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2	1	Cog. Mgr. C. S. Haller	[signature]	9/1/4					
		QA NA							
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2	1	S. J. Eberlein	[signature]	9/1/94					
2	1	D. S. DeLorenzo	Lance C. Amato for	9/1/94					

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6. Author
Name: D.S. DeLorenzo
Lance C. Amato for
Signature
Name: B.C. Simpson
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7. Abstract
This document provides the characterization information and interprets the data for Single-Shell Tank B-110

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Tank Characterization Report for Single-Shell Tank 241-B-110

L. C. Amato
D. S. De Lorenzo
A. T. DiCenso
J. H. Rutherford
R. H. Stephens
Los Alamos Technical Associates, Incorporated

P. G. Heasler
Pacific Northwest Laboratory

T. M. Brown
B. C. Simpson
Westinghouse Hanford Company

Date Published
August 1994

Prepared for Westinghouse Hanford Company by
Los Alamos Technical Associates
8633 Gage Blvd.
Kennewick, WA 99336

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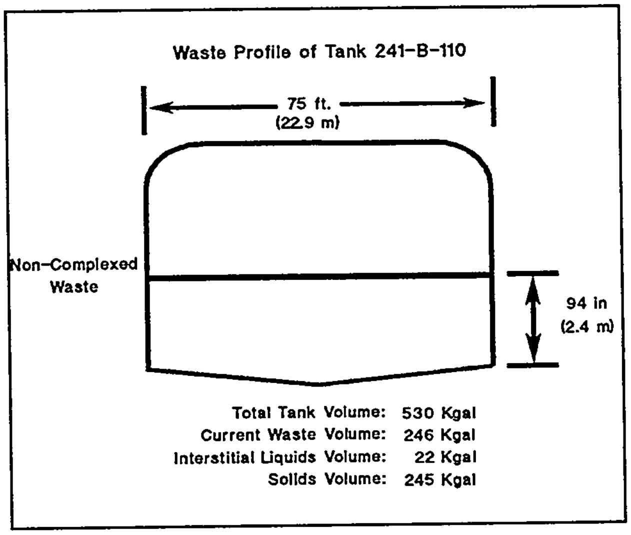
EXECUTIVE SUMMARY

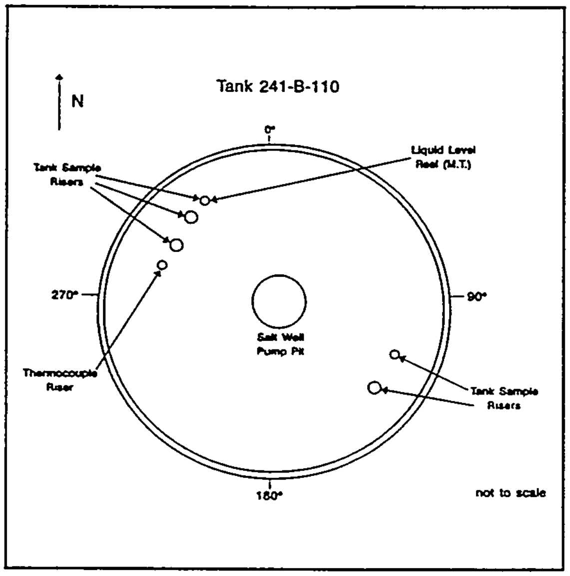
Single-Shell Tank 241-B-110 is an underground storage tank containing radioactive waste. The tank was sampled at various times between August and November of 1989 and later in April of 1990. The analytical data gathered from these sampling efforts were used to generate this Tank Characterization Report. Sampling and characterization of the waste in Tank 241-B-110 contributes toward the fulfillment of Milestone M-44-05 of the *Hanford Federal Facility Agreement and Consent Order*.



Tank 241-B-110, located in the 200 East Area B Tank Farm, was constructed in 1943 and 1944, and went into service in 1945 by receiving second cycle decontamination waste from the B and T Plants. During the service life of the tank, other wastes were added including B Plant flush waste, B Plant fission product waste, B Plant ion exchange waste, PUREX Plant coating waste, and waste from Tank 241-B-105. It is the first tank in a cascade with Tanks 241-B-111 and 241-B-112. The final disposal of the waste in Tank 241-B-110 will be as high- and low-level glass fractions. The tank has an operational capacity of 2,010,000 L (530,000 gallons), and currently contains 931,000 L (246,000 gallons) of non-complexed waste, existing primarily as sludge. Approximately 83,000 L (22,000 gallons) of drainable interstitial liquid and 3,784 L (1,000 gallons) of supernate remain. The solid phase of the waste is heterogeneous, for the top layer and subsequent layers have significantly different chemical compositions and are visually distinct. A complete analysis of the top layer has not been done, and auger sampling of the top layer is recommended to fully characterize the waste in Tank 241-B-110. The tank is not classified as a Watch List tank; however, it is a Confirmed Leaker, having lost nearly 10,000 gallons of waste. The tank was Interim Isolated on 10/30/85. There are no Unreviewed Safety Questions associated with Tank 241-B-110 at this time.

The waste in Tank 241-B-110 is primarily precipitated salts, some of which are composed of radioactive isotopes. The most prevalent analytes include water, bismuth, iron, nitrate, nitrite, phosphate, silicon, sodium, and sulfate. The major radionuclide constituents are ^{137}Cs and ^{90}Sr. Comparisons to established limits of concern for selected analytes can be made by referring to the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

The results of the analyses have been compared to the dangerous waste codes in the *Washington Dangerous Waste Regulations* (WAC 173-303). This assessment was conducted by comparing tank analyses against dangerous waste characteristics ("D" waste codes) and against state waste codes. It did not include checking tank analyses against "U", "P", "F", or "K" waste codes since application of these codes is dependent on the source of the waste and not on particular constituent concentrations. The results indicate that the waste in this tank is adequately described in the Dangerous Waste Permit Application for the Single-Shell Tank System; this permit is discussed in the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).



TANK 241-B-110	
Tank Description	
Type:	Single-Shell
Constructed:	1943 and 1944
In-Service:	May 1945
Out of Service:	1970
Diameter:	75 feet
Usable Depth:	16 feet
Operating Capacity:	530,000 gallons (2,010,000 L)
Bottom Shape:	Dish
Hanford Coordinates:	45.327° North 52.852° West
Total Risers	12
Ventilation:	Passive
Tank Status	
Contents:	Non-Complexed Waste
Manual Tape Surface Level:	85.5 inches (4/94)
Integrity Category:	Confirmed Leaker
Date Declared Leaker:	1981
Leak Volume Estimate:	37,900 L (10,000 gallons) (1986)
Isolation Status	
Interim Stabilized:	12/20/84
Interim Isolated:	10/30/85

Single-Shell Tank 241-B-110 Concentrations and Inventories for Critical List Analytes (as of June 1994)		
Total Tank Volume	530,000 gallons (2,010,000L)	
Total Waste Volume	246,000 gallons (931,000 L) 1,260,000 kg	
Sludge Volume	245,000 gallons (927,000 L) 1,250,000 kg	
Supernatant Volume	1,000 gallons (3,790 L) 4,700 kg	
Interstitial Liquid Volume	22,000 gallons (83,300L) 103,000 kg	
Physical Properties		
Density	1.35 g/ml	
H_2O	58.14 wt%	
Temperature	17°C (as of 1/94)	
pH	8.17	
Heat Load	1.02 KW	
Chemical Constituents	**Average Concentration**	**Solid Inventory**
Al (Aluminum)	0.114 wt%	1,430 kg
Bi (Bismuth)	1.87 wt%	23,300 kg
Ca (Calcium)	0.0812 wt%	1,020 kg
Cr (Chromium)	0.0812 wt%	1,020 kg
Fe (Iron)	1.81 wt%	22,800 kg
Si (Silicon)	0.938 wt%	11,800 kg
Na (Sodium)	9.79 wt%	1.23 E+05 kg
Cl^- (Chloride)	0.124 wt%	1,550 kg
F^- (Fluoride)	0.190 wt%	2,390 kg
NO_3^- (Nitrate)	18.8 wt%	2.36 E+05 kg
NO_2^- (Nitrite)	1.03 wt%	13,000 kg
PO_4^{3-} (Phosphate)	3.94 wt%	49,200 kg
SO_4^{2-} (Sulfate)	1.16 wt%	14,500 kg
Total Organic Carbon	0.0382 wt%	480 kg
Total Inorganic Carbon	0.0902 wt%	1,130 kg
Radionuclides		
Total Plutonium	0.105 μCi/g	133 Ci
Total Uranium	0.021 wt%	262 kg
^{137}Cs	14.9 μCi/g	18,800 Ci
^{90}Sr	108 μCi/g	1.37 E+05 Ci
Total Alpha	0.156 μCi/g	197 Ci
Total Beta	183 μCi/g	2.37 E+05 Ci

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LIST OF TERMS

ANOVA	analysis of variance
B	high level waste rom cesium/strontium recovery at B Plant
CASS	Computer Automated Surveillance System
DNFSB	Defense Nuclear Facilities Safety Board
DOE	United States Department of Energy
DQO	Data Quality Objectives
DSC	differential scanning calorimetry
EB	evaporator bottoms
EOX	extractable organic halides
EPA	United States Environmental Protection Agency
FP	fission products
HTCE	*Historical Tank Content Estimates for the Northeast Quadrant of the Hanford Site 200 East Areas*
IC	ion chromatography
ICP	inductively coupled plasma
IX	ion exchange
MDL	method detection limit
PNL	Pacific Northwest Laboratory
RPD	relative percent difference
RSD	relative standard deviation on the mean concentration
SACS	Surveillance Analysis Computer System
SVOA	semivolatile organics analysis
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TOC	total organic carbon
TOX	total organic halides
TWRS	Tank Waste Remediation System
VOA	volatile organics analysis
WHC	Westinghouse Hanford Company
1C	first cycle
2C	second cycle
5-6#	process waste from Cell 12-L in B Plant

1.0 INTRODUCTION

In 1989 and 1990, Single-Shell Tank 241-B-110 was sampled in order to comply with requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology, EPA & DOE, 1993) and the *Washington Administrative Code* (Ecology, 1991). The analyses also provided information to the Tank Waste Remediation System in terms of tank safety, waste retrieval, and waste disposal.

This Tank Characterization Report (TCR) presents an overview of that tank sampling and analysis effort, and contains observations regarding waste characteristics. It also addresses expected concentration and inventory data for the waste contents based on this latest sampling data and background tank information.

1.1 PURPOSE

The purpose of this report is to describe and characterize the waste in Single-Shell Tank 241-B-110 (hereafter, Tank 241-B-110) based on information given from various sources. This report summarizes the available information regarding the waste in Tank 241-B-110, and using the historical information to place the analytical data in context, arranges this information in a useful format for making management and technical decisions concerning this waste tank. In addition, conclusions and recommendations are given based on safety issues and further characterization needs.

Specific objectives reached by the sampling and characterization of the waste in Tank 241-B-110 are:

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

- Complete safety screening of the contents of Tank 241-B-110 to meet characterization requirements of the *Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 93-5* (Conway, 1993).

- Provide tank waste characterization to the Tank Waste Remediation System (TWRS) Program Elements in accordance with the *TWRS Tank Waste Analysis Plan, Rev. 1* (Bell, 1994).

1.2 SCOPE

This report follows the standard format for Tank Characterization Reports. First, a broad description of the tank and its historical background are presented. This allows a detailed estimation of the contents of Tank 241-B-110 based on historical process information and detailed transaction records. Next, the results of the sampling and analysis effort are summarized and interpreted both qualitatively and statistically. The information obtained from historical sources is then compared with the actual waste measurements to arrive at final waste inventory and concentration estimates. Finally, recommendations are given based on the current waste inventory and tank status.

1.3 ASSUMPTIONS

The concentration and inventory estimates derived for this report are considered by the authors and by the Westinghouse Hanford Company Characterization Program to be the most accurate, defensible, technically valid, and contemporary data concerning Tank 241-B-110. This Tank Characterization Report evaluates all available previous sampling, characterization, and transfer data concerning Tank 241-B-110. In addition, estimates of the current tank contents based on process knowledge and waste transaction records provide important cross-checks and corroboration to the inventory estimates derived from recent analytical data. Given that the analytical data is valid and defensible, this report is therefore the definitive characterization of the contents of Tank 241-B-110.

The term "analytical results" is used in this report to denote sample results from the most recent sampling event. Characterization data from these samples are used as the basis for the analytical section of this report, Section 5.0. The historical characterization of this tank, Section 2.0, is based on the available "historical results" prior to the 1989 and 1990 sampling.

Tank 241-B-110, a Confirmed Leaker, (Welty, 1988) was removed from service in 1970 and Interim Stabilized in 1985 (Husa et al., 1993). The characterization of Tank 241-B-110 is considered accurate and representative of the tank contents as of the date of preparation of this report: August, 1994.

2.0 HISTORICAL TANK INFORMATION

The purpose of this section is to describe Tank 241-B-110 based on historical information. It is divided into five parts. A brief description and historical background of the tank comprises the first part, followed by the current tank status, a summary of the process sources that contributed to the tank waste, and an estimation of the contents of Tank 241-B-110 based on historical information. The final part details surveillance data taken on the tank.

2.1 TANK HISTORY

Single-Shell Tank 241-B-110 consists of a carbon steel tank within a reinforced concrete shell and dome. It has a diameter of 75 ft., an operating depth of 17 ft., and a capacity of 2,010,000 L (530,000 gallons) (Husa et al., 1993). The basic design of Tank 241-B-110 is shown in Figure 2-1. Instruments access Tank 241-B-110 through risers and monitor the temperature, sludge level, and other bulk tank characteristics (Fulton, 1992). The position of these risers is found in Figure 2-2.

The 241-B Tank Farm, built in 1943 and 1944, is one of the initial four tank farms to be used at the Hanford Site. It is located on the northern side of the 200 East Area. Figure 2-3 details the Hanford Site's 200 East Area and the location of the 241-B Tank Farm. As Figure 2-3 illustrates, Tank 241-B-110 is found in the southwest corner of the 241-B Tank Farm.

Tank 241-B-110 is the first tank in a "cascade" connecting it to tanks B-111 and B-112. A cascade was a system where a number of tanks were connected in series by pipes. These pipes were located at the top of the tanks' working depths. Waste could be added to the first tank in a cascade and would flow to the next tank without overfilling the first tank. Also, by using a cascade, fewer connections needed to be made during waste handling operations. This method reduced waste handling requirements, personnel exposure, and the chance of a loss of tank integrity from waste overflow. Another advantage of using the cascades was to clarify the waste. Entrained solids would settle and insoluble constituents would precipitate in the first tank (in this case Tank 241-B-110), and the clarified liquids would flow through the cascade on to the other tanks (B-111 and B-112). This practice led to rapid filling of the first tank with solids and allowed the clarified liquid from the other tanks in the cascade to be discharged to cribs. The cascades in the 241-B Tank Farm are shown in Figure 2-3.

Tank 241-B-110 went into service in 1945, receiving second cycle decontamination waste (Anderson, 1990). Within the year, the tank was full. In 1952, the B-110, 111, 112 cascade actively overflowed to the cribs. In other words, whenever waste was introduced into Tank 241-B-110, an equal amount of waste drained from Tank 241-B-112 to the cribs. This configuration was used until 1954.

Figure 2-1. Basic Design of Tank 241-B-110.

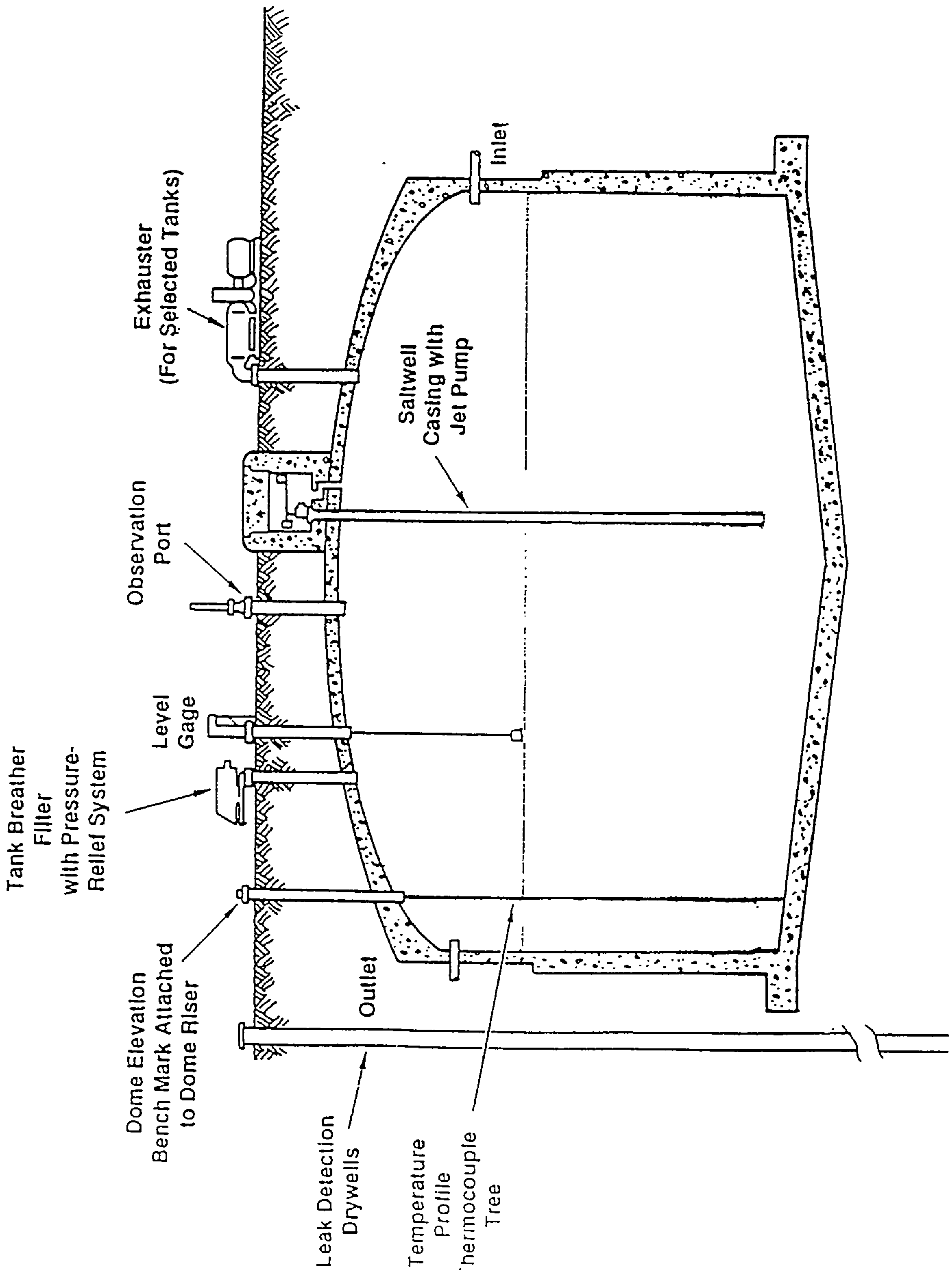
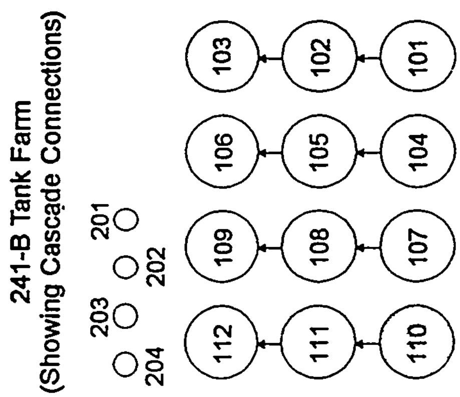
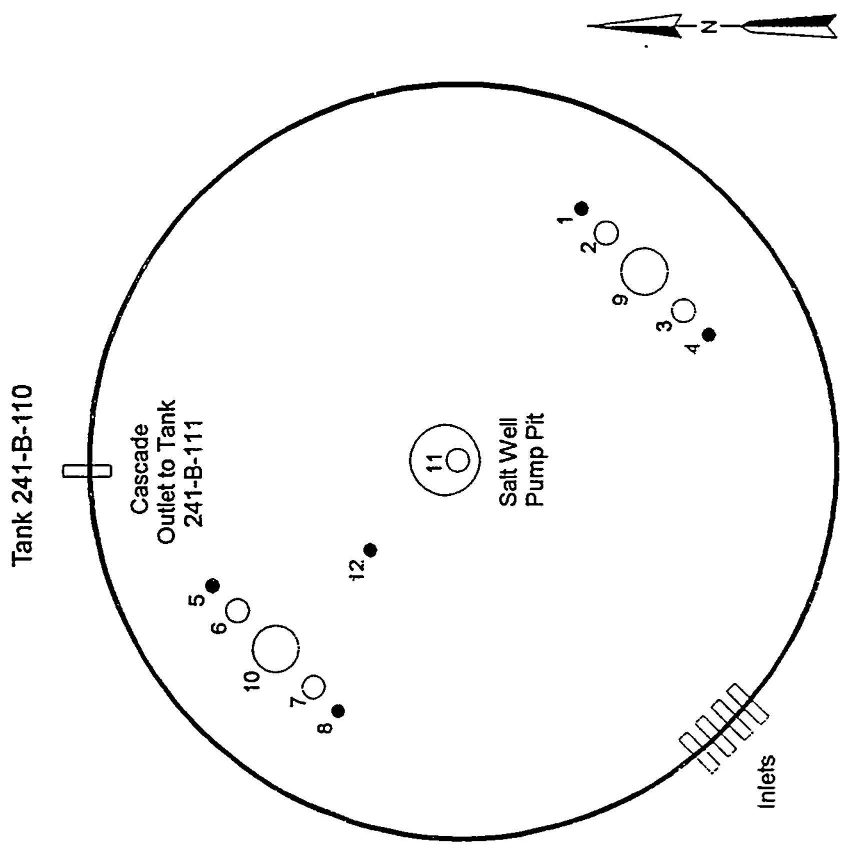


Figure 2-2. Riser Configuration For Tank 241-B-110.

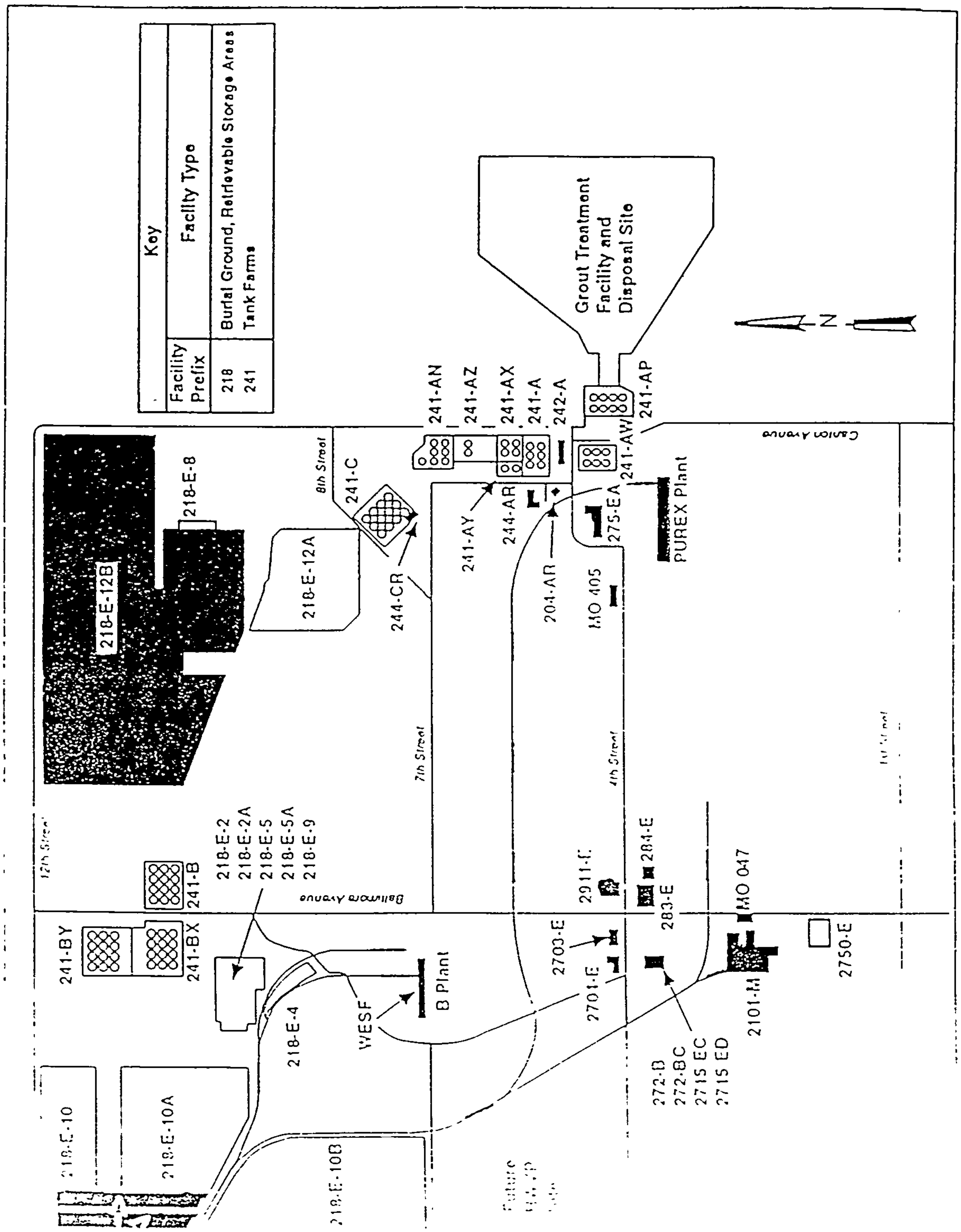
No.	Dia.	Description and Comments
1	4"	Liquid Observation Well
2	12"	Capped Dip Tubes, Below Grade
3	12"	Flange
4	4"	Flange
5	4"	Liquid Level Reel
6	12"	Flange
7	12"	Observation Port
8	4"	Thermocouple Tree
9	42"	Manhole, Below Grade
10	42"	Manhole, Below Grade
11	12"	Saltwell Screen
12	4"	Capped Dip Tubes, Below Grade





Sources: Fulton, 1992
Vitro Eng. Corp., 1978
Hanford Eng. Works, 1944

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



Most of the supernate was removed from Tank 241-B-110 in 1971. Four dry wells were drilled in 1973 (Agnew, 1994). The tank was officially removed from service in 1975. Salt well pumping was in progress from 1972 to 1978. Tank 241-B-110 was Primary Stabilized in 1978. This involved the removal of liquid above the solids (other than isolated surface pockets) by salt well pumping. Level adjustments in 1982 and 1985 brought waste level measurements in the tank to current readings. Tank 241-B-110 was labeled a confirmed leaker in 1981. According to the *Tank Farm Surveillance and Waste Status Summary Report for January, 1994* (Hanlon, 1994), an estimated 37,900 L (10,000 gallons) have leaked from the tank. The tank was designated as Interim Stabilized in 1985. This was an administrative change and required no physical modifications to the tank. Intrusion Prevention was completed on Tank 241-B-110 in 1985. Intrusion Prevention is the administrative designation reflecting the completion of physical modifications to minimize the addition of liquids into the tank.

