 1994, *Statistical Characterization Report for Single-Shell Tank 241-BX-107*, WHC-SD-WM-TI-603, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Statistical analysis of data from 1992 core sampling.

Wheeler, R. E., 1974, *Analysis of Tank Farm Samples, Sample: T-5921 107-BX*, (internal letter to R. L. Walser, November 20) Atlantic Richfield Company, Richland, Washington.

- Reports analytical data of liquid samples from the 1974 grab sampling event.

Weiss, R. L., 1990, *Analysis of Six Supernate Samples from 241-BX Tank Farm*, (internal letter to V. C. Boyles, March 16) Westinghouse Hanford Company, Richland, Washington.

- Reports analytical data of liquid samples from the 1990 grab sampling event.

IIb. Sampling and Analysis of 1C/TBP Waste

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

Brevick, C. H., R. L. Newell, and J. W. Funk, 1996, *Supporting Document for the Historical Tank Content Estimate for BX Tank Farm*, WHC-SD-WM-ER-311, Rev. 1A, Westinghouse Hanford Company, Richland, Washington.

- Contains tank farm description, tank historical summary, level history, and surveillance graphs, in-tank photographs, and waste inventory information.

Kelly, S. E., L. C. Amato, and T. T. Tran, 1995, *Tank Characterization Report for Single-Shell Tank 241-BX-108*, WHC-SD-WM-ER-407, Rev. 0B, Westinghouse Hanford Company, Richland, Washington.

- Summarizes information on the historical uses, status, and the sampling and analysis results of waste stored in this tank.

Simpson, B. C., J. G. Field, and R. D. Schreiber, 1996, *Tank Characterization Report for Single-Shell Tank 241-BX-109*, WHC-SD-WM-ER-572, Rev. 0-A, Westinghouse Hanford Company, Richland, Washington.

- Summarizes information on the historical uses, status, and the sampling and analysis results of waste stored in this tank.

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

IIIa. Inventories from Campaign and Analytical Information

Agnew, S. F., J. Boyer, R. Corbin, T. Duran, J. FitzPatrick, K. Jurgensen, T. Ortiz, B. Young, 1996, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 3*, LA-UR-96-858, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- 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.

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

- Contains major components for waste types and some assumptions. Purchasing records are used to estimate chemical inventories.

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

- Contains major components for waste types and some assumptions.

Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1996, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 Areas*, WHC-SD-WM-ER-349, Rev. 0-A, Westinghouse Hanford Company, Richland, Washington.

- Contains summary information from the supporting documents for Tank Farms A, AX, B, BX, BY, and C, as well as in-tank photo montages and the solid (including the interstitial liquid) composite inventory estimates.

Hartley, S. A., G. Chen, C. A. Lopresti, T. A. Ferryman, A. M. Liebetrau, K. M. Remund, and S. A. Allen, 1996, *A Comparison of Historical Tank Contents Estimates (HTCE) Model, Rev. 3, and Sample-Based Estimates*, PNNL-11429, Pacific Northwest National Laboratory, Richland, Washington.

- Compares the HTCE model waste concentration values with sample-based analysis.

Jungfleisch, F. M., 1980, *Hanford High-Level Defense Waste Characterization, A Status Report*, RHO-CD-1019, Rockwell Hanford Operations, Richland, Washington.

- Discusses identified storage and disposal options, associated development activities to develop them, and the waste characterization required.

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.

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

Remund, K. M., and B. C. Simpson, 1996, *Hanford Waste Tank Grouping Study*, PNNL-11433, Pacific Northwest National Laboratory, Richland, Washington.

- Compare different tanks and waste types.

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

- 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 ^{99}Tc from ORIGEN2 and analytical data.

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

- Contains a tank inventory estimate based on analytical information.

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

- Contains a tank inventory estimate based on analytical information.

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

- Contains a tank inventory estimate based on analytical information.

IIIb. Compendium of Existing Physical and Chemical Documented Data

Brevick, C. H., L. A. Gaddis, and E. D. Johnson, 1995, *Tank Waste Source Term Inventory Validation, Vol I & II.*, WHC-SD-WM-ER-400, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains a quick reference to sampling information in spreadsheet or graphical form for 23 chemicals and 11 radionuclides for all tanks.

Hanlon, B. M., 1996, *Tank Farm Surveillance and Waste Status Summary Report for Month Ending August 31, 1996*, WHC-EP-0182-101, Westinghouse Hanford Company, Richland, Washington.

- Most recent release of a series of summaries including fill volumes, Watch List tanks, occurrences, integrity information, equipment readings, equipment status, tank location, and other miscellaneous tank information. The series includes monthly summaries from December 1947 to the present. However, Hanlon has only compiled the monthly summaries from November 1989 to the present.

Husa, E. I., R. E. Raymond, R. K., Welty, S. M. Griffith, B. M. Hanlon, R. R. Rios, and N. J. Vermeulen, 1993, *Hanford Site Waste Storage Tank Information Notebook*, WHC-EP-0625, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains in-tank photos and summaries on 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.

- Assesses relative dryness between tanks.

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.

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

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Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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Sandia National Laboratory P.O. Box 5800 MS-0744, Dept. 6404 Albuquerque, NM 87815					
D. Powers		X			
Nuclear Consulting Services Inc. P. O. Box 29151 Columbus, OH 43229-01051					
J. L. Kovach		X			
Chemical Reaction Sub-TAP P.O. Box 271 Lindsborg, KS 67456					
B. C. Hudson		X			
Tank Characterization Panel Senior Technical Consultant Contech 7309 Indian School Road Albuquerque, NM 87110					
J. Arvisu		X			
SAIC 20300 Century Boulevard, Suite 200-B Germantown, MD 20874					
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555 Quince Orchard Rd., Suite 500 Gaithersburg, MD 20878					
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Los Alamos Technical Associates					
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Ogden Environmental 101 East Wellsian Way Richland, WA 99352					
R. J. Anema		X			
CH2M Hill P. O. Box 91500 Bellevue, WA 98009-2050					
M. McAfee		X			
Tank Advisory Panel 102 Windham Road Oak Ridge, TN 37830					
D. O. Campbell		X			
ONSITE					
Department of Energy - Richland Operations					
J. F. Thompson	S7-54	X			
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T. J. Kelley	S7-21	X			
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D. B. Engelman	L6-37	X			

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