2.2 TANK STATUS

Tank 241-B-110 currently contains 931,000 L (246,000 gallons) of waste. Of this waste, 3,790 L (1,000 gallons) is supernatant liquid. The remaining 927,000 L (245,000 gallons) is sludge, with an estimated 83,300 L (22,000 gallons) of the sludge being drainable interstitial liquid (Hanlon, 1994). The latest available temperature measurement was 17°C (63°F). Thermocouple data supports the conclusion that heat-generation processes within the tank wastes are moderate and pose no high temperature risk. The tank heat load is further discussed in Section 6.2.3. Waste levels and tank temperatures are further discussed in Section 2.5. Tank 241-B-110 is vented directly to the atmosphere. However, there is no active ventilation of the dome space. All monitoring systems are currently in compliance with established standards (Hanlon, 1994).

The current designation of the tank contents is non-complexed waste. This is a general term used to describe waste that does not have a high content of organic carbon or carbon complexants. Tank 241-B-110 is not a Watch List tank, nor does it have Unreviewed Safety Questions associated with it. Tank 241-B-110 has been labeled a Confirmed Leaker, has been Interim Stabilized, and has undergone Intrusion Prevention.

2.3 PROCESS KNOWLEDGE

The first waste type to be introduced into Tank 241-B-110 was second cycle (2C) waste in May 1945. Second cycle waste was a solution produced in the $BiPO_4$ process at the B and T Plants. The 2C waste completely filled the tank in December 1945 and then cascaded on to Tank 241-B-111, which in turn cascaded to Tank 241-B-112. When Tank 241-B-112 was completely full, the waste overflowed to the cribs. In 1950, the contents of Tank 241-B-110 were cribbed. The waste most likely was composed of primarily clarified liquids since it was discharged to a crib. Before the end of 1950 the tank was completely full again with 2C waste.

In 1952, Tank 241-B-110 began receiving B-Plant flush waste. This waste was a mixture of first cycle (1C) decontamination waste, second cycle (2C) decontamination waste, and process waste from Section 5 of B-Plant (5-6#). Produced in the $BiPO_4$ process at the B and T Plants, 1C waste consisted of byproducts co-precipitated from a plutonium-containing solution. Coating waste from the removal of aluminum fuel element cladding was also added and comprised about 24% of the waste stream. Section 5 in B-Plant was used to collect boil-over from process vessels, and other miscellaneous drains. Normally cribbed, 5-6# waste occasionally was sufficiently radioactive to require disposal in the tank farms. The waste was cascaded to the other tanks in the series (B-111 and B-112). Some of the waste was pumped to Tank 241-C-111, and the supernate was cribbed again.

Waste from Tank 241-B-105 (which contained evaporator bottoms (EB) waste) was transferred to Tank 241-B-110 in 1954. Evaporator Bottoms are a slurry product from the evaporators, and would precipitate as a solid salt cake which was then stored in the single-shell tanks.

In early 1955 the supernatant liquid was pumped from Tank 241-B-110 to Tank 241-B-107 and Tank 241-B-108 leaving 1,320,000 (348,000 gallons). In mid-1955, Tank 241-B-110 began again to receive B-Plant Flush Waste. The tank was completely full by early 1956 and the cascade cycle began again. In 1954, the cascade stopped overflowing directly to the cribs.

Tank 241-B-110 began receiving fission product (FP) waste from B-Plant in 1963. This waste consisted of fission products, but with most of the strontium and cesium removed. In early 1968, waste from Cell 12-L of B-Plant was added. Cell 12-L contained low level evaporator bottoms from B-Plant. Also in 1968, high level waste from cesium/strontium recovery at B-Plant (B) was added (Agnew, 1994).

In the third quarter of 1969, waste from B-Plant ion exchange (IX) was added. ion exchange IX waste included column waste, column wash waste, and cesium purification waste. The supernatant liquid was then pumped to Tank 241-B-112. The tank was allowed to settle for a few years. In 1971, most of the remaining supernate was removed. Salt well pumping further reduced the waste volume. Table 2-1 uses transfer records to present an estimate of the total volume of waste that has been received by Tank 241-B-110.

Table 2-1. Estimated Total Volume of Waste Types Received By Tank 241-B-110 (Agnew, 1994; Jungfleisch 1984a). (2 pages)

Waste Type	Estimated Volume*
2C	6,449,000
SU	342,000
IX	199,000
EB	311,000
FP	1,165,000
5-6#	363,000

Table 2-1. Estimated Total Volume of Waste Types Received By Tank 241-B-110 (Agnew, 1994; Jungfleisch 1984a). (2 pages)

Waste Type	Estimated Volume*
B	135,000
BFSH	555,000

* Total volume is greater than 530,000 gallons because waste was routinely pumped out of Tank 241-B-110 and also cascaded to Tank 241-B-111.

2C Second cycle waste.

SU Supernate from other single-shell tanks.

IX Ion exchange waste.

EB Evaporator bottoms from Cell 12-L in B-Plant.

FP Fission product waste.

5-6 Process waste from Section 5 of B-Plant.

B High level waste from the cesium/strontium process at B-Plant.

BFSH B-Plant flush waste, This was a mixture of first cycle (1C) waste, 2C waste, and 5-6 waste.

2.4 HISTORICAL ESTIMATION OF THE CONTENTS OF TANK 241-B-110

Estimated concentrations for selected elements, compounds, and isotopes in Tank 241-B-110 can be developed by examining the approximate chemical composition of each waste stream introduced to the tank and the historical transaction fill history. It is important to consider, however, that the historical records are incomplete and that some transactions may not be recorded.

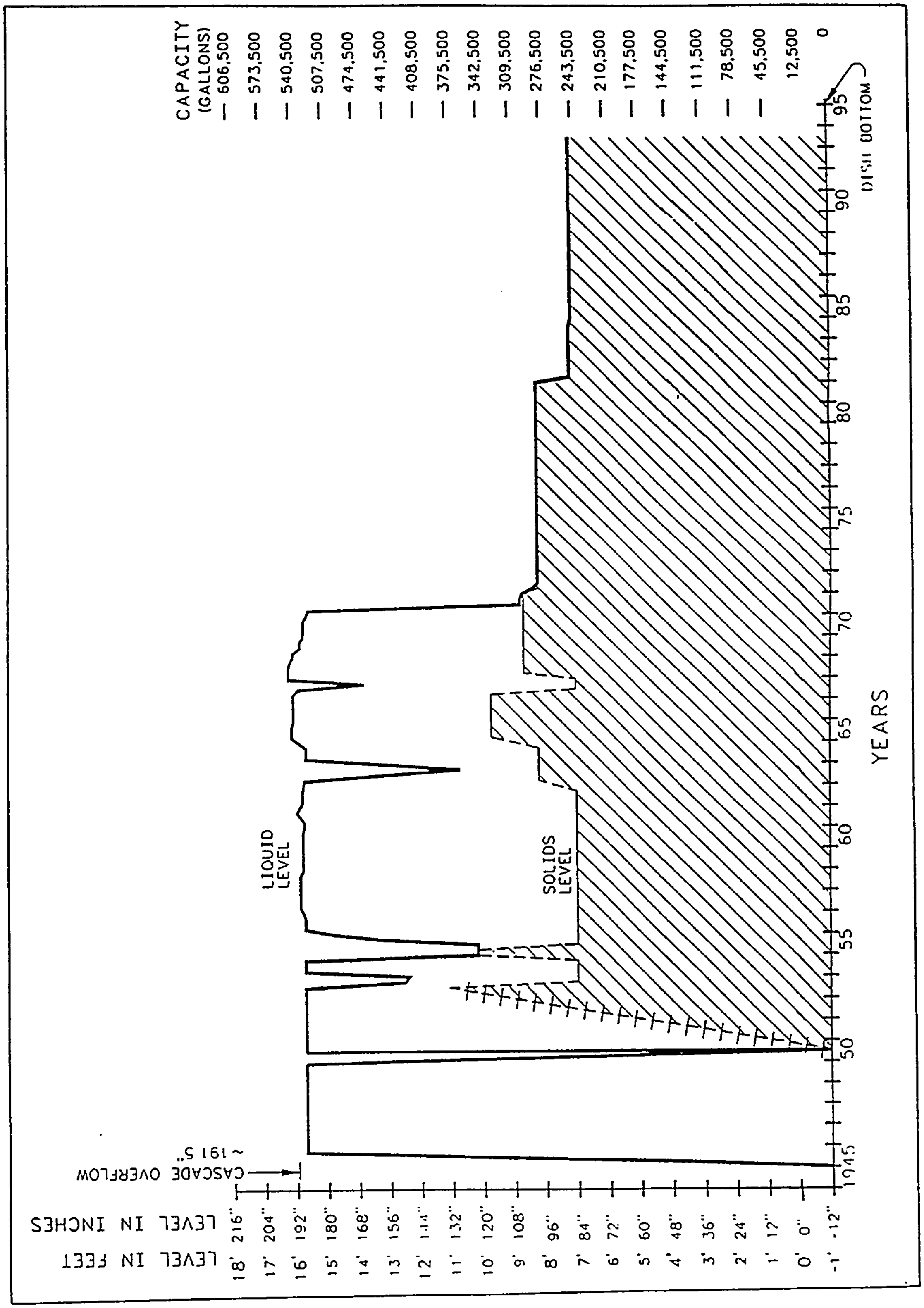
The following waste types have been transferred to Tank 241-B-110 throughout its operational service life: 1C, 2C, EB, FP, B, IX, and 5-6# (Anderson, 1990). During the first eight years of service, 2C was the only waste received, and cascaded through to the remaining two tanks. Since tank 241-B-110 was the first cascade tank, the likelihood that it received a majority of 2C solids is possible. Graphical fill histories generated by ICF Kaiser Hanford (1994) support this conclusion. These histories also show that the majority of solid waste in Tank 241-B-110 came from 2C waste.

Tank 241-B-110 historical tank inventory estimates, shown in Table 2-2, were produced using a model developed by Los Alamos National Laboratories (Agnew, 1994), and reported and explained in the *Historical Tank Content Estimates for the Northeast Quadrant of the Hanford Site 200 East Areas* (HTCE) (ICF Kaiser, 1994). Agnew's inventory numbers were generated based on the assumption that the waste is 100% 2C sludge. These values also appear in Table 5-5 as the Historic Tank Content Estimate for the solid material in Tank 241-B-110. A graphical waste volume history for the tank is included as Figure 2-4.

Table 2-2. Historical Tank Inventory Estimate of Tank 241-B-110 (ICF Kaiser Hanford, 1994) Compared to TRAC Estimates (Jungfleisch, 1984b).

Physical Properties			TRAC
Total Waste	245 kgal (1.22 E+6 kg)		249 kgal
Heat Load	4.01 E+3 BTU/hr (1.17 kW)		
Bulk Density	1.32 g/mL		
Void Fraction	0.68		
Water wt%	66.18		
TOC wt% C (wet)	0.00		
Chemical Constituents			
Analyte	**μg/g**	**kg**	**kg**
Na	1.05E+05	1.28E+05	1.3E+09
Al	0	0	8.1E+06
Fe	1.59E+04	1.94E+04	2.8E+07
Cr	5.75E+02	7.03E+02	1.6E+06
Bi	2.31E+04	2.83E+04	2.1E+09
$ZrO(OH)_2$	0	0	1.1E+03
Pb	0	0	1.0E+03
Ni	0	0	4.7E+05
Sr	0	0	1.8E+02
Mn	0	0	5.5E+04
Ca	0	0	1.6E+04
CO_3^{2-}	29.30	35.82	0
OH^-	2.00E+04	2.45E+04	1.7E+07
NO_3^-	3.74E+04	4.57E+04	3.1E+08
PO_4^{3-}	1.04E+05	1.27E+05	9.5E+08
SO_4^{2-}	2.62E+03	3.21E+03	4.8E-06
SiO_3^{2-}	1.19E+04	1.46E+04	1.5E-36
F^-	2.18E+03	2.67E+03	1.7E-36
$C_6H_5O_7^{3-}$	0	0	9.5E+7
Radiological Constituents			
Radionuclide	**μg/g**	**kg**	**kg**
Pu	0.18 μCi/g	3.73 kg	3.5 kg
U	1.15E+04 μg/g	1.40E+04 kg	2.1E+04 kg
Cs	4.52 μCi/g	5.53E+03 Ci	8.0E+04 Ci
Sr	1.39E+02 μCi/g	1.70E+05 Ci	7.0E+04 Ci

Figure 2-4. Waste Volume History of Tank 241-B-110



Other estimates of historic constituent concentrations exist such as the TRAC model (Jungfleisch, 1984b). Table 2-2 shows the estimated concentrations as predicted by both the TRAC model and the HTCE. It should be noted that the TRAC model takes all waste types into consideration while the HTCE (ICF Kaiser Hanford, 1994), used the assumption that the waste in 241-B-110 is predominantly 2C sludge with a thin layer of fission product waste on top.

2.5 SURVEILLANCE DATA

2.5.1 Surface Level Readings

Tank 241-B-110 is equipped with a manual tape gauge to determine the surface level of the waste. The manual tape uses a conductivity probe which is lowered by a hand crank until contact is made with the waste surface and an electrical circuit is completed. The operator records the manual tape's measurement and enters it into the Computer Automated Surveillance System (CASS).

Surface level readings for Tank 241-B-110 are currently being taken quarterly. The most recent manual tape reading was 85.5 inches in April 1994 (Rios, 1994). As is expected from an out-of-service tank, the waste level in Tank 241-B-110 has remained consistent for several years.

2.5.2 Internal Tank Temperatures

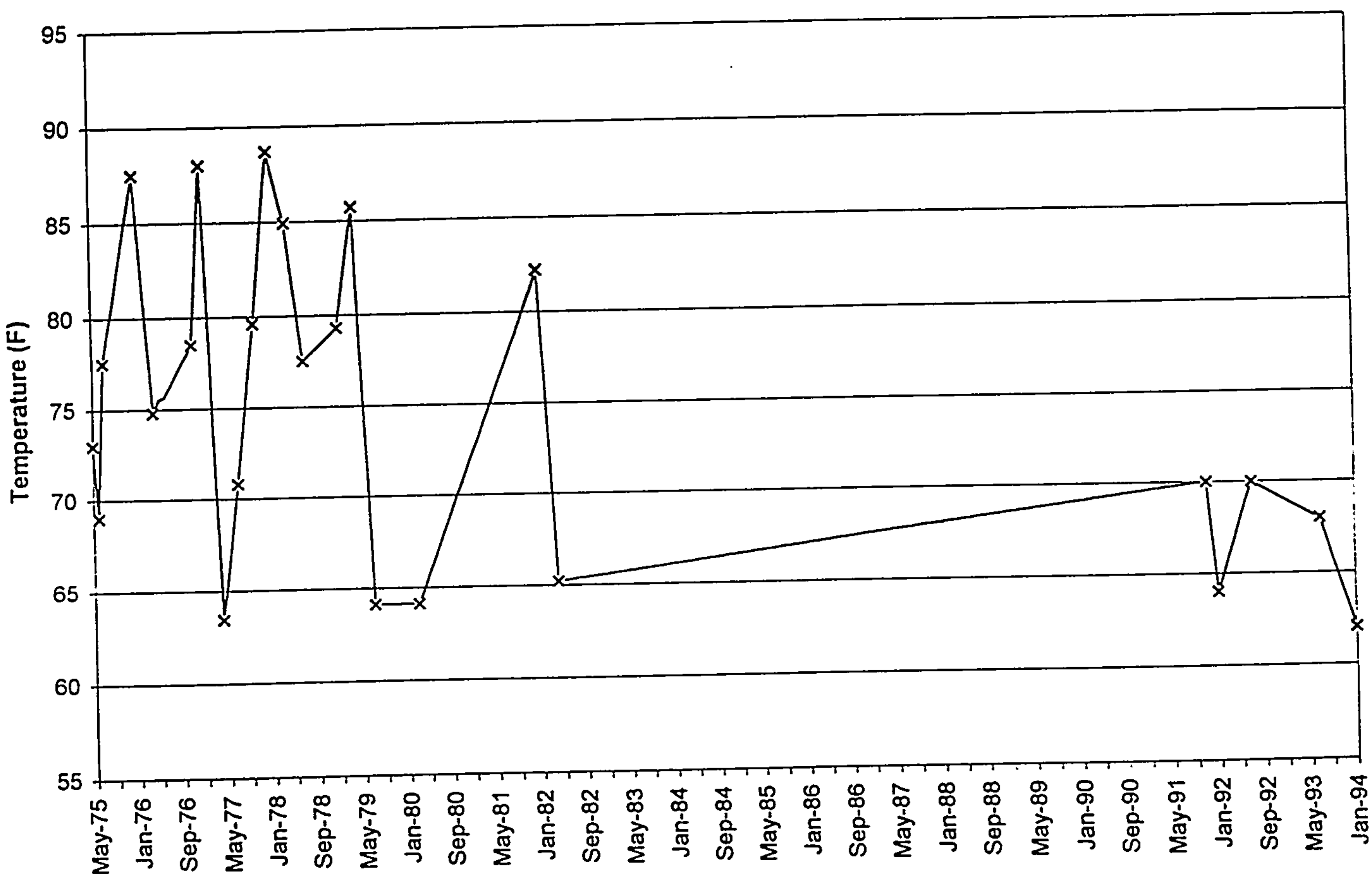
Temperatures are taken in Tank 241-B-110 by a probe which enters the tank through riser 8. The probe has 12 thermocouples which are arranged at different heights in the Tank. Seven of the thermocouples are currently being used. After the temperatures are taken, they are manually recorded on the Surveillance Analysis Computer System (SACS). The most recent temperature reading available was 17°C (63°F) taken in January, 1994. This measurement is consistent with historical measurements of Tank 241-B-110. Plotted temperature readings of Tank 241-B-110 since 1975, when the tank was removed from service, can be found in Figure 2-5.

Tank 241-B-110 is classified as a semiannual tank, meaning that temperatures are to be collected in January and July. However, as shown on the temperature plot in Figure 2-5, this has not always been the case. There is a period between 1982 and 1989, and another period between 1989 and 1991 for which temperature readings were not available. These temperature readings are not available because either the historical data sheets could not be found when temperatures were being input to the database, or temperature readings during these periods were not taken for some reason.

The temperature taken in July 1989 (122°F) was an incorrect reading and thus is not included in Figure 2-5. The historical data shows that the temperature in Tank 241-B-110 can be expected to range between 15.6°C (60°)F and 32.2°C (90°F).

Since 1982, thermocouples 1 through 4, which are located in the waste, have been out of service. Temperatures are thus taken by the remaining thermocouples, which are in the vapor space. Historical data shows that the temperatures of both the waste and the vapor space in Tank 241-B-110 have similar trends, but there is a phase shift because of the thermal mass of the waste. The current readings can be considered accurate.

Figure 2-5. Tank 241-B-110 Temperatures Since 1975.



3.0 TANK SAMPLING OVERVIEW

The purpose of this section is to discuss the sampling effort of Tank 241-B-110. The sampling event is described first, followed by a discussion of the samples analyzed by Battelle's Pacific Northwest Laboratory.

3.1 DESCRIPTION OF SAMPLING EVENT

Between August and November of 1989, seven cores from Tank 241-B-110 were sampled. Since three of these cores were taken from one riser, a decision was made to take one more core from a different riser in order to have more representative sampling locations. Hence, in April of 1990, an eighth core was sampled from Tank 241-B-110. From each of these cores, five segments were taken. Table 3-1 shows the numbers of each of these cores and segments, along with the date sampled and riser location.

The first column in Table 3-1 is the sequential core number. This number uniquely identifies each core sampling event of Hanford Site waste tanks, whether double-shell or single shell. The number sequence began in August of 1989 and will continue through completion of the core sampling program. The second column identifies the riser from which the sample was obtained. The third column is the sampling date. The fourth column is a nonsequential number used to identify each individual segment within a core. The fourth column is a number used to identify each sample as it is processed in the laboratory. Since composite data only were used to calculate the tank inventory estimates, only the composite sample numbers are listed. The fifth and final column is the date of sample receipt by the Pacific Northwest Laboratory.

It is important to note that core 11, (the third core taken from riser number 3), was not analyzed in the laboratory and will not be referred to later in the chemical and statistical analysis of this report. Note also that the last core to be sampled was core 18. This core is incorrectly referred to in the data packages as core 16.

The core samples from Tank 241-B-110 were obtained using a core sampling truck that has sampling equipment mounted on a rotating platform. The core sampling truck worked effectively due to the soft, sludge-like waste material in Tank 241-B-110. A stainless steel sampler was used to obtain a core of waste (maximum volume of 187 milliliters).

Each core taken consists of one or more segments, the total length of which represents the entire column of waste in the tank. These segments are 48 cm (19 inches) long. The first segment always represents the top segments in a core and is the exception to the 48 cm criterion, since the height of the waste column is most likely not an integer multiple of 48 cm.

Unlike current samplers, the sampler used for Tank 241-B-110 was not disposable. This sampler was lowered into the tank through a drill string. The method used when sampling Tank 241-B-110 was push mode, meaning that the sampler was pushed into the waste instead of drilling into the waste.

Table 3-1. Tank 241-B-110 Core and Sample Numbering.

Core	Riser	Date Sampled	PNL Sample Numbers	Date Received by PNL
1	7	8/7/89-8/11/89	89-0621	8/9/89-8/15/89
			89-0622	
			89-0623	
			90-1125	
			90-1126	
2	7	8/14/89-8/18/89	90-0640	8/18/89-8/21/89
			89-1251	
			89-1252	
3	5	8/21/89-8/28/89	89-971	8/28/89-8/30/89
			89-972	
			89-973	
			89-974	
			89-975	
			89-976	
			90-0716	
4	1	9/10/89-9/11/89	90-0714	9/11/89
			90-0715	
			90-0716	
9	3	11/20/89	90-1255	11/21/89-11/22/89
			90-1256	
			90-1257	
10	3	11/21/89	90-1277	11/22/89-12/12/89
			90-1278	
			90-1279	
18	6	4/17/90	90-4178	5/7/90-5/8/90
			90-4179	
			90-4180	

When the segment was captured within the sampler, it was sealed in a stainless steel liner within a shipping cask to prevent liquid from the sample from being lost. When the sample was received into the shielded receiver, the truck rotated the cask to deposit the sample. The sample core and segment number was then recorded and the cask was sealed.

The casks were then transported to the Pacific Northwest Laboratory (PNL) 325-S laboratory. Segments from Cores 1-4 and 9 & 10 were received between August and December, 1989. Segments from Core 18 were received on May 7 and 8, 1990. A chain of custody form was filled out for each segment.

3.2 SAMPLE LOCATIONS

A total of 32 segments from Tank 241-B-110 were received by Battelle's Pacific Northwest Laboratory. Figure 3-1 shows the positions in Tank 241-B-110 from which the segments were taken. These segments were then divided into sub-samples and composites. Table 3-1 shows the sample distribution and custody data for the Pacific Northwest Laboratory. A list of analytes requested for the individual samples is discussed in Winters et al. (1990).

3.3 PROBLEMS WITH THE SAMPLES

As shown in Table 3-2, the waste recovery (percentage of the sampler which was occupied by sample) for Tank 241-B-110 was satisfactory. From all cores, 32 of 35 segments (91%) had recoveries >0%. The majority of the recovery problems experienced in the tank were in the top segment of each core, normally referred to as segment 1. Segment 1 recoveries were 0% for Cores 3,4, and 9. Recoveries were low (18%) for Core 1. Recoveries for all other core segments were ≥35%.

Possible causes for poor segment 1 recoveries are an irregular waste surface (a local area of less than anticipated waste height), or a waste which has a soft, runny texture and will not hold its shape during sample operations.

Figure 3-1. Tank 241-B-110 Core Sampling Positions.

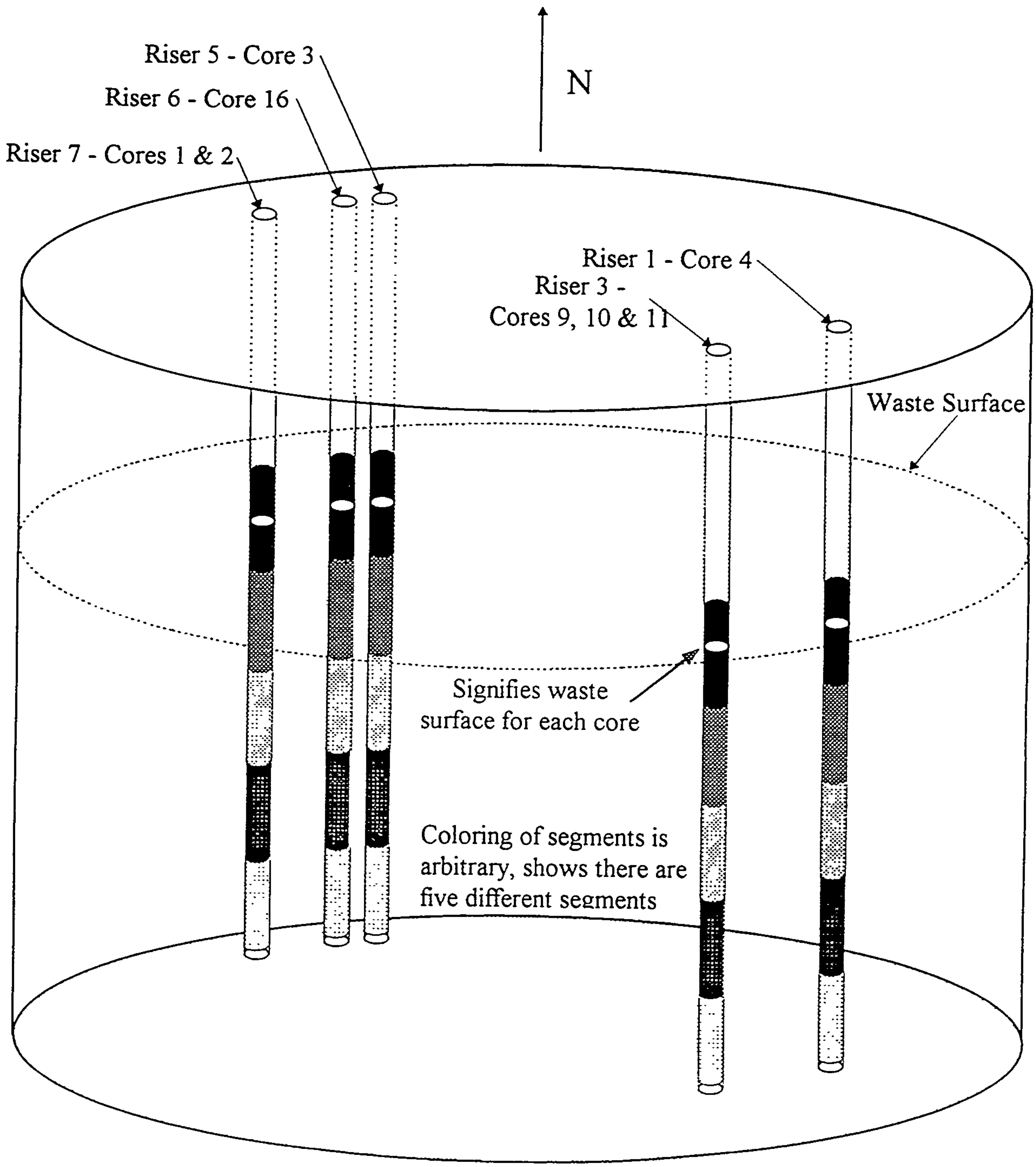


Table 3-2. Percent Core Recoveries for Tank 241-B-110.

	Core 1	Core 2	Core 3	Core 4	Core 9	Core 10	Core 18
Segment 1	18	85	0	0	0	35	81
Segment 2	100	100	100	100	98	100	100
Segment 3	100	100	100	94	100	100	100
Segment 4	100	100	100	100	100	100	100
Segment 5	100	100	100	100	100	100	100

4.0 SAMPLE HANDLING AND ANALYSIS SCHEME

The objective of the waste analyses is primarily to evaluate the waste in meeting requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology, EPA & DOE, 1993). The sampling of Tank 241-B-110 was part of an in-depth "pilot" study to determine the adequacy of current chemical analysis and sampling procedures and therefore contains more data than most other tanks being sampled. The major objectives of the analyses include: the estimation of the average concentration of the measured analytes in the tank; estimation of the laboratory, sampling, and spatial variability within the tank; and evaluation of the sampling methodology; and provision of a basis upon which to make a leave/retrieve decision regarding the waste in Tank 241-B-110.

4.1 WASTE DESCRIPTION

Of the segments collected from Tank 241-B-110, two segments had 10 milliliter or more of drainable liquid. Most segments were not accompanied by any drainable liquid. The liquid that was observed was light brown in color and is probably the tank liquid waste. The true nature of the liquid is not known since an analysis of the liquid was not performed. Because the amount of liquid for each of the segments extruded was less than 25 milliliter, that portion of the sample was mixed back in with the solid portion of the sample. Note that even though there was very little drainable liquid, interstitial liquid was observed in the samples.

At this stage of the sample preparation process, any pre-homogenization samples that were required were taken. The pre-homogenization samples that were taken from Tank 241-B-110 segments were to be used for particle size analysis and volatile organic analysis. All of the necessary samples were taken in order to perform the rheological and physical analyses.

Due to the extensive amount of data for Tank 241-B-110, only results from the homogenized composites are used this report to calculate inventory estimates. Date from the segment analyses were used to evaluate spatial variability, as described in Section 7.2. A core composite is a single representation of the entire core. These core composites were created by mixing portions of each segment of a core together. These portions were proportional by weight to the recovery for each segment of that core.

4.2 HOLD TIME CONSIDERATIONS

For a discussion of holding times see the Tank Characterization Reference Guide (De Lorenzo et al., 1994).

4.3 SAMPLE PREPARATION

Sample preparation procedures are conducted in order to optimize the recovery of each analyte of interest from the tank waste. Water digestion, acid digestion, and KOH Fusion are commonly used to extract metals and several radioisotopes from solid samples, and in some cases digestions are performed on liquid samples to improve analytical matrices. Many separations are specific to a particular analysis and are described within the corresponding analytical methods referenced in Tables 4-1 through 4-3. In order to verify analyte recoveries resulting from separation techniques, laboratory control samples, carriers, tracers, and surrogates are routinely analyzed concurrently with the environmental samples. Further information on this topic is located in the *Tank Characterization Reference Guide* (De Lorenzo et al, 1994).

4.4 ANALYTICAL METHODS

This section briefly describes the analyses used to characterize the waste in Tank 241-B-110. The analyses were performed entirely at Battelle's Pacific Northwest Laboratory (PNL).

4.4.1 Physical and Rheological Tests

Physical tests completed at PNL included: particle size analysis, thermogravimetric analyses (TGA), differential scanning calorimetry (DSC), specific gravity, and %water analyses. The physical properties measured included wt% solids, settling behavior, and wt% dissolved solids. Rheological testing on these samples were performed at PNL and included shear strength and shear stress as a function of shear rate. Rheological properties were measured in duplicate. Table 4-1 lists the analytical methods used for physical and rheological testing (Winters et.al, 1990).

Table 4-1. Analytical Methods for Physical and Rheological Testing.

Analyte	Procedure
Particle Size	2-50.3
Thermogravimetric Analysis	RDS-TA-1
Differential Scanning Calorimetry	RDS-TA-1
Specific Gravity	WHC-053-1
% Water	PNL-ALO-504
Rheology	WHC-053-1
Physical Properties	N/A

4.4.2 Chemical and Radionuclide Constituent Analysis

All of the chemical and radionuclide analyses were performed at PNL, including uranium and plutonium isotopic analyses. All tank samples were analyzed in duplicate. The duplicates were obtained after the appropriate digestion procedures had been performed. Table 4-2 lists the analytical methods used (Winters et.al, 1990).

Table 4-2. Analytical Methods for Chemical and Radionuclide Analyses

Analyte	Method	Procedure Number
Hg	Cold Vapor Atomic Absorption	PNL-ALO-213
F^-, Cl^-, NO_3^-, NO_2^-, PO_4^{3-}, SO_4^{2-}	Ion Chromatography	PNL-ALO-212
CN^-	Distillation/Spectrometric Analysis	PNL-ALO-270
U	Laser Fluorimetry	HTA-4-16
Total Alpha Total Beta	Proportional Counting	HTA-4-22, HTA-4-23 HTA-4-6, HTA-4-8
^{238}Pu, $^{239,240}Pu$, ^{241}Am, ^{237}Np	Alpha Spectrometry	PNL-ALO-423 PNL-ALO-424 PNL-ALO-425
Total Metals	Inductively Coupled Plasma	PNL-SP-7
^{90}Sr	Beta Proportional Counting	PNL-ALO-433
^{99}Tc	Liquid Scintillation	PNL-ALO-432
^{129}I	Low Energy Gamma Analysis	PNL-ALO-454
^{14}C ^{3}H	Liquid Scintillation	PNL-ALO-442 PNL-SP-30
^{154}Eu, ^{155}Eu, ^{241}Am, ^{137}Cs, ^{60}Co	Gamma Energy Analysis	PNL-ALO-451
H^+	pH	PNL-ALO-225
As Se	Atomic Absorption	PNL-ALO-214 PNL-ALO-215
Pu Isotopic U Isotopic	Mass Spectrometry	PNL-ALO-455
TOC	Total Organic Carbon	7-40.7
TIC	Total Inorganic Carbon	7-40.7

4.4.3 Organic Constituent Analyses

All organic analyses of the samples from Tank 241-B-110 were performed at PNL. The organic analyses performed were Volatile Organic Analyses (VOA), Semi-Volatile Organic Analyses (SVOA), Total Organic Halides (TOX), and Extractable Organic Halides (EOX). Duplicates were performed for all of these analyses. Table 4-3 lists the analyses and procedure numbers (Winters et.al, 1990).

Table 4-3. Analytical Methods For Organic Analyses.

Analysis	Method	Procedure Number
VOA	Gas Chromatography/Mass Spectrometry	PNL-ALO-335
SVOA	Gas Chromatography/Mass Spectrometry	PNL-ALO-345
EOX/TOX	Microcoulometric Titration	PNL-ALO-320

4.5 MODULE SPECIFIC ANALYSES

The characterization program for Tank 241-B-110 was intended to satisfy criteria set by the Tank Waste Remediation System (TWRS). The TWRS sample characterization objectives are to provide adequate description of physical, chemical, and radiological properties of Hanford Site tank wastes to support the resolution of Unreviewed Safety Questions, other safety issues surrounding the Watch List tanks, and the design of retrieval, pretreatment, and final disposal systems (Bell, 1994). For this specific tank, analyses to provide sufficient information to confidently determine whether constituent concentrations are within safe operating limits such as nonflammability and nonexplosiveness were performed.

5.0 ANALYTICAL RESULTS AND WASTE INVENTORY

The chemical, radiochemical, and physical results associated with Tank 241-B-110 are presented within this document as indicated in Table 5-1. The samples from which these results were derived were collected in August of 1989, November of 1989, and May of 1990. These sampling events were the most recent regarding Tank 241-B-110 and reflected the most accurate characterization of the tank waste available at the present time. A detailed discussion of the sampling process was presented in Section 3.

Table 5-1. Analytical Data Presentation Tables

Analysis	Tabulated Results
Characterization Report Results for Tank 241-B-110	Table 5-6
Metals	Table A-2
Ions	Table A-3
Radionuclides	Table A-4
Physical Properties and Miscellaneous Chemical Data	Table A-5
Volatile Organics	Table A-6
Semivolatile Organics	Table A-7

The Appendix A tables present the data acquired from core composition sample analyses (no segment data). Data from all digestion methods are listed. Only data from the preferred method of analysis were used to calculate inventory estimates. A preferred method of analysis for a specific analyte is that method which yielded the best tank concentration as determined by Heasler (1993), or the method which yielded the highest concentration.

The sample data presented in the Appendix A tables were obtained by calculating an average concentration value from the initial and duplicate analyses associated with each sample. If an analyte was detected during the original analysis but not the duplicate, or vice-versa, only the detected result was recorded. When both sample runs failed to detect an analyte, the result was stated to be less the detection limit, < DL. Samples exhibiting analyte concentrations below the reported detection limit were excluded from mean and relative standard deviation calculations.

Weighted mean and relative standard deviation values for most analytes were calculated from a statistical model by Pacific Northwest Laboratory personnel. The results of these calculations were initially reported in the *Statistical Evaluation of Core Samples from Hanford Tank B-110* (Heasler et al., 1993), and this document should be consulted if a complete discussion regarding the statistical methodology is desired. If the statistical model could not be applied to a specific analyte due to insufficient data, a weighted mean was calculated which accounted for differences in the numbers of sampling points used when making up the composite samples.

The projected tank inventory value for Tank 241-B-110 constituents was calculated by multiplying the statistical or weighted mean by the volume of waste in the tank, 931,000 liters (Hanlon, 1994). The appropriate conversion factors were included in the calculations to obtain the reported units.

5.1 CHEMICAL ANALYSES

5.1.1 Elemental Constituents

The major waste constituents identified by Inductively Coupled Plasma (ICP) spectroscopy were Al, Bi, Fe, P, Si, and Na; as noted in Table 5-2, all were present in concentrations exceeding 900 μg/g. Although analyzed, the following elements were not detected in the tank waste: Sb, As, Be, Co, Dy, Li, Rh, Se, Th, and Tl.

Table 5-2. Comparison of Analytical and Historical Data for Elemental Constituents.

Element	Lab Result (μg/g)	Historical Estimate (μg/g)	Relative Percent Difference
Bi	26,400	23,100	13.3 %
Cr	980	575	52 %
Fe	35,600	15,900	76 %
Si	11,300	11,900	- 5.2 %
Na	327,000	105,000	103 %
U	1,030	1,150	- 11 %

The historical estimates for Bi, Cr, Fe, Si, Na, and U (ICF Kaiser Hanford, 1994) were available for comparison with the analytical data; a historical comparison regarding phosphorous is discussed in section 5.1.2. The corresponding relative percent differences between the two sources are presented in Table 5-2 and demonstrate that the analytical results are inconsistent with the historical estimates except with respect to bismuth, silicon, and uranium. No analytical or historical data were available for sulfur. The values listed in Table 5-6 were calculated using the ion chromatography results for sulfate.

5.1.2 Anions

The most abundant anion in the waste of Tank 241-B-110 is nitrate which exhibited a concentration of 1.87E+05 μg/g. Phosphate exhibited the second highest concentration among anions, and sulfate, nitrite, fluoride, and chloride were present in the tank to a lesser extent.

After calculating a value for phosphate from the phosphorous data derived from the ICP analyses, the results were compared to the phosphate data obtained by ion chromatography (IC). The comparison is displayed in Table 5-3, and inspection of the table reveals a large discrepancy between the two values. Since much of the phosphate in Tank 241-B-110 exists as a precipitate, the water leaching preparation associated with the IC analysis would not be expected to extract phosphate as efficiently as the KOH fusion process extracts phosphorous for evaluation by ICP. Therefore, the phosphate result calculated from the ICP data is considered to be more accurate. This conclusion is also supported by the historical data as indicated in Table 5-3. Further discussion of phosphate solubility is presented in Section 7.1.

Historical estimates for nitrate, phosphate, sulfate, and fluoride (ICF Kaiser Hanford, 1994) were available for comparison with the analytical data, and the relative percent differences between the two sources are presented in Table 5-3. As indicated by the table, only the fluoride and phosphate data demonstrated good agreement. The historical data underestimated nitrate and sulfate concentrations but overestimated phosphate. The variations observed between historical data and analytical results, although notable, are not unexpected. The mobility and solubility properties of the ions in the waste, possible chemical changes in the waste over time, and incomplete and inconsistent recordkeeping of historical data (at least for purposes of characterization) contribute to the observed spread between analytical and historical data.

Table 5-3. Comparison of Analytical and Historical Results for 241-B-110 Anions

Analyte	Lab Result (μg/g)	Historical Estimate (μg/g)	Relative Percent Difference
Nitrate	187,000	37,400	134
Nitrite	10,290	4,780	73
Phosphate (IC)	25,300	104,000	- 122
Phosphate (ICP)	78,300	104,000	- 28
Sulfate	11530	2,620	126
Fluoride	1,900	2,180	- 14
Chloride	1,230	90	172

5.2 RADIOLOGICAL DETERMINATIONS

The major radioactive constituents in the waste were ^{137}Cs and ^{90}Sr. The following analytes which are of concern with respect radioactivity were estimated from historical records (ICF Kaiser Hanford, 1994): ^{137}Cs, ^{90}Sr, and isotopic Pu. The analytical and historical results are compared in Table 5-4, and the table demonstrates poor agreement between the two sources of ^{137}Cs data. However, a comparison of ^{137}Cs analytical data results with Total Beta shows close agreement (17% relative percent difference).

Agreement between historical and analytical data within a factor of 2 or 3 is considered reasonable. A difference of an order of magnitude or more is considered substantial and warrants a closer inspection of the data source. In such cases reanalysis, resampling, and/or further inspection of historical estimates is appropriate.

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

Analyte	Lab Result (μCi/g)	Historical Estimate (μCi/g)	Relative Percent Difference
^{137}Cs	14.9	4.52	107%
^{90}Sr	108.4	139	25%
Isotopic Pu	0.11	0.18	48%

5.3 ORGANIC CONSTITUENTS

None of the target analytes associated with the volatile and semi-volatile organic analyses were detected, as indicated by Tables A-6 and A-7, during the evaluation of samples from Tank 241-B-110. Because of their volatile nature and relatively small contribution to the waste as indicated by the historical records, the appearance of these compounds was not expected. Contamination resulting from the sampling process caused several normal paraffin hydrocarbons to appear as tentatively identified compounds during the sample analyses, but these compounds were not considered to be indigenous to the tank.

Since volatile and semi-volatile organic compounds were not detected, the organic carbon present in Tank 241-B-110 is assumed to be in the form of complexants. Inorganic carbon was detected in the core composite samples indicating that carbonate salts have likely precipitated in Tank 241-B-110. The average amount of total inorganic carbon in the tank, 900 μg/g, translates into 4500 μg/g of carbonate. The historical data (ICF Kaiser Hanford, 1994) predicted a carbonate concentration of only 29.3 μg/g.

5.4 PHYSICAL MEASUREMENTS

The core samples from Tank 241-B-110 were analyzed for physical properties in the following manner: pre-homogenization segments were used for the analysis of density, penetration resistance, particle size, and wt% solids, and the homogenized composites were used for the analysis of density (bulk slurry, centrifuged solids, and centrifuged supernate), wt% (centrifuged solids, dissolved solids, total solids, and undissolved solids), vol% (centrifuged solids and settled solids), and rheology. The data from these analyses are presented in Table 5-5.

Table 5-5. Tank 241-B-110 Physical and Rheological Data. (7 pages)

Core 1 Segment Data							
		Units	1	2	3	4	5
Pre-Homogenization Segment Data	Density	g/ml	1.3	1.3	1.3	1.3	1.3
	Penetration Resistance	psi	N/A	< 2	< 2	< 2	< 2
Particle Size (Average Probability)	Number	µm	N/A	1.06	1.22	1.19	0.96
	Volume	µm	N/A	13.43	18.98	16.16	4.93
	Wt% Solids	%	N/A	38.7	40.7	40.5	41.4

Core 1 Composite Data

Rheological Analyses

Pipe Diameter inches	Critical Reynold's Number	Critical Velocity feet/second	Critical Flowrate gpm
2.0	4300-4600	4.7-5.1	50-54
3.0	5500-5700	4.1-4.5	95-105
4.0	6600	3.8-4.2	150-166

Physical Analyses

Bulk Slurry Density (g/ml)	Centrifuged Solids Density (g/ml)	Centrifuged Supernate Density (g/ml)	Wt% Centrifuged Solids	Vol% Centrifuged Solids	Wt% Dissolved Solids	Wt% Total Solids	Wt% Undissolved Solids
1.36	1.55	1.25	46.9	41.6	19.7	40.8	21.1

Table 5-5. Tank 241-B-110 Physical and Rheological Data. (7 pages)

<table>
<tr><th colspan="8">Core 2 Segment Data</th></tr>
<tr><td></td><td></td><td>Units</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td rowspan="2">Pre-Homogenization Segment Data</td><td>Density</td><td>g/ml</td><td>1.24</td><td>1.24</td><td>1.29</td><td>1.28</td><td>1.28</td></tr>
<tr><td>Penetration Resistance</td><td>psi</td><td>< 2</td><td>< 2</td><td>< 2</td><td>< 2</td><td>< 2</td></tr>
<tr><td rowspan="2">Particle Size (Average Probability)</td><td>Number</td><td>μm</td><td>1.38</td><td>1.21</td><td>N/A</td><td>1.14</td><td>0.99</td></tr>
<tr><td>Volume</td><td>μm</td><td>33.58</td><td>10.04</td><td>N/A</td><td>15.41</td><td>13.12</td></tr>
<tr><td></td><td>Wt% Solids</td><td>%</td><td>43.6</td><td>38.1</td><td>40.74</td><td>40.48</td><td>41.44</td></tr>
<tr><th colspan="8">Core 2 Composite Data</th></tr>
<tr><th colspan="8">Rheological Analyses</th></tr>
<tr><td colspan="2">Pipe Diameter inches</td><td colspan="2">Critical Reynold's Number</td><td colspan="2">Critical Velocity feet/second</td><td colspan="2">Critical Flowrate gpm</td></tr>
<tr><td colspan="2">2.0</td><td colspan="2">4200-4700</td><td colspan="2">4.6-5.0</td><td colspan="2">48-52</td></tr>
<tr><td colspan="2">3.0</td><td colspan="2">5200-6200</td><td colspan="2">4.1-4.4</td><td colspan="2">94-100</td></tr>
<tr><td colspan="2">4.0</td><td colspan="2">6000-7600</td><td colspan="2">3.8-4.0</td><td colspan="2">150-159</td></tr>
<tr><td>Bulk Slurry Density (g/ml)</td><td>Centrifuged Solids Density (g/ml)</td><td>Centrifuged Supernate Density (g/ml)</td><td>Wt% Centrifuged Solids</td><td>Vol% Centrifuged Solids</td><td>Wt% Dissolved Solids</td><td>Wt% Total Solids</td><td>Wt% Undissolved Solids</td></tr>
<tr><td>1.33</td><td>1.46</td><td>1.21</td><td>48.6</td><td>44.4</td><td>39.8</td><td>17.2</td><td>22.6</td></tr>
</table>

Table 5-5. Tank 241-B-110 Physical and Rheological Data. (7 pages)

Core 3 Segment Data							
		Units	1	2	3	4	5
Pre-Homogenization Segment Data	Density	g/ml	1.3	1.3	1.3	1.3	1.3
	Penetration Resistance	psi	< 2	< 2	< 2	< 2	< 2
Particle Size (Average Probability)	Number	µm	N/A	1.05	1.89	0.91	1.13
	Volume	µm	N/A	11.18	9.77	12.64	8.48
	Wt% Solids	%	N/A	N/A	41.9	N/A	42.7

Core 3 Composite Data

Rheological Analyses

Pipe Diameter (inches	Critical Reynold's Number	Critical Velocity feet/second	Critical Flowrate gpm
2.0	4000-4600	4.1	43
3.0	4900-6000	3.6	83
4.0	5600-7300	3.3	132

Physical Analyses

Bulk Slurry Density (g/ml)	Centrifuged Solids Density (g/ml)	Centrifuged Supernate Density (g/ml)	Wt% Centrifuged Solids	Vol% Centrifuged Solids	Wt% Dissolved Solids	Wt% Total Solids	Wt% Undissolved Solids
1.36	1.57	1.24	44.8	38.1	13.4	39.6	26.3

Table 5-5. Tank 241-B-110 Physical and Rheological Data. (7 pages)

Core 4 Segment Data							
		Units	1	2	3	4	5
Pre-Homogenization Segment Data	Density	g/ml	N/A	1.3	1.3	1.3	1.3
	Penetration Resistance	psi	N/A	< 2	< 2	< 2	< 2
Particle Size (Average Probability)	Number	μm	N/A	1.87	N/A	1.62	1.49
	Volume	μm	N/A	9.83	N/A	10.97	10.26
	Wt% Solids	%	N/A	37.12	39.62	40.09	42.1
Core 4 Composite Data							
Bulk Slurry Density (g/ml)	Centrifuged Solids Density (g/ml)	Centrifuged Supernate Density (g/ml)	Vol% Centrifuged Solids	Wt% Centrifuged Solids	Wt% Dissolved Solids	Vol% Settled Solids	Wt% Undissolved Solids
1.36	1.45	1.24	57.5	60.8	N/A	100	N/A

Table 5-5. Tank 241-B-110 Physical and Rheological Data. (7 pages)

Core 9 Segment Data							
		Units	1	2	3	4	5
Pre-Homogenization Segment Data	Density	g/ml	N/A	1.23	1.30	1.33	1.24
	Penetration Resistance	psi	N/A	N/A	N/A	N/A	N/A
Particle Size (Average Probability)	Number	μm	N/A	1.33	1.86	2.13	1.42
	Volume	μm		19.89	6.21	7.98	11.41
	Wt% Solids	%	N/A	N/A	39.51	N/A	42.31

Core 9 Composite Data

Rheological Analyses

Pipe Diameter inches	Critical Reynold's Number	Critical Velocity feet/second	Critical Flowrate gpm
2.0	4300-4500	3.5-3.7	37-39
3.0	5100-5300	3.2-3.4	73-77
4.0	N/A	N/A	N/A

Physical Analyses

Bulk Slurry Density (g/ml)	Centrifuged Solids Density (g/ml)	Centrifuged Supernate Density (g/ml)	Wt% Centrifuged Solids	Vol% Centrifuged Solids	Wt% Total Solids	Wt% Dissolve d Solids	Wt% Undissolved Solids
1.32	1.44	1.24	40.7	37.2	38.4	20.6	17.8

Table 5-5. Tank 241-B-110 Physical and Rheological Data. (7 pages)

Core 10 Segment Data							
		Units	1	2	3	4	5
Pre-Homogenization Segment Data	Density	g/ml	1.47	1.25	1.17	1.37	1.36
	Penetration Resistance	psi	N/A	< 2	< 2	< 2	< 2
Particle Size (Average Probability)	Number	μm	N/A	1.41	1.47	1.53	1.05
	Volume	μm	N/A	5.94	7.69	11.77	13.47
	Wt% Solids	%	N/A	N/A	40.7	N/A	42.4

Core 10 Composite Data

Rheological Analyses

Pipe Diameter inches	Critical Reynold's Number	Critical Velocity feet/second	Critical Flowrate gpm
2.0	3800-5400	4.3	45
3.0	4300-6800	3.8-3.9	88-89
4.0	N/A	N/A	N/A

Physical Analyses

Bulk Slurry Density (g/ml)	Centrifuged Solids Density (g/ml)	Centrifuged Supernate Density (g/ml)	Wt% Centrifuged Solids	Vol% Centrifuged Solids	Wt% Dissolved Solids	Wt% Total Solids	Wt% Undissolved Solids
1.34	1.47	1.24	46.6	42.4	21.5	40.7	19.2

Table 5-5. Tank 241-B-110 Physical and Rheological Data. (7 pages)

Core 18 Segment Data							
		Units	1	2	3	4	5
Pre-Homogenization Segment Data	Density	g/ml	1.29	1.28	1.31	1.30	1.21
	Penetration Resistance	psi	< 2	N/A	< 2	< 2	N/A
Particle Size (Average Probability)	Number	μm	1.88	1.25	1.07	1.11	1.17
	Volume	μm	21.65	11.83	10.34	11.26	8.76
	Wt% Solids	%	N/A	N/A	40.25	N/A	42.86

Core 18 Composite Data

Rheological Analyses			
Pipe Diameter inches	Critical Reynold's Number	Critical Velocity feet/second	Critical Flowrate gpm
2.0	4800-7200	5.0-5.5	53-57
3.0	5900-10,700	4.4-4.9	101-113
N/A	N/A	N/A	N/A

Physical Data							
Bulk Slurry Density (g/ml)	Centrifuged Solids Density (g/ml)	Centrifuged Supernate Density (g/ml)	Wt% Centrifuged Solids	Vol% Centrifuged Solids	Wt% Dissolved Solids	Wt% Total Solids	Wt% Undissolved Solids
1.37	1.51	1.24	53.8	48.7	17.2	41.6	24.4

Segment Data

Three tests were run on pre-homogenized segment samples: density, penetration resistance, and wt% solids. The density and penetration analyses were performed as part of the initial description of the extruded segments. The RPD's between the highest and lowest segment density results for Cores 1,2,4,9, and 18 were all ≤ 8% (range = 0.1 g/ml). The RPD between the highest and lowest segment density results for Core 10 was approximately 20% (range = 0.3 g/ml).

Penetration resistance values were < 2 psi, which indicates cohesive properties of the waste in Tank 241-B-110. This is consistent with physical descriptions of the waste as 'creamy' in texture.

Particle size analyses were performed on unhomogenized segments of all cores. The average probability number values ranged from 0.96 μm to 2.13 μm, with an average of 5.8 μm. The average probability volume results ranged from 4.93 μm to 33.58 μm, with an average of 12.7 μm.

The wt% solids analyses were performed as part of the energetics determination. The values were in the same approximate range (37.1 wt% - 43.6 wt%) as were the wt% results for the composite analyses (38.4 wt% - 41.6 wt%).

Composite Data

The bulk slurry density as measured on a composite from each core had a range of 1.32 g/ml to 1.37 g/ml, with an average of 1.36 g/ml. The centrifuged supernate density had a range of 1.21 g/ml to 1.25 g/ml, with an average of 1.23 g/ml. The centrifuged solids vol% and wt% analyses resulted in ranges of 40.7% to 60.8 vol%, and 37.2 wt% to 57.1 wt%, and averages of 45.2 vol% and 49.6 wt%. Wt% dissolved solids (which were not run on Core 4 due to insufficient sample) ranged from 17.2 wt% to 21.5 wt%, with an average of 18.7 wt%. As in the case of dissolved solids, wt% undissolved solids were not run on Core 4. The remaining cores exhibited wt% undissolved solids of 17.8 wt% to 24.4 wt%, with an average of 21 wt%.

The gravimetric wt% solids analytical average of 42 wt% (Appendix A, Table A-5) agrees with the mass balance value of 43.1%, presented in Section 7-1. The resultant wt% water value of 58% is in reasonable agreement with the historical value of 66%. Similarly, the bulk density analytical average value of 1.35 g/ml compares favorably with the historical value of 1.32 g/ml.

Rheology tests were run on composite samples for each core, with the exception of Core 4, which was not analyzed due to insufficient sample. The material exhibited pseudoplastic behavior at low shear rates, showing variation of viscosity values at the yield point from 400 cP at 10 Hertz to 100 cP at 20 Hertz. At higher shear rates, the material exhibited newtonian behavior. The samples began exhibiting linearity at viscosity values of 50 cP at 250 Hertz to 25 cP at 280 Hertz.

Critical Reynold's Numbers for Tank 241-B-110 ranged from 3800 to 5400 for 2.0 inch pipe, 4300 to 10,700 for 3.0 inch pipe, and from 6000 to 7600 for 4.0 inch pipe.

Critical velocities exhibited a smooth transition from smaller to larger pipe sizes, with some overlap. The highest critical velocity for a 2.0 inch pipe was 5.5 feet/second. The lowest critical velocity occurred in a 3.0 inch pipe, and had a value of 3.2 feet/second.

Critical flowrates showed no overlap between pipe sizes. The lowest critical flowrate was 37 gallons/minute and occurred in a 2.0 inch pipe. The highest critical flowrate was 160 gallons/minute, in a 4.0 inch pipe.

No critical flow data were available for Core 4, or for 4.0 inch pipe in Cores 9, 10, and 18.

5.4.1 Energetics

Exotherms were not observed in any of the tank waste samples during the differential scanning calorimetry (DSC) analyses. The DSC plots of the composite samples generally yielded two transition regions. The first transition region, 30°C to 140°C, consisted of either two peaks or a single broad peak attributable to the evaporation of interstitial and hydrated water. The second region which occurred at approximately 300°C was most likely caused by a melting salt, possibly sodium nitrate. Both transition periods were endothermic.

5.5 DATA PRESENTATION

The Tank Characterization Report Results reported in Table 5-6 are the final constituent estimates for this document. The values are equal to the "Mean" values presented in the Appendix A tables. Calculation of the "Mean" value is discussed in Section 5.0. If laboratory results were not available for an analyte, the Tank Characterization Result was, if possible, derived from historical data.

Table 5-6. Tank Characterization Report Data in Single-Shell Tank 241-B-110. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report		Total Tank Inventory
		Heasler (1993)	TCR Result	
Metals	(μg/g)	(μg/g)	(μg/g)	(kg)
Aluminum (Al)	---	1,130	1,430	1,730
Antimony (Sb)	---	---	4,440	5,370
Arsenic (As)	---	---	498	603
Barium (Ba)	---	14.14	145	175
Beryllium (Be)	---	---	2.00	2.42
Bismuth (Bi)	23,100	18,520	21,800	26,400
Boron (B)	---	49.43	11,600	14,000
Cadmium (Cd)	---	5.286	53.8	65.1
Calcium (Ca)	---	809.6	1,090	1,320
Cerium (Ce)	---	---	37.1	44.6
Chromium (Cr)	575	810	---	980
Cobalt (Co)	---	---	< 0.376	< 0.455
Copper (Cu)	---	42.50	218	264
Dysprosium (Dy)	---	---	< 0.0134	< 0.0162
Iron (Fe)	15,900	18,100	29,400	35,600
Lanthanum (La)	---	31.81	83.0	100
Lead (Pb)	---	528.4	650	787
Lithium (Li)	---	---	37.0	44.8
Magnesium (Mg)	---	178.5	---	216

Table 5-6. Tank Characterization Report Data in Single-Shell Tank 241-B-110. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report		Total Tank Inventory
		Heasler (1993)	TCR Result	
Metals (continued)	(μg/g)	(μg/g)	(μg/g)	(kg)
Manganese (Mn)	---	66.78	98.2	119
Mercury (Hg)	---	---	1.09	1.32
Molybdenum (Mo)	---	13.54	55.5	67.2
Neodymium (Nd)	---	15.86	---	19.2
Neptunium (Np)	---	---	---	---
Nickel (Ni)	---	18.63	---	22.4
Phosphorus (P)	---	16,100	25,600	31,000
Plutonium (Pu)	---	---	---	---
Potassium (K)	---	311.6	504	610
Rhenium (Re)	---	6.50	71.0	85.9
Rhodium (Rh)	---	---	< 0.114	< 0.138
Ruthenium (Ru)	---	111.3	157	190
Selenium (Se)	---	---	909	1,100
Silicon (Si)	---	9,358	---	11,300
Silver (Ag)	---	46.73	143	173
Sodium (Na)	1.05E+05	97,730	2.70E+05	3.27E+05
Strontium (Sr)	---	211	211	255
Sulfur (S)	---	---	3,840	4,650
Tin (Sn)	---	---	---	---
Tellurium (Te)	---	---	17.8	21.5
Thorium (Th)	---	---	< 0.140	< 0.169
Titanium (Ti)	---	8.413	38.3	46.3
Thallium (Tl)	---	---	< 2.93	< 3.55
Uranium (U)	11,500	208	849	1,030
Vanadium (V)	---	2.788	---	3.35
Zinc (Zn)	---	80.51	203	246
Zirconium (Zr)	---	6.25	487	589
Ions	(μg/g)	(μg/g)	(μg/g)	(kg)
Ammonia (NH_3)	---	263	---	331
Carbonate (CO_3^{2-})	29.30	---	---	35.5
Chloride (Cl^-)	---	1,234	---	1,550
Chromium (VI)(Cr^{+6})	---	41.5	---	52.3
Fluoride (F^-)	2,180	1,895	---	2,390
Hydroxide (OH^-)	20,000	---	---	24,200

Table 5-6. Tank Characterization Report Data in Single-Shell Tank 241-B-110. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report		Total Tank Inventory
		Heasler (1993)	TCR Result	
Ions (continued)	(μg/g)	(μg/g)	(μg/g)	(kg)
Nitrate (NO_3^-)	37,400	1.87E+05	---	2.36E+05
Nitrite (NO_2^-)	---	10,290	---	13,000
Phosphate (PO_4^{3-})	1.04E+05	25,250	---	31,800
Sulfate (SO_4^{2-})	2,620	11,530	---	14,500
Radionuclides	(μCi/g)	(μCi/g)	(μCi/g)	(Ci)
Americium-241	---	0.0725	---	87.7
Carbon-14	---	---	0.00812	11.0
Cerium-144	---	---	0.132	160
Cesium-134	---	---	0.0559	67.6
Cesium-137	---	14.9	---	18,000
Cobalt-60	---	0.0153	---	18.5
Curium-243/244	---	0.00128	---	1.55
Europium-152	---	0.0675	---	81.7
Europium-154	---	---	0.168	203
Europium-155	---	---	0.216	261
Gadolinium-153	---	---	0.181	219
Iodine-129	---	3.61E-05	---	0.0437
Neptunium-237	---	1.12E-04	---	0.136
Plutonium-238	---	0.00321	---	3.88
Plutonium-239/240	---	---	0.112	136
Ruthenium-106	---	---	0.138	167
Strontium-90	---	108	---	1.31E+05
Technetium-99	---	0.0165	---	21.2
Tritium	---	0.00217	---	2.63
Total Alpha	---	0.156	---	189
Total Beta	---	183	---	2.21E+05
Physical Properties				
pH	---	8.17	8.17	---
Bulk Slurry Density	---	1.35	1.35	---
Centrifuged Solid Density	---	1.50	1.50	---
Centrifuged Supernate Density	---	1.24	1.24	---
Wt % Solid	---	41.86	41.9	---
TIC	---	900	---	1,130
TOC	---	381	---	480

6.0 ANALYTICAL RESULTS INTERPRETATION

6.1 TANK WASTE PROFILE

Examination of the analytical results reveals that the waste in Tank 241-B-110 is composed of an identifiably different top layer which covers a relatively homogeneous sludge. Differentiation of constituents comprising the two layers was not feasible due to the lack of substantial sample data specific to the upper segments. The waste is approximately 89 wt% solids (the solids mass minus the mass of the supernatant and interstitial liquids, divided by the total waste mass). The waste solids themselves are 42 wt% solids and 58 wt% water. The following elements and anions are most abundant: Al, Bi, Fe, P, Na, nitrate, and phosphate. The major radionuclides are ^{137}Cs and ^{90}Sr.

6.2 WASTE SUMMARY AND CONDITIONS

6.2.1 Spatial Variability Observations

Three indications of spatial variability were observed in Tank 241-B-110: the first relates to the varying types of waste added to Tank 241-B-110 over its fill history; the second was the observation of the hot cell chemist; the third was the statistical evaluation of the analytical data.

The first indication of spatial variability is the fill history of Tank 241-B-110. The majority of solids in the tank resulted from second cycle decontamination (2C) waste additions prior to 1953 (See Section 2.0). The addition of 5-6# waste probably contained the bulk of the strontium activity, and is most likely responsible for the formation of the upper, distinct layer of the waste.

The hot cell chemist observed that both of the recovered segment 1's were a dark brown color, and that the segment 2's changed in color from a dark brown at the top to a lighter brown or tan at the bottom. The presence of this darker brown near the surface in Tank 241-B-110 is interpreted as a defined layer, and probably has a different makeup than the bulk of the waste material.

This interpretation is supported by the statistical analysis, which showed two distinct layers in the tank (Heasler, 1993). Segment 1 and part of segment 2 consisted of 5-6# waste, whereas the remainder of segment 2 and all of segments 3 to 5 consisted of a 2C waste layer. No information was available on the homogeneity of the upper layer. The sludge was generally homogeneous except for a slight vertical variance. Table 6-1 shows how Total Beta, produced mainly from ^{90}Sr decay, varied by riser and segment. Cores 1 and 2 have the most complete and reliable data, and seem to indicate that the upper segment from each core contains a layer which exhibits a substantially higher Total Beta activity. Therefore, the upper portion of the tank may contain more radioactivity than the sludge layer.

Table 6-1. Total Beta (µCi/g) compared by Segment and Riser.

Segment	Riser 7		Riser 5, 6		Riser 1	Riser 3	
	Core 1	Core 2	Core 3	Core 16	Core 4	Core 9	Core 10
1	*	1240	*	*	*	18.2	*
2	964	18.5	*	*	*	*	*
3	254	15.0	144	17.1	*	*	12.7
4	22.6	14.0	*	*	*	*	*
5	99.8	11.5	13.6	11.8	*	12.7	12.6

* Data not available

6.2.2 Leak Inventory Estimate

In 1981, Tank 241-B-110 was designated a Confirmed Leaker after losing nearly 37,900 L (10,000 gallons) of waste for unknown reasons. An estimated inventory for this lost waste has been generated. These values, which were derived from the analyses of waste samples prepared by water digestion, estimate the concentration of leachate constituents; they are presented in Table 6-2. Simple average calculations were performed to acquire the values, and suspected outliers were not eliminated from the data. The following *Resource Conservation and Recovery Act* (EPA, 1990) regulated metals were not detected in samples prepared by water digestion and subsequently analyzed by ICP: arsenic, barium, and selenium. Therefore, their presence in the leachate is improbable.

Table 6-2. Estimated Inventory Leaked From Tank 241-B-110.

Analyte	Estimated Concentration Leaked	Estimated Mass Leaked[1]	Analyte	Estimated Concentration Leaked	Estimated Mass Leaked[1]
Metal	(µg/g)	(kg)	**Metal**	(µg/g)	(kg)
Calcium (Ca)	23.5	1.10	Potassium (K)	504	23.7
Chromium (Cr)	121	5.66	Silicon (Si)	758	35.6
Iron (Fe)	184	8.66	Silver (Ag)	15.2	0.714
Magnesium (Mg)	6.40	0.301	Sodium (Na)	1.70E+05	7,990
Molybdenum (Mo)	9.20	0.432	Uranium (U)	1.11	0.052
Ion	(µg/g)	(kg)	**Ion**	(µg/g)	(kg)
Ammonia (NH_3)	263	12.4	Nitrite (NO_2^-)	10,300	484
Chloride (Cl^-)	1,230	58.0	Phosphate (PO_4^{-3})	25,300	1190
Fluoride (F^-)	1,900	89.0	Sulfate (SO_4^{-2})	11,500	542
Nitrate (NO_3^-)	1.87E+05	8,790			
Radionuclide	(µCi/L)	(Ci)	**Radionuclide**	(µCi/L)	(Ci)
Cesium-137	8.44	0.320	Strontium-90	0.106	0.00402

[1]'Estimated Mass Leaked' column was calculated using a density of 1.24 g/ml.

6.2.3 Projected Tank Heat Load

Temperature information for Tank 241-B-110 was given in section 2.5. It is unclear whether the temperature fluctuations are caused by ambient temperature changes, calibration problems with the thermocouples, or radiological heating. The amount of heat resulting from radioactivity in the tank was calculated in Table 6-3. Through the use of conversion factors, the reported heat load of 977 Watts translates into a tank temperature increase of approximately 6.1 °C/year (11.0°F). The temperature of the tank generally ranges between 60 and 90°F. Since an upper temperature limit is exhibited, it may be concluded that any heat generated from radioactive sources throughout the year is dissipated.

Table 6-3. Tank 241-B-110 Projected Heat Load.

Radionuclide	Ci	Watts
^{241}Am	87.7	2.88
^{144}Ce	160	1.28
^{134}Cs	67.6	0.690
^{137}Cs	18,000	85.0
^{60}Co	18.5	0.285
$^{243/244}Cm$	1.55	0.0533
^{152}Eu	81.7	0.618
^{154}Eu	203	1.83
^{155}Eu	261	0.190
^{129}I	0.0437	2.05E-05
^{237}Np	0.136	3.92E-03
^{238}Pu	3.88	0.126
$^{239/240}Pu$	136	4.16
^{106}Ru	167	1.61
^{90}Sr	1.31	878
^{99}Tc	21.2	0.0106
^{3}H	2.63	8.87E-05
Watts	977	

6.3 PROGRAM ELEMENT SPECIFIC ANALYSES

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

This Tank Characterization Report is the final step in the characterization of Tank 241-B-110. According to the process and issue based data requirements, the inventory estimates and waste properties contained in this report can be applied to the data requirements of the various program elements. Contained in Table 6-4 is a summary of which program data needs are fulfilled through this characterization of the waste in Tank 241-B-110, based on a review of the stated sampling and analysis requirements. In the future, the applicability of Tank Characterization Report results to each TWRS program element will be documented in tank specific Tank Characterization Plans, prior to the tank sampling.

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

Data Quality Objective	**Applicability to Characterization of Tank 241-B-110**
Tank Safety Screening	applies[1]
Ferrocyanide Safety Issue	does not apply
Flammable Gas Tanks Crust Burn Issue	does not apply
Generic Tank Vapor Issue Resolution	not addressed
Flammable Gas Tank	not completed
Waste Compatibility	does not apply
Organic Fuel Rich Tank	does not apply
Rotary Core Vapor Sampling	does not apply
Evaporator Operations	not completed
Process Control	not completed
Waste Tank Retrieval	not completed
Waste Tank Pretreatment	not completed
High-Level Waste Immobilization	not completed
Low-Level Waste Immobilization	not completed
Solid, Low-Level Waste Disposal	not completed
RCRA Part B Permit Application	not completed
Tank C-106 High-Heat Safety Issue	does not apply

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

Data Quality Objective	Applicability to Characterization of Tank 241-B-110
Organic Layer Sampling of Tank C-103	does not apply
Tank C-103 Vapor and Gas Sampling	does not apply

[1]The sampling requirement for the Safety Screening Data Quality Objective (Babad, 1994) calls for both vertical waste samples and a vapor space sample. The sampling and analysis of Tank 241-B-110 supports full characterization of the waste in the tank; vapor space sampling or characterization was not conducted as part of this activity.

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

does not apply - The data needs expressed in this Data Quality Objectives document do not apply to the waste in Tank 241-B-110.

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

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

7.0 STATISTICAL INTERPRETATION

7.1 MASS AND CHARGE BALANCE

7.1.1 Introduction

The principle objective in performing a mass and charge balance is to determine if the measurements are self-consistent. Mass and charge balance calculations also provide a method for estimating the weight percent of water. In calculating the balances, only analytes detected at a concentration of 500 μg/g or greater were considered. The chemical compounds assumed to be present in the waste and the corresponding analytes are shown in Table 7-1.

Mass and charge balance results are reported in Table 7-2. The identity of the analytes is shown in the left-most column. The next three columns list the raw analytical data. Mass ratios between the assumed species and the corresponding analytes are used to convert from analyte concentrations to assumed-species concentrations which are shown in the last three columns.

7.1.2 Calculations and Discussion

The charge balance is the ratio of cation microequivalents to anion microequivalents. Since the anion data are obtained only from water digest ion chromatography (IC.w), the anions to be considered are those that will form water-soluble species.

Total cation (microequivalents) = $[Na^+]/23.0$

Total anion (microequivalents) =
$[(CO_3)^{2-}]/30.0 + [Cl^-]/35.5 + [F^-]/19.0 + [(NO_3)^-]/62.0 +$
$[(NO_2)^-]/46.0 + [(PO_4)^{3-}]/31.7 + [(SO_4)^{2-}]/48.0$

The analytes were assumed to be present in their most common hydroxide or oxide forms. For example, aluminum hydroxide, $Al(OH)_3$, is taken as the assumed species for the aluminum analyte. Although smaller concentrations of other forms of aluminum such as aluminosilicate are probably also present in the waste, they are not included in order to keep the mass-charge balance calculations simple and consistent.

Phosphorus is determined by inductively coupled plasma (ICP) and phosphate is determined by ion chromatography (IC). Assuming that all the phosphorus is present as phosphate and converting the phosphorus concentration accordingly yields a concentration of 71,100 μg/g, approximately three times the IC value for phosphate of 25,000 μg/g. This indicates that approximately one third of the phosphate is water-soluble and can be accounted for as Na_3PO_4 while two thirds of it are water-insoluble and can be accounted for as $BiPO_4$.

The charge balance results range from unusually large values of 2.56 and 1.46 for the water and acid digests, respectively to a more reasonable value of 0.93 for the fusion digest. This range reflects the wide discrepancy between the acid and fusion digest values for phosphorus and sodium. These values are expected to be approximately the same since the respective compounds should be completely dissolved in both analytical treatments.

Table 7-1. Assumed Species if Different than Analyte.

Analyte	Assumed Species
Al	$Al(OH)_3$
Bi	Bi^{3+}
Ca	$Ca(OH)_2$
Cr	CrO_3
Fe	FeO(OH)
Pb	PbO_2
P	$(PO_4)^{3-}$
Si	SiO_2
Na	Na^+
TIC	$(CO_3)^{2-}$

Table 7-2. Tank 241-B-110 Mass and Charge Balance. (2 pages)

Analyte	Concentrations (μg/g) from Analytical Data			Concentrations (μg/g) from Assumed Species		
Method	**ICP.w**	**ICP.a**	**ICP.f**	**ICP.w**	**ICP.a**	**ICP.f**
Al		1130	1430		3260	4130
Bi		21800	18500		21800	18500
Ca		810	1090		1500	2020
Cr		810	796		1560	1530
Fe		29400	18100		46800	28800
Pb		528	650		610	750
P	23200	25600	16100	71100	78500	49300
Si	1210	945	9360	2590	2020	20000
Na	2.70E5	1.53E5	97700	2.70E5	1.53E5	97700
Method	**IC.w**			**IC.w**		
TIC	900			4500		
Cl^-	1230			1230		
F^-	1900			1900		
$(NO_3)^-$	1.87E5			1.87E5		
$(NO_2)^-$	10300			10300		
$(PO_4)^{3-}$	25300			25300		
$(SO_4)^{2-}$	11500			11500		

Table 7-2. Tank 241-B-110 Mass and Charge Balance. (2 pages)

Analyte	Concentrations (µg/g) from Analytical Data			Concentrations (µg/g) from Assumed Species		
TOTAL						
(+)				11700	6650	4250
(-)				4560	4560	4560
(+/-)				2.57	1.46	0.93
[x]				560000	525000	439000
% Water				44.0	47.5	56.0

(+) = cation
(-) = anion
(+/-) = charge balance
[x] = analyte concentration

The mass balance can be calculated from the formula below. The factor 0.0001 is the conversion factor from µg/g to weight percent. The ICP value for phosphate, which includes both water-soluble and water-insoluble forms of phosphate, is used in calculating the total concentration instead of the IC value.

Mass balance = % Water + 0.0001 x {Analyte Concentration}
= % Water + 0.0001 x {$[Al(OH)_3]$ + $[Bi^{3+}]$ + $[Ca(OH)_2]$ + $[CrO_3]$ + $[FeO(OH)]$ + $[PbO_2]$ + $[SiO_2]$ + $[Na^+]$ + $[(CO_3)^{2-}]$ + $[Cl^-]$ + $[F^-]$ + $[(NO_3)^-]$ + $[(NO_2)^-]$ + $[(PO_4)^{3-}]$ + $[(SO_4)^{2-}]$}

However, since the experimental value for % water is not available, a mass balance cannot be obtained. Instead, only a total concentration of all the major species can be calculated. These total concentration values are higher, as expected, than the analytical weight percent of solids, 41.9%, because they also include water-soluble species. Furthermore, if a mass balance of 1.00 is assumed, a % water can be estimated.

7.2 STATISTICAL ANALYSIS

7.2.1 Introduction

This section contains the results of a statistical analysis of data for Tank 241-B-110 (Heasler et al., 1993). Five topics are addressed here: the horizontal and vertical components of tank waste spatial variability, the repeatability of core sample measurements, the ability of the 222-S Process and Analytical Laboratory to homogenize core segments, the comparability of composite and segment-level sampling estimates, and the analytical errors associated with the different variance components.

Seven core samples were extracted through two riser pairs located at opposite ends of Tank 241-B-110 (see Figure 3-1). The riser pairs were about 10 feet apart, while the risers at opposite ends of the tank were separated by 70 feet. Replicate cores were taken from risers 3, 7, and 5,6 to evaluate sampling repeatability. Riser location 5,6 actually consisted of two risers (5 and 6) separated by about 3 feet. Since they were so close, they were statistically grouped into one riser location and treated as a duplicate pair. Each core consisted of five sequentially extracted 19-inch segments. Two separate mixing procedures formed two different types of samples: segment-level and composite-level samples. Homogenized segment-level samples were created by mixing (using a milkshake-like blender) the contents of a segment to produce samples yielding information about vertical (segment to segment) and horizontal (riser to riser) variations in the tank. The composite samples were created by mixing portions of each segment-level sample from a core together to produce samples yielding information about only vertical (riser to riser) variations in the tank. If the mixing step is efficient, the composite sample should provide the best data for determining average analyte concentration in a core (or tank). For both the homogenized segment-level and composite-level samples, two replicates were analyzed to evaluate the adequacy of mixing, and two aliquots from each replicate to determine the analytical error for each replicate.

Table 7-3 illustrates the number of constituents analyzed from a given core/segment and how they were spatially distributed. An important point made by this table is that the measurements are not balanced from location to location in the tank. This makes it difficult to compare the results obtained for different constituents since any difference in average concentration may simply be due to their being sampled at different locations. Analysis of variance (ANOVA) procedures can mitigate the effects of unbalanced data to a degree, but when too much data is missing, it is not possible to obtain unbiased results. There was not sufficient information to assess the magnitude of this bias. This problem is especially acute for the segment-level data, since 13 out of 35 possible segments were not recovered by the sampler. Thus, segment level chemical analyses were not obtained for these locations. Segment 1 data was so limited that it was analyzed separately from the rest of the information. Segment 1 was entirely composed of a waste layer that was observed to be much different visually and in chemical composition from the rest of the waste, based on an analysis of the limited data available.

Table 7-3. Overview of Number of Chemical Constituents Measured in Tank 241-B-110.

Segment	Riser 7		Riser 5, 6		Riser 1	Riser 3	
	Core 1	Core 2	Core 3	Core 16	Core 4	Core 9	Core 10
1	0	12	0	0	0	3	0
2	52	54	0	0	49	0	0
3	52	52	52	18	50	50	60
4	52	54	0	0	50	0	0
5	52	53	53	18	50	53	60

Approximately 40% of the chemically analyzed measurements on Tank 241-B-110 samples were not utilized in the ANOVAs for one or more of the following reasons: the measurements associated with some constituents were too incomplete, too many of the measurements were below the detection limit, and only data measured using the most "accurate" chemical analysis method (preferred method) for a given analyte was used.

7.2.2 Significance Tests on Variance Components

Tables 7-4 and 7-5 give the ANOVA results of significance tests conducted on the segment-level and composite-level variance components, respectively. These tests determine whether or not analyte concentrations are significantly different from each other between locations (at the $p=0.05$ level of significance). If the value for a given constituent is less than 0.05, then that variance component is significantly different from zero. The tests were only conducted on those constituents for which a complete set of data was available to estimate the variance components. These analyses were performed only on the data provided by Heasler et al. (1993).

Spatial variability is described by two terms: riser and segment variance. The riser term measures horizontal variability, while the segment term measures vertical variability. The riser p-values for both tables were generally not significant from zero, indicating that the tank contents are homogeneous in the horizontal direction.

Since vertical variability can only be estimated from segment level data, the pertinent p-values are found only in Table 7-4. Six of the 16 analytes considered were significantly different from zero, indicating a general, if moderate, vertical variation. This analysis was conducted on segments 2-5 only, which eliminated the heterogeneous effect of including the segment 1 layer data, and therefore describes only a portion of the tank vertical variability. Nevertheless, segment 2 contained varying amounts of this material also, which may have skewed the data toward heterogeneity. If the effect of the crust in segment 2 was eliminated, the tank would have been reasonably homogeneous vertically.

Table 7-4a lists the six analytes that were found to have significant concentration differences between sample locations. Uranium, nitrite, TIC, and ^{137}cesium decrease in concentration with increasing depth, while nitrate and phosphate behave in the opposite manner. The largest change in concentration was an eight-fold difference for uranium.

In summary, the tank is composed of two layers that are chemically different from each other: a distinct layer on top and a sludge layer beneath. Information on whether the top layer was homogeneous or not was unavailable, but the sludge layer beneath is generally homogeneous with only a slight vertical variation shown by several analytes.

The core term is derived from the three duplicate cores taken from three of the four risers, and describes how repeatable core sampling is. The two tables revealed many analytes which were significantly different from zero, indicating that the present core sampling procedure is not producing a repeatable description of the tank contents, at least not at the segment level. The core p-values are in fact the largest component of variation for all the analytes tested except the anions in Table 7-4.

Table 7-4. Level of Significance for Segment-Level Variance Components in Tank 241-B-110.

Constituent	Variance component P-values			
	Riser	Segment	Core	Homog.
CATIONS				
Bismuth	0.11	0.60	0.00*	0.14
Iron	0.66	0.17	0.001*	0.85
Sodium	1.00	0.09	0.28	0.18
Phosphorus	0.94	0.20	0.07	0.20
Silicon	0.02*	0.24	0.07	0.84
Uranium	1.00	0.001*	0.00*	1.00
ANIONS				
Chloride	0.06	1.00	1.00	0.00*
Fluoride	1.00	0.07	1	0.00*
Nitrate	1.00	0.001*	1.00	0.20
Nitrite	1.00	0.00*	1.00	0.00*
Phosphate	0.99	0.01*	1.00	0.65
Sulfate	1.00	0.21	1.00	0.00*
TIC-Total Inorganic Carbon	1.00	0.00*	1.00	0.00*
TOC-Total Organic Carbon	0.92	0.12	1.00	0.001*
RADIONUCLIDES				
^{60}Cobalt	0.56	0.12	0.80	0.73
^{137}Cesium	1.00	0.002*	1.00	0.01*

* Significant at the p=0.05 level.

Table 7-4a. Analyte Concentration vs Depth (ppm or μCi/g).

Analyte	Segment 2	Segment 3	Segment 4	Segment 5
Uranium	450	170	60	60
Nitrate	143,000	166,000	177,000	186,000
Nitrite	15,500	11,400	7,000	4,000
Phosphate	21,200	24,500	24,000	26,500
TIC	1,800	800	400	400
^{137}Cesium	14.7	14.8	13.2	12.2

Table 7-5. Level of Significance for Composite-Level Variance Components in Tank 241-B-110.

Constituent	Variance component P-values		
	Riser	Core	Homog.
CATIONS			
Bismuth	0.154	0.049*	0.691
Iron	0.703	0.004*	1.000
Sodium	0.576	0.240	0.912
Phosphorus	1.000	0.004*	1.000
Silicon	0.269	0.124	0.956
Uranium	0.815	0.000*	0.367
RADIONUCLIDES			
^{241}Americium	0.066	0.009	1.000
^{243,244}Curium	1.000	0.249	1.000
^{60}Cobalt	1.000	1.000	0.953
^{137}Cesium	0.255	0.021*	0.103
^{129}Iodine	1.000	0.003*	1.000
^{237}Neptunium	0.491	1.000	0.061
^{238}Plutonium	1.000	0.028*	0.146
^{90}Strontium	0.028*	0.553	1.000
^{99}Technitium	0.525	0.407	0.262

* Significant at the $p=0.05$ level.

The homogenization p-values were usually the smallest component of variation for the analytes tested. An exception appears to be the anions in Table 7-4. Of the eight anions tested, six were significantly different from zero. However, their homogenization p-values were comparable in magnitude to the laboratory measurement errors, and not considered to be large.

In a comparison of concentration estimates calculated from composite samples and segment-level samples, no significant differences were found in 87% of the cases. In the 13% of the cases where significant differences were found, many were due to the fact that the segment-level data were unbalanced and therefore did not produce unbiased estimates. This indicates that the two sampling methods yielded similar results, and supports the conclusion that the homogenization process is adequate.

7.2.3 Estimates of Variance Components

Tables 7-6 and 7-7 provide the relative standard deviation (RSD) estimates for the variance components of the segment-level and composite-level analyses, respectively. An RSD is the ratio of a standard deviation to a mean. It is a unitless measurement of variability and allows comparisons of variability across constituents whose magnitudes might widely differ.

The first column in the tables identifies the constituent, followed by several containing the RSDs for each variance component. The last two columns contain the estimated mean concentration and the overall RSD. These analyses were performed only on the data provided by Heasler et al. (1993).

The average concentration of a typical constituent has an RSD of about 10%. However, the uncertainty ranges from a few percent up to about 100%. One factor that affects this uncertainty is the number of measurements made on each constituent. Some constituents were measured quite extensively, while others had little data.

It is difficult to make generalizations about the relative magnitudes of the variance components. However, it could probably be said that the homogenization procedure was the smallest source of variability, measurement variability next, followed by horizontal variability, and sampling variability (core and segment replication error) the largest.

Table 7-6. Relative Standard Deviations for the Estimates of Variability, Segment-Level Data, Tank 241-B-110. (3 pages)

Analyte	Riser	Seg	Core	Homog	Lab	Mean (ppm)	RSD (mean)
CATIONS							
Al	0	0	1.324	*	0.078	383.2	0.312
Ba	0	0.100	0.164	*	0.062	12.82	0.050
Bi	0.139	0.048	0.101	0.031	0.046	17,730	0.075
B	1.109	0	0.108	*	0.094	115	0.556
Cd	0	0	0.406	*	0.193	5.25	0.101
Ca	0.338	0.422	0.269	*	0.078	746.4	0.222
Cr	0.038	0	0.098	*	0.029	821.2	0.031
Cu	0	0.123	0.404	*	0.239	25.08	0.110
Fe	0.052	0.059	0.053	0.008	0.037	15,750	0.034
La	0	0	1.8	*	0.091	16.67	0.425
Li	0.379	0	1.326	*	0.207	6.974	0.375
Pb	0	0	1.118	*	0.044	347.3	0.264
Mg	0	0.146	0.180	*	0.041	159	0.061
Mn	0.039	0	0.233	*	0.056	54.29	0.060
Mo	0.384	0	1.287	*	0.260	20.09	0.370
Nd	0	0	1.389	*	0.430	20.97	0.335

Table 7-6. Relative Standard Deviations for the Estimates of Variability, Segment-Level Data, Tank 241-B-110. (3 pages)

Analyte	Riser	Seg	Core	Homog	Lab	Mean (ppm)	RSD (mean)
CATIONS (continued)							
Ni	0.193	0	1.159	*	0.218	30.13	0.295
P	0.046	0.071	0.053	0.030	0.045	15,570	0.034
K	0	0.147	0.268	*	0.208	356.9	0.085
Re	0.402	0.227	0.238	*	0.332	8.305	0.229
Ru	1.07	0	0.245	*	0.063	55.38	0.539
Si	0.086	0.038	0.031	0.008	0.035	8,275	0.045
Ag	0	0.715	1.022	*	0.272	11.51	0.325
Na	0	0.045	0.024	0.027	0.032	92,770	0.016
Sr	0.261	0.125	0.047	*	0.028	209.2	0.137
Te	0.689	0.301	0.377	*	0.467	27.48	0.379
Ti	0	0.178	0.585	*	0.207	6.338	0.152
U	0	0.999	0.306	0	0.142	142.1	0.363
V	0.373	0	0.509	*	0.375	2.557	0.236
Zn	0	0.507	0.203	*	0.055	87.85	0.155
Zr	0	0	0.625	*	0.268	7.017	0.154
ANIONS							
Cl	0.097	0	0	0.095	0.049	1,090	0.054
F	0	0.208	0	0.125	0.065	1,775	0.066
NO3	0	0.116	0	0.030	0.046	170,900	0.035
NO2	0	0.524	0	0.080	0.034	8,776	0.152
PO4	0.071	0.139	0	0.026	0.076	24,550	0.056
SO4	0	0.050	0	0.044	0.028	10,860	0.018
TIC	0	0.650	0	0.151	0.069	807.1	0.191
TOC	0.120	0.221	0	0.167	0.112	468.2	0.097
RADIONUCLIDES							
^{241}Am	0.083	0.175	*	0	0.101	7.29E-03	0.110
$^{243,244}Cm$	1.074	0.619	*	0	0.697	1.48E-03	0.849
^{60}Co	1.514	1.74	0.308	0.332	0.820	0.105	0.965
^{137}Cs	0	0.114	0	0.051	0.052	13.61	0.035
^{152}Eu	*	0	*	*	0.648	0.014	0.324
^{129}I	0.379	0	*	0	0.069	5.75E-05	0.269
^{237}Np	0.467	0	*	0	0.290	6.46E-05	0.342

Table 7-6. Relative Standard Deviations for the Estimates of Variability, Segment-Level Data, Tank 241-B-110. (3 pages)

Analyte	Riser	Seg	Core	Homog	Lab	Mean (ppm)	RSD (mean)
RADIONUCLIDES (continued)							
^{238}Pu	1.104	0	*	0	0.554	3.85E-03	0.800
^{90}Sr	0	0.527	*	0	0.150	0.673	0.267
^{99}Tc	0	0.618	*	0	0.073	0.0115	0.31

* Data was not available to estimate this effect.

Table 7-7. Relative Standard Deviations for the Estimates of Variability, Composite Level Data, Tank 241-B-110. (2 pages)

Analyte	Riser	Core	Homog	Lab	Mean (ppm)	RSD (mean)
CATIONS						
Al	0	0.413	*	0.011	1,133	0.156
Ba	0	0.115	*	0.027	14.14	0.044
Bi	0.122	0.068	0.020	0.067	18,520	0.068
B	0	0.333	*	0.176	49.43	0.134
Cd	0	0.291	*	0.226	5.286	0.125
Ca	0	0.185	*	0.027	809.6	0.070
Ce	0	0.727	*	0.149	37.14	0.278
Cr	0.039	0.042	*	0.006	810	0.025
Cu	0.526	0.184	*	0.217	42.52	0.280
Fe	0.055	0.075	*	0.049	18,060	0.041
La	0.445	0.510	*	0.037	31.81	0.297
Pb	0.202	0.528	*	0.036	528.4	0.225
Mg	0	0.105	*	0.024	178.5	0.040
Mn	0	0.287	*	0.011	66.78	0.108
Mo	0.222	0.994	*	0.176	13.54	0.396
Nd	0.343	0.632	*	0.194	15.86	0.301
Ni	0	0.096	*	0.085	18.63	0.043
P	0	0.109	0	0.088	16,060	0.044
K	0	0.095	*	0.115	311.6	0.048
Re	0	0.104	*	0.148	6.5	0.056
Ru	0	0.644	*	0.027	111.3	0.244
Si	0.061	0.042	0.004	0.052	9,358	0.036
Ag	0.996	0.148	*	0.065	46.73	0.502
Na	0.055	0.039	0.009	0.052	97,730	0.033
Sr	0.187	0.047	*	0.005	211	0.095
Te	0.358	0.278	*	0.227	19.26	0.218
Ti	0.143	0.367	*	0.123	8.413	0.160
U	0.102	0.181	0.025	0.039	208	0.087
V	0	0.479	*	0.103	2.788	0.183
Zn	0.105	0.143	*	0.022	80.51	0.076
Zr	0	0.292	*	0.046	6.25	0.12

Table 7-7. Relative Standard Deviations for the Estimates of Variability, Composite Level Data, Tank 241-B-110. (2 pages)

Analyte	Riser	Core	Homog	Lab	Mean (ppm)	RSD (mean)
ANIONS						
Cl	0.075	0.135	*	0.023	1,234	0.064
F	0.091	0.111	*	0.041	1,895	0.063
NO3	0.162	0.007	*	0.031	187,100	0.081
NO2	0	0.101	*	0.021	10,290	0.039
PO4	0.072	0	*	0.045	25,250	0.038
SO4	0.124	0.035	*	0.018	11,530	0.064
TIC-Total Inorganic Carbon	0.033	0.169	*	0.067	899.5	0.069
TOC-Total Organic Carbon	0	0.151	*	0.081	381.2	0.061
RADIONUCLIDES						
^{241}Am	0.681	0.150	0	0.090	0.0725	0.347
^{243,244}Cm	0.889	0.422	0	0.379	1.28E-03	0.500
^{60}Co	0	0	1.022	1.71	0.0153	0.445
^{137}Cs	0.072	0.028	0.014	0.020	14.9	0.038
^{152}Eu	0.483	*	0	0.337	0.0675	0.386
^{3}H	0.061	0.902	*	0.309	2.17E-03	0.352
^{129}I	0	0.929	0	0.290	3.61E-05	0.385
^{237}Np	0.399	0	0.442	0.241	1.12E-04	0.248
^{238}Pu	0	0.587	0.134	0.138	3.21E-03	0.245
^{90}Sr	0.808	0.083	0	0.173	108.4	0.408
^{99}Tc	0.254	0.103	0.074	0.086	0.0165	0.140

* Data was not available to estimate this effect.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 SAFETY ISSUES

Characterization of Single-Shell Tank 241-B-110 supports the classification of the tank as non-Watch List. Given the current tank inventory of fissionable radionuclides and organic or exothermic waste constituents, no credible potential exists for further loss of tank integrity or release of radioactivity due to in tank processes. Tank 241-B-110 is a Confirmed Leaker; however the liquid volume and waste level in the tank have remained relatively constant since 1982 (ICF Kaiser Hanford, 1994). Tank 241-B-110 is within established operating safety requirements, as defined by applicable Data Quality Objectives.

Thermocouple data support the conclusion that there are no significant heat-generating processes within the tank waste; there is no credible risk of self-boiling or excessive heating of the current waste contents. Given the generally stable waste properties, and taking into account the still questionable tank integrity, the continued storage of the waste in Tank 241-B-110 poses no unreasonable risk to personnel, the public, or the environment.

8.2 FURTHER CHARACTERIZATION NEEDS AND TANK ACTIVITIES

Characterization of the solid contents of Tank 241-B-110 has been performed in this report. While the current characterization is quite extensive, further sampling and analysis of Tank 241-B-110 is suggested for the following waste properties:

- While the majority of the waste in Tank 241-B-110 is composed of reasonably homogenous solids (see Section 7.0), the presence of an upper layer with significantly different characteristics has also been identified (see Section 6.2.1). Complete analysis of this identifiably different top layer was not conducted as part of the analytical determinations, and therefore detailed estimates of its composition are not possible. In order to more fully characterize this portion of the waste, auger samples should be taken before further intrusive tank activities are planned.

8.3 CONCLUSIONS

This Tank Characterization Report contains comparisons made between core sampling analytical data and on-going efforts to historically predict the waste contents of Tank 241-B-110 (Section 5.0). A more detailed and systematic review of these data sources will be possible as additional Hanford Site waste tanks are characterized. Hypotheses to be tested during this comparison include whether it will be possible to perform a preliminary Safety Screening of a waste tank prior to core sampling, and whether process design decisions can be made based on extremes in expected tank contents. One function of this report is to initiate this effort.

9.0 REFERENCES

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APPENDIX A

ANALYTICAL RESULTS

A.1 INTRODUCTION

A.1.1 Appendix A presents the chemical and radiological characteristics of Tank 241-B-110 in a tabular form, in terms of the specific concentrations of metals, anions, radionuclides, physical properties, organic complexes and volatile and semivolatile compounds.

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

A.2 TABLE DESCRIPTION

A.2.1 Abbreviations

Standard abbreviations are used to describe analytical methods.

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

A.3 Column Headings

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

Possible digestion methods are: d - direct; a - acid digestion; w - water leach; and f - potassium hydroxide fusion, followed by acid digestion. Table A-1 lists each analyte with a preferred digestion for Tank 241-B-110.

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

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

A.3.3 "Analytical Data Result" is the specific concentration of the analyte determined at different sampling points. No quality control data such as matrix spikes, serial dilutions, or duplicate analyses are listed. This information may be obtained from the 241-B-110 data package. Data which was qualified as estimated (denoted by "J" or "UJ" in the data package) will be enclosed in parentheses, i.e., (395) μg/ml. Unusable data (denoted by "R" in the data package) will be entered with a strikeout, i.e., ~~395~~ μg/ml. Unqualified data will be entered in standard form.

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

A.3.5 The "Mean" is derived as discussed in Section 5.0

A.3.6 The "Relative Standard Deviation" (RSD) is defined as the relative standard deviation on the mean concentration (Heasler, 1993).

A.3.7 "Projected Inventory," is the product of the concentration of the analyte and the volume of the waste in the tank (246,000 gallons or 931,000 L).

LIST OF TABLES FOR APPENDIX A

LIST OF TABLES FOR APPENDIX A (continued)

Table A-1. Preferred Digestion Method for Tank 241-B-110 Constituents (Heasler et al., 1993)

Analyte	Digestion	Analyte	Digestion	Analyte	Digestion
Al	ICP.f	P	ICP.a	^{241}Am	GEA.f
Sb	ICP.w	K	ICP.w	^{14}C	RAD.w
As	ICP.f	Re	ICP.f	^{144}Ce	GEA.f
Ba	ICP.f	Rh	ICP.f	$^{243/244}Cm$	RAD.f
Be	ICP.f	Ru	ICP.f	^{60}Co	GEA.f
Bi	ICP.a	Se	ICP.f	^{134}Cs	GEA.f
B	ICP.f	Si	ICP.f	^{137}Cs	GEA.f
Ca	ICP.f	Ag	ICP.f	^{152}Eu	GEA.f
Cd	ICP.f	Na	ICP.w	^{154}Eu	GEA.f
Ce	ICP.a	Sr	ICP.a	^{155}Eu	GEA.f
Cr	ICP.a	Te	ICP.a	^{153}Gd	GEA.f
Co	ICP.w	Th	ICP.w	^{3}H	RAD.w
Cu	ICP.w	Ti	ICP.f	^{129}I	RAD.f
Dy	ICP.f	Tl	ICP.w	^{237}Np	RAD.f
Fe	ICP.a	U	ICP.a	^{238}Pu	RAD.f
La	ICP.f	V	ICP.a	$^{239/240}Pu$	RAD.f
Pb	ICP.f	Zn	ICP.f	^{106}Ru	GEA.f
Li	ICP.w	Zr	ICP.f	^{75}Se	GEA.f
Mg	ICP.a	Cl^-	IC	^{90}Sr	RAD.f
Mn	ICP.f	F^-	IC	^{99}Tc	RAD.w
Mo	ICP.f	NO_3^-	IC	Total α	RAD.f
Nd	ICP.a	NO_2^-	IC	Total β	RAD.f
Ni	ICP.a	PO_4^{3-}	IC	TOC	IC
		SO_4^{2-}	IC	TIC	IC

Table A-2. Tank 241-B-110 Analytical Data: Aluminum

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Al	Sample 89-0621	< 0.0258	< 0.0258 to 36.0	30.0	---	---
	Sample 90-0640	< 0.0258				
	Sample 89-0977	< 0.0258				
	Sample 90-0716	36.0				
	Sample 90-1257	< 0.0258				
	Sample 90-1279	28.0				
	Sample 90-4180	26.0				
ICP.f.Al	Sample 89-0622	3,970	< 0.0438 to 4,500	1,430	---	1,730
	Sample 89-0623	4,500				
	Sample 90-1125	1,170				
	Sample 90-1126	1,130				
	Sample 89-1251	1,840				
	Sample 89-1252	1,880				
	Sample 89-0971	< 0.0438				
	Sample 89-0972	734				
	Sample 89-0973	1,120				
	Sample 89-0974	1,270				
	Sample 89-0975	1,280				
	Sample 89-0976	< 0.0438				
	Sample 90-0714	1,200				
	Sample 90-0715	1,240				
	Sample 90-1255	396				
	Sample 90-1256	351				
	Sample 90-1277	1,320				
	Sample 90-1278	1,210				
	Sample 90-4178	1,470				
	Sample 90-4179	1,500				
ICP.a.Al	Sample 89-0621	5,790	334 to 5,790	1,130	0.1562	---
	Sample 90-0640	1,760				
	Sample 89-0977	756				
	Sample 90-0716	1,250				
	Sample 90-1257	334				
	Sample 90-1279	1,210				
	Sample 90-4180	1,480				

Table A-2. Tank 241-B-110 Analytical Data: Antimony

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Sb	Sample 89-0621	4,440	< 0.0898 to 4,440	4,440	---	5,370
	Sample 90-0640	< 0.0898				
	Sample 89-0977	< 0.0898				
	Sample 90-0716	< 0.0898				
	Sample 90-1257	< 0.0898				
	Sample 90-1279	< 0.0898				
	Sample 90-4180	< 0.0898				
ICP.f.Sb	Sample 89-0622	1,390	< 0.256 to 1,390	1,340	---	---
	Sample 89-0623	< 0.256				
	Sample 90-1125	< 0.256				
	Sample 90-1126	< 0.256				
	Sample 89-1251	< 0.256				
	Sample 89-1252	< 0.256				
	Sample 89-0971	< 0.256				
	Sample 89-0972	< 0.256				
	Sample 89-0973	1,290				
	Sample 89-0974	< 0.256				
	Sample 89-0975	< 0.256				
	Sample 89-0976	< 0.256				
	Sample 90-0714	< 0.256				
	Sample 90-0715	< 0.256				
	Sample 90-1255	< 0.256				
	Sample 90-1256	< 0.256				
	Sample 90-1277	< 0.256				
	Sample 90-1278	< 0.256				
	Sample 90-4178	< 0.256				
	Sample 90-4179	< 0.256				
ICP.a.Sb	Sample 89-0621	< 0.121	N/A	< 0.121	---	---
	Sample 90-0640	< 0.121				
	Sample 89-0977	< 0.121				
	Sample 90-0716	< 0.121				
	Sample 90-1257	< 0.121				
	Sample 90-1279	< 0.121				
	Sample 90-4180	< 0.121				
GFAA.Sb	Sample 90-0640	< 22.5	N/A	< 22.5	---	---

Table A-2. Tank 241-B-110 Analytical Data: Arsenic (2 pages)

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.As	Sample 89-0621	< 0.0596	N/A	< 0.0596	---	---
	Sample 90-0640	< 0.0596				
	Sample 89-0977	< 0.0596				
	Sample 90-0716	< 0.0596				
	Sample 90-1257	< 0.0596				
	Sample 90-1279	< 0.0596				
	Sample 90-4180	< 0.0596				
ICP.f.As	Sample 89-0622	< 0.0867	< 0.0867 to 498	498	---	603
	Sample 89-0623	< 0.0867				
	Sample 90-1125	< 0.0867				
	Sample 90-1126	< 0.0867				
	Sample 89-1251	< 0.0867				
	Sample 89-1252	< 0.0867				
	Sample 89-0971	< 0.0867				
	Sample 89-0972	< 0.0867				
	Sample 89-0973	< 0.0867				
	Sample 89-0974	498				
	Sample 89-0975	< 0.0867				
	Sample 89-0976	< 0.0867				
	Sample 90-0714	< 0.0867				
	Sample 90-0715	< 0.0867				
	Sample 90-1255	< 0.0867				
	Sample 90-1256	< 0.0867				
	Sample 90-1277	< 0.0867				
	Sample 90-1278	< 0.0867				
	Sample 90-4178	< 0.0867				
	Sample 90-4179	< 0.0867				
ICP.a.As	Sample 89-0621	< 0.0653	N/A	< 0.0653	---	---
	Sample 90-0640	< 0.0653				
	Sample 89-0977	< 0.0653				
	Sample 90-0716	< 0.0653				
	Sample 90-1257	< 0.0653				
	Sample 90-1279	< 0.0653				
	Sample 90-4180	< 0.0653				

Table A-2. Tank 241-B-110 Analytical Data: Arsenic (2 pages)

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
GFAA.As	Sample 89-0621	< 24.0	< 2.00 to < 24.0	< 24.0	---	---
	Sample 90-0640	< 22.5				
	Sample 89-0977	< 24.0				
	Sample 90-0716	< 2.00				
	Sample 90-1257	< 2.00				
	Sample 90-1279	< 2.00				
	Sample 90-4180	< 2.00				

Table A-2. Tank 241-B-110 Analytical Data: Barium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Ba	Sample 89-0621	< 0.00300	N/A	< 0.00300	---	---
	Sample 90-0640	< 0.00300				
	Sample 89-0977	< 0.00300				
	Sample 90-0716	< 0.00300				
	Sample 90-1257	< 0.00300				
	Sample 90-1279	< 0.00300				
	Sample 90-4180	< 0.00300				
ICP.f.Ba	Sample 89-0622	1,310	< 0.00326 to 1,500	145	---	175
	Sample 89-0623	1,500				
	Sample 90-1125	26.0				
	Sample 90-1126	13.0				
	Sample 89-1251	19.0				
	Sample 89-1252	16.0				
	Sample 89-0971	22.0				
	Sample 89-0972	25.5				
	Sample 89-0973	22.5				
	Sample 89-0974	25.5				
	Sample 89-0975	27.0				
	Sample 89-0976	21.0				
	Sample 90-0714	< 0.00326				
	Sample 90-0715	< 0.00326				
	Sample 90-1255	32.0				
	Sample 90-1256	31.0				
	Sample 90-1277	26.5				
	Sample 90-1278	24.5				
	Sample 90-4178	< 0.00326				
	Sample 90-4179	57.5				
ICP.a.Ba	Sample 89-0621	65.0	12.0 to 65.0	14.14	0.04413	---
	Sample 90-0640	13.0				
	Sample 89-0977	14.0				
	Sample 90-0716	14.0				
	Sample 90-1257	12.0				
	Sample 90-1279	16.0				
	Sample 90-4180	17.0				

Table A-2. Tank 241-B-110 Analytical Data: Beryllium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Be	Sample 89-0621	< 1.48E-04	N/A	< 1.48E-04	---	---
	Sample 90-0640	< 1.48E-04				
	Sample 89-0977	< 1.48E-04				
	Sample 90-0716	< 1.48E-04				
	Sample 90-1257	< 1.48E-04				
	Sample 90-1279	< 1.48E-04				
	Sample 90-4180	< 1.48E-04				
ICP.f.Be	Sample 89-0622	< 2.22E-04	< 2.22E-04 to 2.00	2.00	---	2.42
	Sample 89-0623	< 2.22E-04				
	Sample 90-1125	< 2.22E-04				
	Sample 90-1126	< 2.22E-04				
	Sample 89-1251	< 2.22E-04				
	Sample 89-1252	< 2.22E-04				
	Sample 89-0971	< 2.22E-04				
	Sample 89-0972	< 2.22E-04				
	Sample 89-0973	< 2.22E-04				
	Sample 89-0974	< 2.22E-04				
	Sample 89-0975	< 2.22E-04				
	Sample 89-0976	< 2.22E-04				
	Sample 90-0714	< 2.22E-04				
	Sample 90-0715	< 2.22E-04				
	Sample 90-1255	2.00				
	Sample 90-1256	< 2.22E-04				
	Sample 90-1277	< 2.22E-04				
	Sample 90-1278	< 2.22E-04				
	Sample 90-4178	< 2.22E-04				
	Sample 90-4179	< 2.22E-04				
ICP.a.Be	Sample 89-0621	< 1.48E-04	N/A	< 1.48E-04	---	---
	Sample 90-0640	< 1.48E-04				
	Sample 89-0977	< 1.48E-04				
	Sample 90-0716	< 1.48E-04				
	Sample 90-1257	< 1.48E-04				
	Sample 90-1279	< 1.48E-04				
	Sample 90-4180	< 1.48E-04				

Table A-2. Tank 241-B-110 Analytical Data: Bismuth

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Bi	Sample 90-0640	342	< DL to 342	342	---	---
	Sample 89-0977	< DL				
	Sample 90-0716	< DL				
	Sample 90-1257	< DL				
	Sample 90-1279	< DL				
	Sample 90-4180	< DL				
ICP.f.Bi	Sample 89-0622	18,000	14,400 to 23,000	18,520	0.06785	---
	Sample 89-0623	20,000				
	Sample 90-1125	17,900				
	Sample 90-1126	17,300				
	Sample 89-1251	20,500				
	Sample 89-1252	21,300				
	Sample 89-0971	21,700				
	Sample 89-0972	22,500				
	Sample 89-0973	23,000				
	Sample 89-0974	21,700				
	Sample 89-0975	21,000				
	Sample 89-0976	22,500				
	Sample 90-0714	18,100				
	Sample 90-0715	17,900				
	Sample 90-1255	15,100				
	Sample 90-1256	14,900				
	Sample 90-1277	14,400				
	Sample 90-1278	17,100				
	Sample 90-4178	19,200				
	Sample 90-4179	19,600				
ICP.a.Bi	Sample 89-0621	34,000	16,400 to 34,000	21,800	---	26,400
	Sample 90-0640	21,300				
	Sample 89-0977	21,900				
	Sample 90-0716	19,100				
	Sample 90-1257	16,400				
	Sample 90-1279	18,200				
	Sample 90-4180	21,600				

Detect Limit for ICP.w.Bi not given in Lab Package

Table A-2. Tank 241-B-110 Analytical Data: Boron

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.B	Sample 89-0621	< 0.0496	< 0.0496 to 30.0	30.0	---	---
	Sample 90-0640	< 0.0496				
	Sample 89-0977	< 0.0496				
	Sample 90-0716	30.0				
	Sample 90-1257	< 0.0496				
	Sample 90-1279	< 0.0496				
	Sample 90-4180	< 0.0496				
ICP.f.B	Sample 89-0622	10,100	< 0.0850 to 13,000	11,600	---	14,000
	Sample 89-0623	13,000				
	Sample 90-1125	< 0.0850				
	Sample 90-1126	< 0.0850				
	Sample 89-1251	< 0.0850				
	Sample 89-1252	< 0.0850				
	Sample 89-0971	< 0.0850				
	Sample 89-0972	< 0.0850				
	Sample 89-0973	< 0.0850				
	Sample 89-0974	< 0.0850				
	Sample 89-0975	< 0.0850				
	Sample 89-0976	< 0.0850				
	Sample 90-0714	< 0.0850				
	Sample 90-0715	< 0.0850				
	Sample 90-1255	< 0.0850				
	Sample 90-1256	< 0.0850				
	Sample 90-1277	< 0.0850				
	Sample 90-1278	< 0.0850				
	Sample 90-4178	< 0.0850				
	Sample 90-4179	< 0.0850				
ICP.a.B	Sample 89-0621	< 0.115	< 0.115 to 84.0	49.43	0.1344	---
	Sample 90-0640	40.0				
	Sample 89-0977	36.0				
	Sample 90-0716	62.0				
	Sample 90-1257	< 0.115				
	Sample 90-1279	84.0				
	Sample 90-4180	44.0				

Table A-2. Tank 241-B-110 Analytical Data: Cadmium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Cd	Sample 89-0621	< 0.00530	< 0.00530 to 25.0	25.0	---	---
	Sample 90-0640	< 0.00530				
	Sample 89-0977	25.0				
	Sample 90-0716	< 0.00530				
	Sample 90-1257	< 0.00530				
	Sample 90-1279	< 0.00530				
	Sample 90-4180	< 0.00530				
ICP.f.Cd	Sample 89-0622	< 0.00748	< 0.00748 to 86.0	53.8	---	65.1
	Sample 89-0623	< 0.00748				
	Sample 90-1125	< 0.00748				
	Sample 90-1126	< 0.00748				
	Sample 89-1251	59.0				
	Sample 89-1252	< 0.00748				
	Sample 89-0971	86.0				
	Sample 89-0972	56.0				
	Sample 89-0973	34.5				
	Sample 89-0974	37.5				
	Sample 89-0975	43.5				
	Sample 89-0976	34.0				
	Sample 90-0714	< 0.00748				
	Sample 90-0715	< 0.00748				
	Sample 90-1255	< 0.00748				
	Sample 90-1256	< 0.00748				
	Sample 90-1277	< 0.00748				
	Sample 90-1278	< 0.00748				
	Sample 90-4178	< 0.00748				
	Sample 90-4179	< 0.00748				
ICP.a.Cd	Sample 89-0621	< 0.0924	< 0.0924 to 7.00	5.286	0.1253	---
	Sample 90-0640	5.00				
	Sample 89-0977	3.00				
	Sample 90-0716	5.00				
	Sample 90-1257	< 0.0924				
	Sample 90-1279	5.00				
	Sample 90-4180	7.00				

Table A-2. Tank 241-B-110 Analytical Data: Calcium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Ca	Sample 89-0621	790	14.0 to 790	133	---	---
	Sample 90-0640	14.0				
	Sample 89-0977	37.0				
	Sample 90-0716	20.0				
	Sample 90-1257	28.0				
	Sample 90-1279	26.0				
	Sample 90-4180	16.0				
ICP.f.Ca	Sample 89-0622	2,750	613 to 3,000	1,090	---	1,320
	Sample 89-0623	3,000				
	Sample 90-1125	945				
	Sample 90-1126	793				
	Sample 89-1251	758				
	Sample 89-1252	628				
	Sample 89-0971	1,050				
	Sample 89-0972	1,030				
	Sample 89-0973	984				
	Sample 89-0974	1,010				
	Sample 89-0975	1,000				
	Sample 89-0976	1,030				
	Sample 90-0714	980				
	Sample 90-0715	1,130				
	Sample 90-1255	616				
	Sample 90-1256	613				
	Sample 90-1277	844				
	Sample 90-1278	1,050				
	Sample 90-4178	719				
	Sample 90-4179	850				
ICP.a.Ca	Sample 89-0621	1,420	622 to 1,420	809.6	0.07036	---
	Sample 90-0640	655				
	Sample 89-0977	990				
	Sample 90-0716	839				
	Sample 90-1257	622				
	Sample 90-1279	984				
	Sample 90-4180	722				

Table A-2. Tank 241-B-110 Analytical Data: Cerium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Ce	Sample 89-0621	< 0.192	N/A	< 0.192	---	---
	Sample 90-0640	< 0.192				
	Sample 89-0977	< 0.192				
	Sample 90-0716	< 0.192				
	Sample 90-1257	< 0.192				
	Sample 90-1279	< 0.192				
	Sample 90-4180	< 0.192				
ICP.f.Ce	Sample 89-0622	< 0.238	N/A	< 0.238	---	---
	Sample 89-0623	< 0.238				
	Sample 90-1125	< 0.238				
	Sample 90-1126	< 0.238				
	Sample 89-1251	< 0.238				
	Sample 89-1252	< 0.238				
	Sample 89-0971	< 0.238				
	Sample 89-0972	< 0.238				
	Sample 89-0973	< 0.238				
	Sample 89-0974	< 0.238				
	Sample 89-0975	< 0.238				
	Sample 89-0976	< 0.238				
	Sample 90-0714	< 0.238				
	Sample 90-0715	< 0.238				
	Sample 90-1255	< 0.238				
	Sample 90-1256	< 0.238				
	Sample 90-1277	< 0.238				
	Sample 90-1278	< 0.238				
	Sample 90-4178	< 0.238				
	Sample 90-4179	< 0.238				
ICP.a.Ce	Sample 89-0621	< 0.0700	< 0.0700 to 68.0	37.1	---	44.6
	Sample 90-0640	68.0				
	Sample 89-0977	< 0.0700				
	Sample 90-0716	66.0				
	Sample 90-1257	< 0.0700				
	Sample 90-1279	< 0.0700				
	Sample 90-4180	< 0.0700				

Table A-2. Tank 241-B-110 Analytical Data: Chromium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Cr	Sample 89-0621	650	71.0 to 650	196	---	---
	Sample 90-0640	154				
	Sample 89-0977	71.0				
	Sample 90-0716	138				
	Sample 90-1257	102				
	Sample 90-1279	140				
	Sample 90-4180	118				
ICP.f.Cr	Sample 89-0622	738	738 to 863	796	---	---
	Sample 89-0623	744				
	Sample 90-1125	808				
	Sample 90-1126	797				
	Sample 89-1251	843				
	Sample 89-1252	861				
	Sample 89-0971	784				
	Sample 89-0972	807				
	Sample 89-0973	778				
	Sample 89-0974	824				
	Sample 89-0975	840				
	Sample 89-0976	766				
	Sample 90-0714	863				
	Sample 90-0715	859				
	Sample 90-1255	746				
	Sample 90-1256	753				
	Sample 90-1277	759				
	Sample 90-1278	765				
	Sample 90-4178	794				
	Sample 90-4179	783				
ICP.a.Cr	Sample 89-0621	4,120	720 to 4,120	810	0.02539	980
	Sample 90-0640	821				
	Sample 89-0977	836				
	Sample 90-0716	1,390				
	Sample 90-1257	720				
	Sample 90-1279	794				
	Sample 90-4180	820				

Table A-2. Tank 241-B-110 Analytical Data: Cobalt

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Co	Sample 89-0621	< 0.376	N/A	< 0.376	---	< 0.455
	Sample 90-0640	< 0.376				
	Sample 89-0977	< 0.376				
	Sample 90-0716	< 0.376				
	Sample 90-1257	< 0.376				
	Sample 90-1279	< 0.376				
	Sample 90-4180	< 0.376				
ICP.f.Co	Sample 89-0622	< 0.370	N/A	< 0.370	---	---
	Sample 89-0623	< 0.370				
	Sample 90-1125	< 0.370				
	Sample 90-1126	< 0.370				
	Sample 89-1251	< 0.370				
	Sample 89-1252	< 0.370				
	Sample 89-0971	< 0.370				
	Sample 89-0972	< 0.370				
	Sample 89-0973	< 0.370				
	Sample 89-0974	< 0.370				
	Sample 89-0975	< 0.370				
	Sample 89-0976	< 0.370				
	Sample 90-0714	< 0.370				
	Sample 90-0715	< 0.370				
	Sample 90-1255	< 0.370				
	Sample 90-1256	< 0.370				
	Sample 90-1277	< 0.370				
	Sample 90-1278	< 0.370				
	Sample 90-4178	< 0.370				
	Sample 90-4179	< 0.370				
ICP.a.Co	Sample 89-0621	< 0.161	N/A	< 0.161	---	---
	Sample 90-0640	< 0.161				
	Sample 89-0977	< 0.161				
	Sample 90-0716	< 0.161				
	Sample 90-1257	< 0.161				
	Sample 90-1279	< 0.161				
	Sample 90-4180	< 0.161				

Table A-2. Tank 241-B-110 Analytical Data: Copper

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Cu	Sample 89-0621	360	< 0.0167 to 360	218	---	264
	Sample 90-0640	< 0.0167				
	Sample 89-0977	76.0				
	Sample 90-0716	< 0.0167				
	Sample 90-1257	< 0.0167				
	Sample 90-1279	< 0.0167				
	Sample 90-4180	< 0.0167				
ICP.f.Cu	Sample 89-0622	< 0.0113	< 0.0113 to 572	160	---	---
	Sample 89-0623	< 0.0133				
	Sample 90-1125	84.0				
	Sample 90-1126	56.0				
	Sample 89-1251	60.0				
	Sample 89-1252	52.5				
	Sample 89-0971	70.0				
	Sample 89-0972	86.5				
	Sample 89-0973	103				
	Sample 89-0974	100				
	Sample 89-0975	572				
	Sample 89-0976	73.0				
	Sample 90-0714	< 0.0113				
	Sample 90-0715	< 0.0113				
	Sample 90-1255	261				
	Sample 90-1256	171				
	Sample 90-1277	234				
	Sample 90-1278	47.5				
	Sample 90-4178	350				
	Sample 90-4179	232				
ICP.a.Cu	Sample 89-0621	< 0.00222	< 0.00222 to 80.0	42.50	0.2795	---
	Sample 90-0640	36.0				
	Sample 89-0977	80.0				
	Sample 90-0716	30.0				
	Sample 90-1257	43.0				
	Sample 90-1279	24.0				
	Sample 90-4180	75.0				

Table A-2. Tank 241-B-110 Analytical Data: Dysprosium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Dy	Sample 89-0621	< 0.0133	N/A	< 0.0133	---	---
	Sample 90-0640	< 0.0133				
	Sample 89-0977	< 0.0133				
	Sample 90-0716	< 0.0133				
	Sample 90-1257	< 0.0133				
	Sample 90-1279	< 0.0133				
	Sample 90-4180	< 0.0133				
ICP.f.Dy	Sample 89-0622	< 0.0134	N/A	< 0.0134	---	< 0.0162
	Sample 89-0623	< 0.0134				
	Sample 90-1125	< 0.0134				
	Sample 90-1126	< 0.0134				
	Sample 89-1251	< 0.0134				
	Sample 89-1252	< 0.0134				
	Sample 89-0971	< 0.0134				
	Sample 89-0972	< 0.0134				
	Sample 89-0973	< 0.0134				
	Sample 89-0974	< 0.0134				
	Sample 89-0975	< 0.0134				
	Sample 89-0976	< 0.0134				
	Sample 90-0714	< 0.0134				
	Sample 90-0715	< 0.0134				
	Sample 90-1255	< 0.0134				
	Sample 90-1256	< 0.0134				
	Sample 90-1277	< 0.0134				
	Sample 90-1278	< 0.0134				
	Sample 90-4178	< 0.0134				
	Sample 90-4179	< 0.0134				
ICP.a.Dy	Sample 89-0621	< 0.00289	N/A	< 0.00289	---	---
	Sample 90-0640	< 0.00289				
	Sample 89-0977	< 0.00289				
	Sample 90-0716	< 0.00289				
	Sample 90-1257	< 0.00289				
	Sample 90-1279	< 0.00289				
	Sample 90-4180	< 0.00289				

Table A-2. Tank 241-B-110 Analytical Data: Iron

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Fe	Sample 89-0621	1,610	59.0 to 1,610	388	---	---
	Sample 90-0640	160				
	Sample 89-0977	59.0				
	Sample 90-0716	350				
	Sample 90-1257	74.0				
	Sample 90-1279	281				
	Sample 90-4180	182				
ICP.f.Fe	Sample 89-0622	17,500	14,500 to 23,200	18,100	0.04081	---
	Sample 89-0623	17,800				
	Sample 90-1125	23,200				
	Sample 90-1126	18,300				
	Sample 89-1251	18,700				
	Sample 89-1252	18,800				
	Sample 89-0971	17,400				
	Sample 89-0972	18,300				
	Sample 89-0973	17,600				
	Sample 89-0974	18,300				
	Sample 89-0975	18,400				
	Sample 89-0976	17,900				
	Sample 90-0714	18,700				
	Sample 90-0715	19,400				
	Sample 90-1255	14,600				
	Sample 90-1256	14,500				
	Sample 90-1277	17,600				
	Sample 90-1278	18,100				
	Sample 90-4178	18,500				
	Sample 90-4179	18,200				
ICP.a.Fe	Sample 89-0621	97,200	14,700 to 97,200	29,400	---	35,600
	Sample 90-0640	18,200				
	Sample 89-0977	18,700				
	Sample 90-0716	20,400				
	Sample 90-1257	14,700				
	Sample 90-1279	18,300				
	Sample 90-4180	18,400				

Table A-2. Tank 241-B-110 Analytical Data: Lanthanum

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.La	Sample 89-0621	< 0.0173	N/A	< 0.0173	---	---
	Sample 90-0640	< 0.0173				
	Sample 89-0977	< 0.0173				
	Sample 90-0716	< 0.0173				
	Sample 90-1257	< 0.0173				
	Sample 90-1279	< 0.0173				
	Sample 90-4180	< 0.0173				
ICP.f.La	Sample 89-0622	< 0.0183	< 0.0183 to 83.0	83.0	---	100
	Sample 89-0623	< 0.0183				
	Sample 90-1125	83.0				
	Sample 90-1126	< 0.0183				
	Sample 89-1251	< 0.0183				
	Sample 89-1252	< 0.0183				
	Sample 89-0971	< 0.0183				
	Sample 89-0972	< 0.0183				
	Sample 89-0973	< 0.0183				
	Sample 89-0974	< 0.0183				
	Sample 89-0975	< 0.0183				
	Sample 89-0976	< 0.0183				
	Sample 90-0714	< 0.0183				
	Sample 90-0715	< 0.0183				
	Sample 90-1255	< 0.0183				
	Sample 90-1256	< 0.0183				
	Sample 90-1277	< 0.0183				
	Sample 90-1278	< 0.0183				
	Sample 90-4178	< 0.0183				
	Sample 90-4179	< 0.0183				
ICP.a.La	Sample 89-0621	315	6.00 to 315	31.81	0.2973	---
	Sample 90-0640	28.0				
	Sample 89-0977	17.0				
	Sample 90-0716	53.0				
	Sample 90-1257	15.0				
	Sample 90-1279	30.0				
	Sample 90-4180	6.00				

Table A-2. Tank 241-B-110 Analytical Data: Lead

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Pb	Sample 89-0621	< 0.0567	N/A	< 0.0567	---	---
	Sample 90-0640	< 0.0567				
	Sample 89-0977	< 0.0567				
	Sample 90-0716	< 0.0567				
	Sample 90-1257	< 0.0567				
	Sample 90-1279	< 0.0567				
	Sample 90-4180	< 0.0567				
ICP.f.Pb	Sample 89-0622	654	228 to 1,120	650	---	787
	Sample 89-0623	967				
	Sample 90-1125	1,120				
	Sample 90-1126	949				
	Sample 89-1251	388				
	Sample 89-1252	228				
	Sample 89-0971	< 0.0782				
	Sample 89-0972	< 0.0782				
	Sample 89-0973	< 0.0782				
	Sample 89-0974	830				
	Sample 89-0975	530				
	Sample 89-0976	< 0.0782				
	Sample 90-0714	571				
	Sample 90-0715	748				
	Sample 90-1255	< 0.0782				
	Sample 90-1256	557				
	Sample 90-1277	513				
	Sample 90-1278	522				
	Sample 90-4178	< 0.0782				
	Sample 90-4179	< 0.0782				
ICP.a.Pb	Sample 89-0621	5,660	282 to 5,660	528.4	0.2251	---
	Sample 90-0640	465				
	Sample 89-0977	372				
	Sample 90-0716	628				
	Sample 90-1257	278				
	Sample 90-1279	530				
	Sample 90-4180	282				

Table A-2. Tank 241-B-110 Analytical Data: Lead

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
GFAA.Pb	Sample 90-0640	460	185 to 516	365	---	---
	Sample 90-0716	516				
	Sample 89-1257	259				
	Sample 90-1279	407				
	Sample 90-4180	185				

Table A-2. Tank 241-B-110 Analytical Data: Lithium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Li	Sample 89-0621	< 0.00790	< 0.00790 to 37.0	37.0	---	44.8
	Sample 90-0640	< 0.00790				
	Sample 89-0977	37.0				
	Sample 90-0716	< 0.00790				
	Sample 90-1257	< 0.00790				
	Sample 90-1279	< 0.00790				
	Sample 90-4180	< 0.00790				
ICP.f.Li	Sample 89-0622	< 0.0159	N/A	< 0.0159	---	---
	Sample 89-0623	< 0.0159				
	Sample 90-1125	< 0.0159				
	Sample 90-1126	< 0.0159				
	Sample 89-1251	< 0.0159				
	Sample 89-1252	< 0.0159				
	Sample 89-0971	< 0.0159				
	Sample 89-0972	< 0.0159				
	Sample 89-0973	< 0.0159				
	Sample 89-0974	< 0.0159				
	Sample 89-0975	< 0.0159				
	Sample 89-0976	< 0.0159				
	Sample 90-0714	< 0.0159				
	Sample 90-0715	< 0.0159				
	Sample 90-1255	< 0.0159				
	Sample 90-1256	< 0.0159				
	Sample 90-1277	< 0.0159				
	Sample 90-1278	< 0.0159				
	Sample 90-4178	< 0.0159				
	Sample 90-4179	< 0.0159				
ICP.a.Li	Sample 89-0621	< 0.00348	N/A	< 0.00348	---	---
	Sample 90-0640	< 0.00348				
	Sample 89-0977	< 0.00348				
	Sample 90-0716	< 0.00348				
	Sample 90-1257	< 0.00348				
	Sample 90-1279	< 0.00348				
	Sample 90-4180	< 0.00348				

Table A-2. Tank 241-B-110 Analytical Data: Magnesium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Mg	Sample 89-0621	100	< 5.19E-04 to 100	22.0	---	---
	Sample 90-0640	4.00				
	Sample 89-0977	< 5.19E-04				
	Sample 90-0716	6.00				
	Sample 90-1257	8.00				
	Sample 90-1279	8.00				
	Sample 90-4180	6.00				
ICP.f.Mg	Sample 89-0622	195	117 to 201	158	---	---
	Sample 89-0623	201				
	Sample 90-1125	163				
	Sample 90-1126	146				
	Sample 89-1251	144				
	Sample 89-1252	137				
	Sample 89-0971	136				
	Sample 89-0972	136				
	Sample 89-0973	139				
	Sample 89-0974	150				
	Sample 89-0975	146				
	Sample 89-0976	139				
	Sample 90-0714	186				
	Sample 90-0715	187				
	Sample 90-1255	140				
	Sample 90-1256	138				
	Sample 90-1277	172				
	Sample 90-1278	191				
	Sample 90-4178	155				
	Sample 90-4179	117				
ICP.a.Mg	Sample 89-0621	965	163 to 965	178.5	0.0411	216
	Sample 90-0640	163				
	Sample 89-0977	174				
	Sample 90-0716	196				
	Sample 90-1257	158				
	Sample 90-1279	228				
	Sample 90-4180	164				

Table A-2. Tank 241-B-110 Analytical Data: Manganese

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Mn	Sample 89-0621	< 0.00130	< 0.00130 to 4.00	3.00	---	---
	Sample 90-0640	< 0.00130				
	Sample 89-0977	< 0.00130				
	Sample 90-0716	2.00				
	Sample 90-1257	< 0.00130				
	Sample 90-1279	4.00				
	Sample 90-4180	< 0.00130				
ICP.f.Mn	Sample 89-0622	74.0	59.0 to 158	98.2	---	119
	Sample 89-0623	83.0				
	Sample 90-1125	125				
	Sample 90-1126	79.0				
	Sample 89-1251	65.5				
	Sample 89-1252	70.5				
	Sample 89-0971	83.0				
	Sample 89-0972	94.0				
	Sample 89-0973	59.0				
	Sample 89-0974	76.0				
	Sample 89-0975	91.0				
	Sample 89-0976	105				
	Sample 90-0714	97.5				
	Sample 90-0715	108				
	Sample 90-1255	91.0				
	Sample 90-1256	96.0				
	Sample 90-1277	129				
	Sample 90-1278	114				
	Sample 90-4178	96.0				
	Sample 90-4179	158				
ICP.a.Mn	Sample 89-0621	365	51.0 to 365	66.78	0.1083	---
	Sample 90-0640	55.0				
	Sample 89-0977	56.0				
	Sample 90-0716	136				
	Sample 90-1257	51.0				
	Sample 90-1279	103				
	Sample 90-4180	54.0				

Table A-2. Tank 241-B-110 Analytical Data: Mercury

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
CVAA.Hg	Sample 89-0621	1.02	0.730 to 1.68	1.09	---	1.32
	Sample 90-0640	1.43				
	Sample 89-0977	0.915				
	Sample 90-1257	0.730				
	Sample 89-1279	1.68				
	Sample 90-4180	0.760				

Table A-2. Tank 241-B-110 Analytical Data: Molybdenum

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Mo	Sample 89-0621	< 0.00580	< 0.00580 to 12.0	9.20	---	---
	Sample 90-0640	10.0				
	Sample 89-0977	< 0.00580				
	Sample 90-0716	10.0				
	Sample 90-1257	6.00				
	Sample 90-1279	8.00				
	Sample 90-4180	12.0				
ICP.f.Mo	Sample 89-0622	< 0.0269	< 0.0269 to 60.5	55.5	---	67.2
	Sample 89-0623	< 0.0269				
	Sample 90-1125	< 0.0269				
	Sample 90-1126	< 0.0269				
	Sample 89-1251	< 0.0269				
	Sample 89-1252	< 0.0269				
	Sample 89-0971	< 0.0269				
	Sample 89-0972	< 0.0269				
	Sample 89-0973	52.0				
	Sample 89-0974	54.0				
	Sample 89-0975	60.5				
	Sample 89-0976	< 0.0269				
	Sample 90-0714	< 0.0269				
	Sample 90-0715	< 0.0269				
	Sample 90-1255	< 0.0269				
	Sample 90-1256	< 0.0269				
	Sample 90-1277	< 0.0269				
	Sample 90-1278	< 0.0269				
	Sample 90-4178	< 0.0269				
	Sample 90-4179	< 0.0269				
ICP.a.Mo	Sample 89-0621	< 0.0126	< 0.0126 to 22.0	13.54	0.3959	---
	Sample 90-0640	10.0				
	Sample 89-0977	18.0				
	Sample 90-0716	22.0				
	Sample 90-1257	< 0.0126				
	Sample 90-1279	5.00				
	Sample 90-4180	8.00				

Table A-2. Tank 241-B-110 Analytical Data: Neodymium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Nd	Sample 89-0621	< 0.0828	N/A	< 0.0828	---	---
	Sample 90-0640	< 0.0828				
	Sample 89-0977	< 0.0828				
	Sample 90-0716	< 0.0828				
	Sample 90-1257	< 0.0828				
	Sample 90-1279	< 0.0828				
	Sample 90-4180	< 0.0828				
ICP.f.Nd	Sample 89-0622	< 0.0823	N/A	< 0.0823	---	---
	Sample 89-0623	< 0.0823				
	Sample 90-1125	< 0.0823				
	Sample 90-1126	< 0.0823				
	Sample 89-1251	< 0.0823				
	Sample 89-1252	< 0.0823				
	Sample 89-0971	< 0.0823				
	Sample 89-0972	< 0.0823				
	Sample 89-0973	< 0.0823				
	Sample 89-0974	< 0.0823				
	Sample 89-0975	< 0.0823				
	Sample 89-0976	< 0.0823				
	Sample 90-0714	< 0.0823				
	Sample 90-0715	< 0.0823				
	Sample 90-1255	< 0.0823				
	Sample 90-1256	< 0.0823				
	Sample 90-1277	< 0.0823				
	Sample 90-1278	< 0.0823				
	Sample 90-4178	< 0.0823				
	Sample 90-4179	< 0.0823				
ICP.a.Nd	Sample 89-0621	< 0.0326	< 0.0326 to 30.0	15.86	0.3009	19.2
	Sample 90-0640	26.0				
	Sample 89-0977	< 0.0326				
	Sample 90-0716	30.0				
	Sample 90-1257	< 0.0326				
	Sample 90-1279	< 0.0326				
	Sample 90-4180	< 0.0326				

Table A-2. Tank 241-B-110 Analytical Data: Nickel

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Ni	Sample 89-0621	< 0.0181	N/A	< 0.0181	---	---
	Sample 90-0640	< 0.0181				
	Sample 89-0977	< 0.0181				
	Sample 90-0716	< 0.0181				
	Sample 90-1257	< 0.0181				
	Sample 90-1279	< 0.0181				
	Sample 90-4180	< 0.0181				
ICP.a.Ni	Sample 89-0621	< 0.00741	< 0.00741 to 314	18.63	0.04346	22.4
	Sample 90-0640	20.0				
	Sample 89-0977	20.0				
	Sample 90-0716	314				
	Sample 90-1257	17.0				
	Sample 90-1279	21.0				
	Sample 90-4180	19.0				

Table A-2. Tank 241-B-110 Analytical Data: Phosphorus

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.P	Sample 89-0621	77,300	7,640 to 77,300	23,200	---	---
	Sample 90-0640	15,500				
	Sample 89-0977	7,640				
	Sample 90-0716	16,300				
	Sample 90-1257	15,500				
	Sample 90-1279	14,600				
	Sample 90-4180	15,900				
ICP.f.P	Sample 89-0622	15,000	13,200 to 19,900	16,100	0.04381	---
	Sample 89-0623	15,500				
	Sample 90-1125	17,100				
	Sample 90-1126	16,700				
	Sample 89-1251	14,500				
	Sample 89-1252	13,900				
	Sample 89-0971	16,600				
	Sample 89-0972	17,900				
	Sample 89-0973	17,200				
	Sample 89-0974	19,200				
	Sample 89-0975	19,900				
	Sample 89-0976	16,400				
	Sample 90-0714	17,200				
	Sample 90-0715	16,600				
	Sample 90-1255	15,600				
	Sample 90-1256	15,800				
	Sample 90-1277	13,200				
	Sample 90-1278	14,200				
	Sample 90-4178	15,600				
	Sample 90-4179	14,900				
ICP.a.P	Sample 89-0621	82,700	14,700 to 82,700	25,600	---	31,000
	Sample 90-0640	16,500				
	Sample 89-0977	17,600				
	Sample 90-0716	16,100				
	Sample 90-1257	14,700				
	Sample 90-1279	15,400				
	Sample 90-4180	16,200				

Table A-2. Tank 241-B-110 Analytical Data: Potassium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.K	Sample 89-0621	< 0.458	< 0.458 to 774	504	---	610
	Sample 90-0640	418				
	Sample 89-0977	774				
	Sample 90-0716	508				
	Sample 90-1257	458				
	Sample 90-1279	474				
	Sample 90-4180	392				
ICP.a.K	Sample 89-0621	< 0.310	< 0.310	311.6	0.0482	---
	Sample 90-0640	378				
	Sample 89-0977	277				
	Sample 90-0716	716				
	Sample 90-1257	270				
	Sample 90-1279	338				
	Sample 90-4180	323				

Table A-2. Tank 241-B-110 Analytical Data: Rhenium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Re	Sample 89-0621	< 0.0143	N/A	< 0.0143	---	---
	Sample 90-0640	< 0.0143				
	Sample 89-0977	< 0.0143				
	Sample 90-0716	< 0.0143				
	Sample 90-1257	< 0.0143				
	Sample 90-1279	< 0.0143				
	Sample 90-4180	< 0.0143				
ICP.f.Re	Sample 89-0622	< 0.0184	< 0.0184 to 71.0	71.0	---	85.9
	Sample 89-0623	< 0.0184				
	Sample 90-1125	< 0.0184				
	Sample 90-1126	< 0.0184				
	Sample 89-1251	< 0.0184				
	Sample 89-1252	< 0.0184				
	Sample 89-0971	< 0.0184				
	Sample 89-0972	< 0.0184				
	Sample 89-0973	< 0.0184				
	Sample 89-0974	< 0.0184				
	Sample 89-0975	71.0				
	Sample 89-0976	< 0.0184				
	Sample 90-0714	< 0.0184				
	Sample 90-0715	< 0.0184				
	Sample 90-1255	< 0.0184				
	Sample 90-1256	< 0.0184				
	Sample 90-1277	< 0.0184				
	Sample 90-1278	< 0.0184				
	Sample 90-4178	< 0.0184				
	Sample 90-4179	< 0.0184				
ICP.a.Re	Sample 89-0621	< 0.00696	< 0.00696 to 9.00	6.50	0.05567	---
	Sample 90-0640	9.00				
	Sample 89-0977	6.00				
	Sample 90-0716	6.00				
	Sample 90-1257	6.00				
	Sample 90-1279	6.00				
	Sample 90-4180	7.00				

Table A-2. Tank 241-B-110 Analytical Data: Rhodium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Rh	Sample 89-0621	< 0.107	N/A	< 0.107	---	---
	Sample 90-0640	< 0.107				
	Sample 89-0977	< 0.107				
	Sample 90-0716	< 0.107				
	Sample 90-1257	< 0.107				
	Sample 90-1279	< 0.107				
	Sample 90-4180	< 0.107				
ICP.f.Rh	Sample 89-0622	< 0.114	N/A	< 0.114	---	< 0.138
	Sample 89-0623	< 0.114				
	Sample 90-1125	< 0.114				
	Sample 90-1126	< 0.114				
	Sample 89-1251	< 0.114				
	Sample 89-1252	< 0.114				
	Sample 89-0971	< 0.114				
	Sample 89-0972	< 0.114				
	Sample 89-0973	< 0.114				
	Sample 89-0974	< 0.114				
	Sample 89-0975	< 0.114				
	Sample 89-0976	< 0.114				
	Sample 90-0714	< 0.114				
	Sample 90-0715	< 0.114				
	Sample 90-1255	< 0.114				
	Sample 90-1256	< 0.114				
	Sample 90-1277	< 0.114				
	Sample 90-1278	< 0.114				
	Sample 90-4178	< 0.114				
	Sample 90-4179	< 0.114				
ICP.a.Rh	Sample 89-0621	< 0.0289	N/A	< 0.0289	---	---
	Sample 90-0640	< 0.0289				
	Sample 89-0977	< 0.0289				
	Sample 90-0716	< 0.0289				
	Sample 90-1257	< 0.0289				
	Sample 90-1279	< 0.0289				
	Sample 90-4180	< 0.0289				

Table A-2. Tank 241-B-110 Analytical Data: Ruthenium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Ru	Sample 89-0621	< 0.0511	N/A	< 0.0511	---	---
	Sample 90-0640	< 0.0511				
	Sample 89-0977	< 0.0511				
	Sample 90-0716	< 0.0511				
	Sample 90-1257	< 0.0511				
	Sample 90-1279	< 0.0511				
	Sample 90-4180	< 0.0511				
ICP.f.Ru	Sample 89-0622	< 0.0607	< 0.0607 to 157	157	---	190
	Sample 89-0623	< 0.0607				
	Sample 90-1125	< 0.0607				
	Sample 90-1126	< 0.0607				
	Sample 89-1251	< 0.0607				
	Sample 89-1252	< 0.0607				
	Sample 89-0971	< 0.0607				
	Sample 89-0972	< 0.0607				
	Sample 89-0973	< 0.0607				
	Sample 89-0974	< 0.0607				
	Sample 89-0975	< 0.0607				
	Sample 89-0976	< 0.0607				
	Sample 90-0714	< 0.0607				
	Sample 90-0715	< 0.0607				
	Sample 90-1255	< 0.0607				
	Sample 90-1256	< 0.0607				
	Sample 90-1277	157				
	Sample 90-1278	< 0.0607				
	Sample 90-4178	< 0.0607				
	Sample 90-4179	< 0.0607				
ICP.a.Ru	Sample 89-0621	< 0.0484	< 0.0484 to 185	111.3	0.2437	---
	Sample 90-0640	172				
	Sample 89-0977	< 0.0484				
	Sample 90-0716	< 0.0484				
	Sample 90-1257	139				
	Sample 90-1279	175				
	Sample 90-4180	185				

Table A-2. Tank 241-B-110 Analytical Data: Selenium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Se	Sample 89-0621	< 0.0648	N/A	< 0.0648	---	---
	Sample 90-0640	< 0.0648				
	Sample 89-0977	< 0.0648				
	Sample 90-0716	< 0.0648				
	Sample 90-1257	< 0.0648				
	Sample 90-1279	< 0.0648				
	Sample 90-4180	< 0.0648				
ICP.f.Se	Sample 89-0622	< 0.172	< 0.172 to 923	909	---	1,100
	Sample 89-0623	< 0.172				
	Sample 90-1125	< 0.172				
	Sample 90-1126	< 0.172				
	Sample 89-1251	< 0.172				
	Sample 89-1252	< 0.172				
	Sample 89-0971	923				
	Sample 89-0972	895				
	Sample 89-0973	< 0.172				
	Sample 89-0974	< 0.172				
	Sample 89-0975	< 0.172				
	Sample 89-0976	< 0.172				
	Sample 90-0714	< 0.172				
	Sample 90-0715	< 0.172				
	Sample 90-1255	< 0.172				
	Sample 90-1256	< 0.172				
	Sample 90-1277	< 0.172				
	Sample 90-1278	< 0.172				
	Sample 90-4178	< 0.172				
	Sample 90-4179	< 0.172				
ICP.a.Se	Sample 89-0621	< 0.0648	< 0.0648 to 62.0	62.0	---	---
	Sample 90-0640	< 0.0648				
	Sample 89-0977	< 0.0648				
	Sample 90-0716	62.0				
	Sample 90-1257	< 0.0648				
	Sample 90-1279	< 0.0648				
	Sample 90-4180	< 0.0648				

Table A-2. Tank 241-B-110 Analytical Data: Selenium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
GFAA.Se	Sample 89-0621	< 24.0	< 22.5 to < 24.0	< 24.0	---	< 29.0
	Sample 90-0640	< 22.5				
	Sample 89-0977	< 24.0				
	Sample 90-0716	**				
	Sample 90-1257	**				
	Sample 90-1279	**				
	Sample 90-4180	**				

** Analyte suppression due to matrix effect observed on final dilution run

Table A-2. Tank 241-B-110 Analytical Data: Silicon

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Si	Sample 89-0621	3,890	424 to 3,890	1,210	---	---
	Sample 90-0640	742				
	Sample 89-0977	424				
	Sample 90-0716	644				
	Sample 90-1257	928				
	Sample 90-1279	894				
	Sample 90-4180	918				
ICP.f.Si	Sample 89-0622	15,800	8,190 to 19,900	9,358	0.0358	11,300
	Sample 89-0623	19,900				
	Sample 90-1125	9,400				
	Sample 90-1126	9,400				
	Sample 89-1251	9,870				
	Sample 89-1252	9,920				
	Sample 89-0971	9,050				
	Sample 89-0972	9,550				
	Sample 89-0973	9,000				
	Sample 89-0974	9,360				
	Sample 89-0975	9,620				
	Sample 89-0976	8,980				
	Sample 90-0714	9,300				
	Sample 90-0715	9,120				
	Sample 90-1255	8,290				
	Sample 90-1256	8,190				
	Sample 90-1277	8,780				
	Sample 90-1278	9,000				
	Sample 90-4178	10,100				
	Sample 90-4179	10,100				
ICP.a.Si	Sample 89-0621	2,860	420 to 2,860	945	---	---
	Sample 90-0640	693				
	Sample 89-0977	928				
	Sample 90-0716	564				
	Sample 90-1257	525				
	Sample 90-1279	690				
	Sample 90-4180	420				

Table A-2. Tank 241-B-110 Analytical Data: Silver

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Ag	Sample 89-0621	< 0.0134	< 0.0134 to 20.0	15.2	---	---
	Sample 90-0640	14.0				
	Sample 89-0977	14.0				
	Sample 90-0716	20.0				
	Sample 90-1257	8.00				
	Sample 90-1279	20.0				
	Sample 90-4180	< 0.0134				
ICP.f.Ag	Sample 89-0622	< 0.0147	< 0.0147 to 303	143	---	173
	Sample 89-0623	< 0.0147				
	Sample 90-1125	53.0				
	Sample 90-1126	< 0.0147				
	Sample 89-1251	49.0				
	Sample 89-1252	< 0.0147				
	Sample 89-0971	< 0.0147				
	Sample 89-0972	< 0.0147				
	Sample 89-0973	< 0.0147				
	Sample 89-0974	< 0.0147				
	Sample 89-0975	42.0				
	Sample 89-0976	< 0.0147				
	Sample 90-0714	262				
	Sample 90-0715	303				
	Sample 90-1255	163				
	Sample 90-1256	142				
	Sample 90-1277	132				
	Sample 90-1278	142				
	Sample 90-4178	< 0.0147				
	Sample 90-4179	< 0.0147				
ICP.a.Ag	Sample 89-0621	105	10.0 to 115	46.73	0.5017	---
	Sample 90-0640	22.0				
	Sample 89-0977	10.0				
	Sample 90-0716	115				
	Sample 90-1257	31.0				
	Sample 90-1279	48.0				
	Sample 90-4180	11.0				

Table A-2. Tank 241-B-110 Analytical Data: Sodium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Na	Sample 89-0621	8.66E+05	84,400 to 8.66E+05	2.70E+05	---	3.27E+05
	Sample 90-0640	1.76E+05				
	Sample 89-0977	84,400				
	Sample 90-0716	2.08E+05				
	Sample 90-1257	1.89E+05				
	Sample 90-1279	1.96E+05				
	Sample 90-4180	1.69E+05				
ICP.f.Na	Sample 89-0622	1.06E+05	90,200 to 1.09E+05	97,730	0.03285	---
	Sample 89-0623	1.09E+05				
	Sample 90-1125	98,700				
	Sample 90-1126	97,100				
	Sample 89-1251	94,700				
	Sample 89-1252	96,200				
	Sample 89-0971	90,200				
	Sample 89-0972	94,900				
	Sample 89-0973	91,100				
	Sample 89-0974	92,800				
	Sample 89-0975	94,900				
	Sample 89-0976	92,500				
	Sample 90-0714	1.08E+05				
	Sample 90-0715	1.05E+05				
	Sample 90-1255	92,500				
	Sample 90-1256	91,600				
	Sample 90-1277	90,900				
	Sample 90-1278	94,400				
	Sample 90-4178	96,200				
	Sample 90-4179	92,700				
ICP.a.Na	Sample 89-0621	4.85E+05	93,500 to 4.85E+05	1.53E+05	---	---
	Sample 90-0640	97,700				
	Sample 89-0977	94,900				
	Sample 90-0716	1.07E+05				
	Sample 90-1257	94,000				
	Sample 90-1279	96,100				
	Sample 90-4180	93,500				

Table A-2. Tank 241-B-110 Analytical Data: Strontium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Sr	Sample 89-0621	< 0.00104	< 0.00104 to 2.00	2.00	---	---
	Sample 90-0640	< 0.00104				
	Sample 89-0977	< 0.00104				
	Sample 90-0716	2.00				
	Sample 90-1257	< 0.00140				
	Sample 90-1279	2.00				
	Sample 90-4180	2.00				
ICP.f.Sr	Sample 89-0622	213	173 to 258	211	---	---
	Sample 89-0623	217				
	Sample 90-1125	205				
	Sample 90-1126	202				
	Sample 89-1251	212				
	Sample 89-1252	213				
	Sample 89-0971	243				
	Sample 89-0972	256				
	Sample 89-0973	245				
	Sample 89-0974	251				
	Sample 89-0975	258				
	Sample 89-0976	245				
	Sample 90-0714	180				
	Sample 90-0715	180				
	Sample 90-1255	174				
	Sample 90-1256	173				
	Sample 90-1277	186				
	Sample 90-1278	194				
	Sample 90-4178	263				
	Sample 90-4179	258				
ICP.a.Sr	Sample 89-0621	1,040	174 to 1,040	211	0.09523	255
	Sample 90-0640	211				
	Sample 89-0977	268				
	Sample 90-0716	181				
	Sample 90-1257	174				
	Sample 90-1279	196				
	Sample 90-4180	267				

Table A-2. Tank 241-B-110 Analytical Data: Tellurium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.Te	Sample 89-0621	< 0.0463	N/A	< 0.0463	---	---
	Sample 90-0640	< 0.0463				
	Sample 89-0977	< 0.0463				
	Sample 90-0716	< 0.0463				
	Sample 90-1257	< 0.0463				
	Sample 90-1279	< 0.0463				
	Sample 90-4180	< 0.0463				
ICP.f.Te	Sample 89-0622	< 0.0749	N/A	< 0.0749	---	---
	Sample 89-0623	< 0.0749				
	Sample 90-1125	< 0.0749				
	Sample 90-1126	< 0.0749				
	Sample 89-1251	< 0.0749				
	Sample 89-1252	< 0.0749				
	Sample 89-0971	< 0.0749				
	Sample 89-0972	< 0.0749				
	Sample 89-0973	< 0.0749				
	Sample 89-0974	< 0.0749				
	Sample 89-0975	< 0.0749				
	Sample 89-0976	< 0.0749				
	Sample 90-0714	< 0.0749				
	Sample 90-0715	< 0.0749				
	Sample 90-1255	< 0.0749				
	Sample 90-1256	< 0.0749				
	Sample 90-1277	< 0.0749				
	Sample 90-1278	< 0.0749				
	Sample 90-4178	< 0.0749				
	Sample 90-4179	< 0.0749				
ICP.a.Te	Sample 89-0621	< 0.0203	< 0.0203 to 23.0	17.8	---	21.5
	Sample 90-0640	23.0				
	Sample 89-0977	< 0.0203				
	Sample 90-0716	18.0				
	Sample 90-1257	13.0				
	Sample 90-1279	< 0.0203				
	Sample 90-4180	17.0				

Table A-2. Tank 241-B-110 Analytical Data: Thallium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Tl	Sample 89-0621	< 2.93	N/A	< 2.93	---	< 3.55
	Sample 90-0640	< 2.93				
	Sample 89-0977	< 2.93				
	Sample 90-0716	< 2.93				
	Sample 90-1257	< 2.93				
	Sample 90-1279	< 2.93				
	Sample 90-4180	< 2.93				
ICP.f.Tl	Sample 89-0622	< 1.86	N/A	< 1.86	---	---
	Sample 89-0623	< 1.86				
	Sample 90-1125	< 1.86				
	Sample 90-1126	< 1.86				
	Sample 89-1251	< 1.86				
	Sample 89-1252	< 1.86				
	Sample 89-0971	< 1.86				
	Sample 89-0972	< 1.86				
	Sample 89-0973	< 1.86				
	Sample 89-0974	< 1.86				
	Sample 89-0975	< 1.86				
	Sample 89-0976	< 1.86				
	Sample 90-0714	< 1.86				
	Sample 90-0715	< 1.86				
	Sample 90-1255	< 1.86				
	Sample 90-1256	< 1.86				
	Sample 90-1277	< 1.86				
	Sample 90-1278	< 1.86				
	Sample 90-4178	< 1.86				
	Sample 90-4179	< 1.86				
ICP.a.Tl	Sample 89-0621	< 1.17	N/A	< 1.17	---	---
	Sample 90-0640	< 1.17				
	Sample 89-0977	< 1.17				
	Sample 90-0716	< 1.17				
	Sample 90-1257	< 1.17				
	Sample 90-1279	< 1.17				
	Sample 90-4180	< 1.17				
GFAA.Tl	Sample 90-0640	< 22.5	N/A	< 22.5	---	< 27.2

Table A-2. Tank 241-B-110 Analytical Data: Thorium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Th	Sample 89-0621	< 0.140	N/A	< 0.140	---	< 0.169
	Sample 90-0640	< 0.140				
	Sample 89-0977	< 0.140				
	Sample 90-0716	< 0.140				
	Sample 90-1257	< 0.140				
	Sample 90-1279	< 0.140				
	Sample 90-4180	< 0.140				
ICP.f.Th	Sample 89-0622	< 0.130	N/A	< 0.130	---	---
	Sample 89-0623	< 0.130				
	Sample 90-1125	< 0.130				
	Sample 90-1126	< 0.130				
	Sample 89-1251	< 0.130				
	Sample 89-1252	< 0.130				
	Sample 89-0971	< 0.130				
	Sample 89-0972	< 0.130				
	Sample 89-0973	< 0.130				
	Sample 89-0974	< 0.130				
	Sample 89-0975	< 0.130				
	Sample 89-0976	< 0.130				
	Sample 90-0714	< 0.130				
	Sample 90-0715	< 0.130				
	Sample 90-1255	< 0.130				
	Sample 90-1256	< 0.130				
	Sample 90-1277	< 0.130				
	Sample 90-1278	< 0.130				
	Sample 90-4178	< 0.130				
	Sample 90-4179	< 0.130				
ICP.a.Th	Sample 89-0621	< 0.0622	N/A	< 0.0622	---	---
	Sample 90-0640	< 0.0622				
	Sample 89-0977	< 0.0622				
	Sample 90-0716	< 0.0622				
	Sample 90-1257	< 0.0622				
	Sample 90-1279	< 0.0622				
	Sample 90-4180	< 0.0622				

Table A-2. Tank 241-B-110 Analytical Data: Titanium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Ti	Sample 89-0621	< 0.00896	N/A	< 0.00896	---	---
	Sample 90-0640	< 0.00896				
	Sample 89-0977	< 0.00896				
	Sample 90-0716	< 0.00896				
	Sample 90-1257	< 0.00896				
	Sample 90-1279	< 0.00896				
	Sample 90-4180	< 0.00896				
ICP.f.Ti	Sample 89-0622	< 0.0100	< 0.0100 to 46.0	38.3	---	46.3
	Sample 89-0623	46.0				
	Sample 90-1125	< 0.0100				
	Sample 90-1126	< 0.0100				
	Sample 89-1251	24.0				
	Sample 89-1252	< 0.0100				
	Sample 89-0971	< 0.0100				
	Sample 89-0972	< 0.0100				
	Sample 89-0973	< 0.0100				
	Sample 89-0974	< 0.0100				
	Sample 89-0975	< 0.0100				
	Sample 89-0976	< 0.0100				
	Sample 90-0714	< 0.0100				
	Sample 90-0715	< 0.0100				
	Sample 90-1255	< 0.0100				
	Sample 90-1256	< 0.0100				
	Sample 90-1277	44.0				
	Sample 90-1278	39.0				
	Sample 90-4178	< 0.0100				
	Sample 90-4179	< 0.0100				
ICP.a.Ti	Sample 89-0621	< 0.00540	< 0.00540 to 14.0	8.413	0.1604	---
	Sample 90-0640	7.00				
	Sample 89-0977	7.00				
	Sample 90-0716	12.0				
	Sample 90-1257	7.00				
	Sample 90-1279	14.0				
	Sample 90-4180	5.00				

Table A-2. Tank 241-B-110 Analytical Data: Uranium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.U	Sample 89-0621	< 1.22	N/A	< 1.22	---	---
	Sample 90-0640	< 1.22				
	Sample 89-0977	< 1.22				
	Sample 90-0716	< 1.22				
	Sample 90-1257	< 1.22				
	Sample 90-1279	< 1.22				
	Sample 90-4180	< 1.22				
ICP.f.U	Sample 89-0622	< 1.20	N/A	< 1.20	---	---
	Sample 89-0623	< 1.20				
	Sample 90-1125	< 1.20				
	Sample 90-1126	< 1.20				
	Sample 89-1251	< 1.20				
	Sample 89-1252	< 1.20				
	Sample 89-0971	< 1.20				
	Sample 89-0972	< 1.20				
	Sample 89-0973	< 1.20				
	Sample 89-0974	< 1.20				
	Sample 89-0975	< 1.20				
	Sample 89-0976	< 1.20				
	Sample 90-0714	< 1.20				
	Sample 90-0715	< 1.20				
	Sample 90-1255	< 1.20				
	Sample 90-1256	< 1.20				
	Sample 90-1277	< 1.20				
	Sample 90-1278	< 1.20				
	Sample 90-4178	< 1.20				
	Sample 90-4179	< 1.20				
ICP.a.U	Sample 89-0621	< 0.472	< 0.472 to 971	849	---	1,030
	Sample 90-0640	971				
	Sample 89-0977	900				
	Sample 90-0716	716				
	Sample 90-1257	610				
	Sample 90-1279	950				
	Sample 90-4180	947				

Table A-2. Tank 241-B-110 Analytical Data: Uranium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
LF.f.U	Sample 89-0622	238	142 to 788	208	0.08654	---
	Sample 89-0623	232				
	Sample 89-0465	711				
	Sample 89-0466	788				
	Sample 90-0636	391				
	Sample 89-0727	157				
	Sample 89-0728	155				
	Sample 89-1251	230				
	Sample 89-1252	225				
	Sample 89-0971	178				
	Sample 89-0972	182				
	Sample 90-0714	209				
	Sample 90-0715	223				
	Sample 90-1255	179				
	Sample 90-1256	185				
	Sample 90-1277	262				
	Sample 90-1278	283				
	Sample 90-4178	142				

Table A-2. Tank 241-B-110 Analytical Data: Vanadium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		μg/g	μg/g	μg/g		kg
ICP.w.V	Sample 89-0621	< 0.00793	N/A	< 0.00793	---	---
	Sample 90-0640	< 0.00793				
	Sample 89-0977	< 0.00793				
	Sample 90-0716	< 0.00793				
	Sample 90-1257	< 0.00793				
	Sample 90-1279	< 0.00793				
	Sample 90-4180	< 0.00793				
ICP.f.V	Sample 89-0622	< 0.0128	N/A	< 0.0128	---	---
	Sample 89-0623	< 0.0128				
	Sample 90-1125	< 0.0128				
	Sample 90-1126	< 0.0128				
	Sample 89-1251	< 0.0128				
	Sample 89-1252	< 0.0128				
	Sample 89-0971	< 0.0128				
	Sample 89-0972	< 0.0128				
	Sample 89-0973	< 0.0128				
	Sample 89-0974	< 0.0128				
	Sample 89-0975	< 0.0128				
	Sample 89-0976	< 0.0128				
	Sample 90-0714	< 0.0128				
	Sample 90-0715	< 0.0128				
	Sample 90-1255	< 0.0128				
	Sample 90-1256	< 0.0128				
	Sample 90-1277	< 0.0128				
	Sample 90-1278	< 0.0128				
	Sample 90-4178	< 0.0128				
	Sample 90-4179	< 0.0128				
ICP.a.V	Sample 89-0621	< 0.00370	< 0.00370 to 5.00	2.788	0.1833	3.35
	Sample 90-0640	4.00				
	Sample 89-0977	< 0.00370				
	Sample 90-0716	5.00				
	Sample 90-1257	2.00				
	Sample 90-1279	4.00				
	Sample 90-4180	4.00				

Table A-2. Tank 241-B-110 Analytical Data: Zinc

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Zn	Sample 89-0621	80.0	< 0.00467 to 81.0	54.3	---	---
	Sample 90-0640	< 0.00467				
	Sample 89-0977	81.0				
	Sample 90-0716	2.00				
	Sample 90-1257	< 0.00467				
	Sample 90-1279	< 0.00467				
	Sample 90-4180	< 0.00467				
ICP.f.Zn	Sample 89-0622	210	89.0 to 1,370	203	---	246
	Sample 89-0623	176				
	Sample 90-1125	1,370				
	Sample 90-1126	114				
	Sample 89-1251	149				
	Sample 89-1252	141				
	Sample 89-0971	184				
	Sample 89-0972	210				
	Sample 89-0973	167				
	Sample 89-0974	186				
	Sample 89-0975	217				
	Sample 89-0976	200				
	Sample 90-0714	118				
	Sample 90-0715	108				
	Sample 90-1255	149				
	Sample 90-1256	119				
	Sample 90-1277	174				
	Sample 90-1278	89.0				
	Sample 90-4178	229				
	Sample 90-4179	248				
ICP.a.Zn	Sample 89-0621	460	53.0 to 460	80.51	0.07609	---
	Sample 90-0640	95.0				
	Sample 89-0977	76.0				
	Sample 90-0716	85.0				
	Sample 90-1257	53.0				
	Sample 90-1279	80.0				
	Sample 90-4180	82.0				

Table A-2. Tank 241-B-110 Analytical Data: Zirconium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Metal		µg/g	µg/g	µg/g		kg
ICP.w.Zr	Sample 89-0621	< 0.00844	N/A	< 0.00844	---	---
	Sample 90-0640	< 0.00844				
	Sample 89-0977	< 0.00844				
	Sample 90-0716	< 0.00844				
	Sample 90-1257	< 0.00844				
	Sample 90-1279	< 0.00844				
	Sample 90-4180	< 0.00844				
ICP.f.Zr	Sample 89-0622	< 0.0106	< 0.0106 to 519	487	---	589
	Sample 89-0623	< 0.0106				
	Sample 90-1125	< 0.0106				
	Sample 90-1126	< 0.0106				
	Sample 89-1251	455				
	Sample 89-1252	519				
	Sample 89-0971	< 0.0106				
	Sample 89-0972	< 0.0106				
	Sample 89-0973	< 0.0106				
	Sample 89-0974	< 0.0106				
	Sample 89-0975	< 0.0106				
	Sample 89-0976	< 0.0106				
	Sample 90-0714	< 0.0106				
	Sample 90-0715	< 0.0106				
	Sample 90-1255	< 0.0106				
	Sample 90-1256	< 0.0106				
	Sample 90-1277	< 0.0106				
	Sample 90-1278	< 0.0106				
	Sample 90-4178	< 0.0106				
	Sample 90-4179	< 0.0106				
ICP.a.Zr	Sample 89-0621	< 0.00410	< 0.00410 to 9.00	6.25	0.120	---
	Sample 90-0640	7.00				
	Sample 89-0977	5.00				
	Sample 90-0716	9.00				
	Sample 90-1257	4.00				
	Sample 90-1279	8.00				
	Sample 90-4180	5.00				

Table A-3. Tank 241-B-110 Analytical Data: Ammonia

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Cation		$\mu g/g$	$\mu g/g$	$\mu g/g$		kg
KTN.NH_3	Sample 89-0621	259	148 to 364	263	1.00	331
	Sample 90-0640	222				
	Sample 89-0977	319				
	Sample 90-1257	268				
	Sample 90-1279	148				
	Sample 90-4180	364				

Table A-3. Tank 241-B-110 Analytical Data: Chloride

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Anion		$\mu g/g$	$\mu g/g$	$\mu g/g$		kg
IC.w.Cl^-	Sample 89-0621	1,020	1,020 to 1,480	1,234	0.0639	1,550
	Sample 90-0640	1,070				
	Sample 89-0977	1,050				
	Sample 90-0716	1,480				
	Sample 90-1257	1,260				
	Sample 90-1279	1,280				
	Sample 90-4180	1,440				

Table A-3. Tank 241-B-110 Analytical Data: Hexavalent Chromium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Value	Mean	RSD	Projected Inventory
Cation		µg/g	µg/g	µg/g		kg
Spec.Cr^{6+}	Sample 89-0621	67.0	31.4 to 52.9	41.5	0.365	52.3
	Sample 90-0640	32.7				
	Sample 89-0977	28.6				
	Sample 90-1257	36.6				
	Sample 90-1279	52.9				
	Sample 90-4180	31.4				

Table A-3. Tank 241-B-110 Analytical Data: Fluoride

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Anion		µg/g	µg/g	µg/g		kg
IC.w.F^-	Sample 89-0621	1,650	1,480 to 2,260	1,895	0.0633	2,390
	Sample 90-0640	1,740				
	Sample 89-0977	1,480				
	Sample 90-0716	2,260				
	Sample 90-1257	2,010				
	Sample 90-1279	2,020				
	Sample 90-4180	1,980				

Table A-3. Tank 241-B-110 Analytical Data: Nitrate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Anion		μg/g	μg/g	μg/g		kg
IC.w.NO_3^-	Sample 89-0621	1.62E+05	1.62E+-05 to 2.31E+05	1.87E+05	0.0814	2.36E+05
	Sample 90-0640	1.70E+05				
	Sample 89-0977	1.63E+05				
	Sample 90-0716	2.31E+05				
	Sample 90-1257	1.88E+05				
	Sample 90-1279	1.86E+05				
	Sample 90-4180	1.69E+05				

Table A-3. Tank 241-B-110 Analytical Data: Nitrite

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Anion		μg/g	μg/g	μg/g		kg
IC.w.NO_2^-	Sample 89-0621	9,860	8,950 to 12,000	10,290	0.0387	13,000
	Sample 90-0640	10,700				
	Sample 89-0977	9,210				
	Sample 90-0716	12,000				
	Sample 90-1257	8,950				
	Sample 90-1279	11,100				
	Sample 90-4180	10,300				

Table A-3. Tank 241-B-110 Analytical Data: Phosphate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Anion		μg/g	μg/g	μg/g		kg
IC.w.PO_4^{-3}	Sample 89-0621	25,400	22,700 to 28,100	25,250	0.0380	31,800
	Sample 90-0640	24,800				
	Sample 89-0977	22,700				
	Sample 90-0716	28,100				
	Sample 90-1257	25,200				
	Sample 90-1279	24,400				
	Sample 90-4180	24,000				

Table A-3. Tank 241-B-110 Analytical Data: Sulfate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Anion		μg/g	μg/g	μg/g		kg
IC.w.SO_4^{-2}	Sample 89-0621	10,500	10,200 to 13,800	11,530	0.0638	14,500
	Sample 90-0640	10,600				
	Sample 89-0977	10,200				
	Sample 90-0716	13,800				
	Sample 90-1257	11,100				
	Sample 90-1279	11,500				
	Sample 90-4180	11,200				

Table A-4. Tank 241-B-110 Analytical Data: Americium-241 (2 pages)

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		μCi/g	μCi/g	μCi/g		Ci
GEA.f.^{241}Am	Sample 89-0622	0.138	0.0175 to 0.140	0.0725	0.347	87.7
	Sample 89-0623	0.140				
	Sample 89-0980	0.0716				
	Sample 89-0981	0.0803				
	Sample 89-1251	0.0667				
	Sample 89-1252	0.0738				
	Sample 89-0971	0.0389				
	Sample 89-0972	0.0327				
	Sample 89-0973	0.0379				
	Sample 89-0974	0.0382				
	Sample 89-0975	0.0315				
	Sample 89-0976	0.0345				
	Sample 90-0714	0.116				
	Sample 90-0715	0.0989				
	Sample 90-1255	0.0492				
	Sample 90-1256	0.0388				
	Sample 90-1277	0.0855				
	Sample 90-1278	0.0853				
	Sample 90-4178	0.0188				
	Sample 90-4179	0.0175				

Table A-4. Tank 241-B-110 Analytical Data: Americium-241 (2 pages)

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
AEA.f.^{241}Am	Sample 89-0622	0.135	0.0168 to 0.136	0.0602	---	72.8
	Sample 89-0623	0.136				
	Sample 89-0971	0.0230				
	Sample 89-0972	0.0294				
	Sample 90-0714	0.0856				
	Sample 90-0715	0.0932				
	Sample 90-1255	0.0362				
	Sample 90-1256	0.0361				
	Sample 90-1277	0.0561				
	Sample 90-1278	0.0592				
	Sample 90-4178	0.0168				
AEA.w.^{241}Am	Sample 89-0621	0.00453	9.69E-05 to 0.00453	0.00147	---	---
	Sample 89-0640	5.09E-04				
	Sample 89-0977	2.13E-04				
	Sample 90-0716	0.00239				
	Sample 90-1257	3.67E-04				
	Sample 90-1279	0.00215				
	Sample 90-4180	9.69E-05				

Table A-4. Tank 241-B-110 Analytical Data: Carbon-14

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
LSC.w.^{14}C	Sample 89-0621	0.0243	1.02E-09 to 0.0243	0.00812	---	11.0
	Sample 89-0977	< 0.00360				
	Sample 90-1279	4.95E-05				
	Sample 90-4180	1.02E-09				

Table A-4. Tank 241-B-110 Analytical Data: Cerium-144

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
GEA.f.^{144}Ce	Sample 89-0622	0.252	0.0127 to 0.252	0.132	---	160
	Sample 89-0623	0.221				
	Sample 89-0974	0.294				
	Sample 89-0976	0.0127				
	Sample 90-1255	0.0475				
	Sample 90-1256	0.0320				
	Sample 90-4178	0.0646				
	Sample 90-4179	0.0911				

Table A-4. Tank 241-B-110 Analytical Data: Cesium-134

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		μCi/g	μCi/g	μCi/g		Ci
GEA.f.^{134}Cs	Sample 89-0981	0.0192	0.00275 to 0.0417	0.0171	---	---
	Sample 89-0971	0.00516				
	Sample 89-0974	0.0115				
	Sample 89-0976	0.00275				
	Sample 90-0715	0.0417				
	Sample 90-4178	0.0121				
GEA.w.^{134}Cs	Sample 89-0621	0.111	7.38E-04 to 0.111	0.0559	---	67.6
	Sample 90-4180	7.38E-04				

Table A-4. Tank 241-B-110 Analytical Data: Cesium-137

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		μCi/g	μCi/g	μCi/g		Ci
GEA.f.^{137}Cs	Sample 89-0622	14.5	13.1 to 16.8	14.9	0.0378	18,000
	Sample 89-0623	14.8				
	Sample 89-0980	14.4				
	Sample 89-0981	14.7				
	Sample 89-1251	15.0				
	Sample 89-1252	15.1				
	Sample 89-0971	13.9				
	Sample 89-0972	14.0				
	Sample 89-0973	13.5				
	Sample 89-0974	13.6				
	Sample 89-0975	13.1				
	Sample 89-0976	14.2				
	Sample 90-0714	16.8				
	Sample 90-0715	16.4				
	Sample 90-1255	13.6				
	Sample 90-1256	14.5				
	Sample 90-1277	15.0				
	Sample 90-1278	14.7				
	Sample 90-4178	14.2				
	Sample 90-4179	14.2				
GEA.w.^{137}Cs	Sample 89-0621	8.43	7.52 to 10.2	8.44	---	---
	Sample 89-0640	7.85				
	Sample 89-0977	7.61				
	Sample 90-0716	10.2				
	Sample 90-1257	8.80				
	Sample 90-1279	8.64				
	Sample 90-4180	7.52				

Table A-4. Tank 241-B-110 Analytical Data: Cobalt-60

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
GEA.f.^{60}Co	Sample 89-0980	0.00711	0.00129 to 0.163	0.0153	0.445	18.5
	Sample 89-0981	0.00862				
	Sample 89-1251	0.121				
	Sample 89-1252	0.0333				
	Sample 89-0971	0.00129				
	Sample 89-0972	0.00241				
	Sample 89-0973	0.00386				
	Sample 89-0974	0.0527				
	Sample 89-0975	0.00229				
	Sample 89-0976	0.0118				
	Sample 90-0714	0.00536				
	Sample 90-0715	0.00508				
	Sample 90-1256	0.00574				
	Sample 90-4178	0.00511				
	Sample 90-4179	0.163				
GEA.w.^{60}Co	Sample 90-0716	4.37E-04	N/A	4.37E-04	---	---

Table A-4. Tank 241-B-110 Analytical Data: Curium-243/244

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
AEA.f.$^{243/244}$Cm	Sample 89-0622	0.00329	1.79E-04 to 0.00329	0.00128	0.500	1.55
	Sample 89-0623	0.00221				
	Sample 89-0971	7.66E-04				
	Sample 89-0972	6.52E-04				
	Sample 90-0714	6.53E-04				
	Sample 90-0715	7.88E-04				
	Sample 90-1256	6.80E-04				
	Sample 90-1277	2.71E-04				
	Sample 90-1278	1.79E-04				
AEA.w.$^{243/244}$Cm	Sample 89-0621	7.66E-05	1.54E-06 to 0.00151	3.19E-04	---	---
	Sample 89-0640	1.54E-06				
	Sample 89-0977	2.25E-06				
	Sample 90-0716	5.18E-06				
	Sample 90-4180	0.00151				

Table A-4. Tank 241-B-110 Analytical Data: Europium-152

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
GEA.f.^{152}Eu	Sample 89-1251	0.0963	0.0475 to 0.252	0.0675	0.386	81.7
	Sample 89-1252	0.0838				
	Sample 90-1255	0.0475				
	Sample 90-1256	0.0320				
	Sample 90-4179	0.252				

Table A-4. Tank 241-B-110 Analytical Data: Europium-154

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
GEA.f.^{154}Eu	Sample 89-0622	0.388	0.0297 to 0.415	0.168	---	203
	Sample 89-0623	0.392				
	Sample 89-0980	0.415				
	Sample 89-0981	0.272				
	Sample 89-1251	0.316				
	Sample 89-1252	0.257				
	Sample 89-0971	0.0476				
	Sample 89-0972	0.0497				
	Sample 89-0973	0.0489				
	Sample 89-0974	0.0601				
	Sample 89-0975	0.0428				
	Sample 89-0976	0.0447				
	Sample 90-0714	0.113				
	Sample 90-0715	0.188				
	Sample 90-1255	0.113				
	Sample 90-1256	0.117				
	Sample 90-1277	0.145				
	Sample 90-1278	0.158				
	Sample 90-4178	0.0741				
	Sample 90-4179	0.0297				
GEA.w.^{154}Eu	Sample 89-0621	0.0102	0.00334 to 0.0102	0.00628	---	---
	Sample 90-0716	0.00530				
	Sample 90-1279	0.00334				

Table A-4. Tank 241-B-110 Analytical Data: Europium-155

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
GEA.f.^{155}Eu	Sample 89-0622	0.609	0.0128 to 0.609	0.216	---	261
	Sample 89-0623	0.609				
	Sample 89-0980	0.231				
	Sample 89-0981	0.234				
	Sample 89-1251	0.251				
	Sample 89-1252	0.248				
	Sample 89-0971	0.0796				
	Sample 89-0972	0.0689				
	Sample 89-0973	0.0633				
	Sample 89-0974	0.0852				
	Sample 89-0975	0.0691				
	Sample 89-0976	0.0696				
	Sample 90-0714	0.332				
	Sample 90-0715	0.408				
	Sample 90-1255	0.171				
	Sample 90-1256	0.172				
	Sample 90-1277	0.207				
	Sample 90-1278	0.219				
	Sample 90-4178	0.0128				
GEA.w.^{155}Eu	Sample 89-0621	0.0250	0.00441 to 0.0250	0.0126	---	---
	Sample 90-0716	0.00840				
	Sample 90-1279	0.00441				

Table A-4. Tank 241-B-110 Analytical Data: Gadolinium-153

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		μCi/g	μCi/g	μCi/g		Ci
GEA.f.^{153}Gd	Sample 89-0980	0.571	0.00876 to 0.571	0.181	---	219
	Sample 89-0981	0.267				
	Sample 89-1251	0.258				
	Sample 89-1252	0.189				
	Sample 89-0974	0.0149				
	Sample 89-0975	0.0130				
	Sample 89-0976	0.00876				
	Sample 90-4179	0.0690				

Table A-4. Tank 241-B-110 Analytical Data: Iodine-129

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		μCi/g	μCi/g	μCi/g		Ci
BPC.f.^{129}I	Sample 89-0622	< 1.55E-05	< 1.46E-05 to 1.31E-04	3.61E-05	0.248	0.0437
	Sample 89-0623	3.00E-05				
	Sample 89-0971	< 1.49E-05				
	Sample 89-0972	< 1.53E-05				
	Sample 90-0714	< 2.42E-05				
	Sample 90-0715	< 2.28E-05				
	Sample 90-1255	< 1.46E-05				
	Sample 90-1256	< 1.53E-05				
	Sample 90-1277	< 4.14E-05				
	Sample 90-1278	< 4.10E-05				
	Sample 90-4178	< 1.31E-04				
BPC.w.^{129}I	Sample 89-0621	< 9.90E-07	< 9.90E-07 to < 1.44E-05	3.13E-06	---	---
	Sample 89-0640	3.13E-06				
	Sample 89-0977	< 1.44E-05				
	Sample 90-0716	< 4.50E-06				
	Sample 90-1257	< 4.84E-06				
	Sample 90-1279	< 4.95E-06				
	Sample 90-4180	< 1.17E-05				

Table A-4. Tank 241-B-110 Analytical Data: Neptunium-237

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
AEA.f.^{237}Np	Sample 89-0622	1.01E-04	< 3.38E-05 to 3.99E-04	1.12E-04	0.248	0.136
	Sample 89-0623	3.99E-04				
	Sample 89-0971	7.89E-05				
	Sample 89-0972	8.13E-05				
	Sample 90-0714	< 1.39E-04				
	Sample 90-0715	< 1.08E-04				
	Sample 90-1255	8.40E-05				
	Sample 90-1256	7.56E-05				
	Sample 90-1277	9.91E-05				
	Sample 90-1278	< 8.65E-05				
	Sample 90-4178	< 3.38E-05				
AEA.w.^{237}Np	Sample 89-0640	< 3.29E-04	< 2.37E-06 to < 3.29E-04	2.80E-06	---	---
	Sample 89-0977	9.23E-06				
	Sample 90-0716	< 1.89E-04				
	Sample 90-1257	2.37E-06				
	Sample 90-1279	< 1.80E-05				
	Sample 90-4180	< 7.21E-06				

Table A-4. Tank 241-B-110 Analytical Data: Plutonium-238

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		μCi/g	μCi/g	μCi/g		Ci
AEA.f.^{238}Pu	Sample 89-0622	0.00351	0.00143 to 0.00703	0.00321	0.245	3.88
	Sample 89-0623	0.00369				
	Sample 89-0971	0.00277				
	Sample 89-0972	0.00183				
	Sample 90-0714	0.00245				
	Sample 90-0715	0.00309				
	Sample 90-1255	0.00143				
	Sample 90-1256	0.00247				
	Sample 90-1277	0.00148				
	Sample 90-1278	0.00208				
	Sample 90-4178	0.00703				
AEA.w.^{238}Pu	Sample 89-0621	1.05E-04	1.24E-05 to 1.05E-04	4.92E-05	---	---
	Sample 89-0640	4.96E-05				
	Sample 89-0977	3.00E-05				
	Sample 90-0716	6.76E-05				
	Sample 90-1257	1.24E-05				
	Sample 90-1279	3.91E-05				
	Sample 90-4180	4.10E-05				

Table A-4. Tank 241-B-110 Analytical Data: Plutonium-239/240

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
AEA.f.$^{239/240}$Pu	Sample 89-0622	0.111	0.0700 to 0.150	0.112	---	136
	Sample 89-0623	0.106				
	Sample 89-0971	0.150				
	Sample 89-0972	0.124				
	Sample 90-0714	0.114				
	Sample 90-0715	0.120				
	Sample 90-1255	0.0926				
	Sample 90-1256	0.0962				
	Sample 90-1277	0.0700				
	Sample 90-1278	0.114				
	Sample 90-4178	0.121				
AEA.w.$^{239/240}$Pu	Sample 89-0621	0.00173	1.36E-06 to 0.00192	0.00125	---	---
	Sample 89-0640	1.34E-06				
	Sample 89-0977	0.00192				
	Sample 90-0716	0.00159				
	Sample 90-1257	6.53E-04				
	Sample 90-1279	0.00131				
	Sample 90-4180	0.00154				

Table A-4. Tank 241-B-110 Analytical Data: Ruthenium-106

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
GEA.f.^{106}Ru	Sample 89-0623	0.121	0.0231 to 0.270	0.138	---	167
	Sample 89-1252	0.270				
	Sample 89-0976	0.0231				

Table A-4. Tank 241-B-110 Analytical Data: Strontium-90

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
BPC.f.^{90}Sr	Sample 89-0622	224	6.78 to 224	108	0.408	1.31E+05
	Sample 89-0623	210				
	Sample 89-0971	26.9				
	Sample 89-0972	26.0				
	Sample 90-0714	127				
	Sample 90-0715	155				
	Sample 90-1255	50.0				
	Sample 90-1256	47.1				
	Sample 90-1277	62.4				
	Sample 90-1278	73.4				
	Sample 90-4178	6.78				
BPC.w.^{90}Sr	Sample 89-0621	0.220	0.00374 to 0.302	0.106	---	---
	Sample 89-0640	0.302				
	Sample 89-0977	0.0814				
	Sample 90-0716	0.0746				
	Sample 90-1257	0.0103				
	Sample 90-1279	0.0486				
	Sample 90-4180	0.00374				

Table A-4. Tank 241-B-110 Analytical Data: Technetium-99

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
BPC.f.^{99}Tc	Sample 89-0622	0.0207	0.00610 to 0.0223	0.0165	0.140	---
	Sample 89-0623	0.0208				
	Sample 89-0971	0.00778				
	Sample 89-0972	0.00610				
	Sample 90-0714	0.0223				
	Sample 90-0715	0.0180				
	Sample 90-1255	0.0154				
	Sample 90-1256	0.0149				
	Sample 90-1277	0.0127				
	Sample 90-1278	0.0119				
	Sample 90-4178	0.0113				
BPC.w.^{99}Tc	Sample 89-0621	0.0181	0.0156 to 0.0226	0.0175	---	21.2
	Sample 89-0640	0.0226				
	Sample 89-0977	0.0160				
	Sample 90-0716	0.0187				
	Sample 90-1257	0.0156				
	Sample 90-1279	0.0159				
	Sample 90-4180	0.0158				

Table A-4. Tank 241-B-110 Analytical Data: Tritium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
LSC.w.^{3}H	Sample 89-0621	0.00146	3.14E-06 to 0.00590	0.00217	0.352	2.63
	Sample 89-0640	3.14E-06				
	Sample 89-0977	< 0.00225				
	Sample 90-0716	0.00136				
	Sample 90-1257	0.00360				
	Sample 90-1279	< 3.96E-06				
	Sample 90-4180	0.00590				

Table A-4. Tank 241-B-110 Analytical Data: Total Alpha

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		μCi/g	μCi/g	μCi/g		Ci
APC.f.Total α	Sample 89-0622	0.228	0.113 to 0.228	0.156	0.100	189
	Sample 89-0623	0.219				
	Sample 89-1251	0.135				
	Sample 89-1252	0.127				
	Sample 89-0971	0.137				
	Sample 89-0972	0.145				
	Sample 90-0714	0.162				
	Sample 90-0715	0.174				
	Sample 90-1255	0.113				
	Sample 90-1256	0.117				
	Sample 90-1277	0.150				
	Sample 90-1278	0.159				
APC.w.Total α	Sample 89-0621	0.00581	9.30E-04 to 0.00581	0.00288	---	---
	Sample 89-0640	0.00190				
	Sample 89-0977	0.00171				
	Sample 90-0716	0.00445				
	Sample 90-1257	9.30E-04				
	Sample 90-1279	0.00249				

Table A-4. Tank 241-B-110 Analytical Data: Total Beta

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Radionuclide		µCi/g	µCi/g	µCi/g		Ci
BPC.f.Total ß	Sample 89-0622	509	29.6 to 514	183	0.369	2.21E+05
	Sample 89-0623	514				
	Sample 89-1251	151				
	Sample 89-1252	148				
	Sample 89-0971	61.1				
	Sample 89-0972	66.7				
	Sample 90-0714	255				
	Sample 90-0715	313				
	Sample 90-1255	170				
	Sample 90-1256	108				
	Sample 90-1277	158				
	Sample 90-1278	153				
	Sample 90-4178	29.6				
BPC.w.Total ß	Sample 89-0621	14.1	7.46 to 14.1	9.95	---	---
	Sample 89-0640	8.58				
	Sample 89-0977	7.46				
	Sample 90-0716	12.0				
	Sample 90-1257	9.12				
	Sample 90-1279	10.6				
	Sample 90-4180	7.81				

Table A-5. Tank 241-B-110 Analytical Data: Bulk Slurry Density

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Physical Property		g/ml	g/ml	g/ml		
Bulk Slurry Density	Core 1	1.36	1.32 to 1.37	1.35	0.0146	---
	Core 2	1.33				
	Core 3	1.36				
	Core 9	1.32				
	Core 10	1.34				
	Core 16	1.37				

Table A-5. Tank 241-B-110 Analytical Data: Centrifuged Solids Density

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Cation		g/ml	g/ml	g/ml		
Centrifuged Solids Density	Core 1	1.55	1.44 to 1.57	1.50	0.0348	---
	Core 2	1.46				
	Core 3	1.57				
	Core 9	1.44				
	Core 10	1.47				
	Core 16	1.51				

Table A-5. Tank 241-B-110 Analytical Data: Centrifuged Supernate Density

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Physical Property		g/ml	g/ml	g/ml		
Centrifuged Supernate Density	Core 1	1.25	1.21 to 1.25	1.24	0.0110	---
	Core 2	1.21				
	Core 3	1.24				
	Core 9	1.24				
	Core 10	1.24				
	Core 16	1.24				

Table A-5. Tank 241-B-110 Analytical Data: pH

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Physical Property						
pH	Sample 89-0621	8.23	7.73 to 8.94	8.17	0.0509	---
	Sample 90-0640	8.94				
	Sample 89-0977	7.73				
	Sample 90-1257	7.91				
	Sample 90-1279	8.11				
	Sample 90-4180	8.10				

Table A-5. Tank 241-B-110 Analytical Data: wt% Solids

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Physical Property		wt%	wt%	wt%		
wt%	Sample 89-0622	41.16	40.4 to 45.6	41.86	0.0390	---
	Sample 89-0623	41.04				
	Sample 90-0640	43.51				
	Sample 90-1251	42.23				
	Sample 90-1252	42.10				
	Sample 89-0971	40.85				
	Sample 89-0972	41.48				
	Sample 89-0973	40.94				
	Sample 89-0974	40.73				
	Sample 89-0975	40.85				
	Sample 89-0976	40.85				
	Sample 89-0977	40.70				
	Sample 90-0714	45.62				
	Sample 90-0715	45.56				
	Sample 90-1257	40.37				
	Sample 90-1279	40.83				
	Sample 90-4180	42.72				

Table A-5. Tank 241-B-110 Analytical Data: Total Inorganic Carbon

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Physical Property		µg/g	µg/g	µg/g		kg
IC.w.TIC	Sample 89-0621	1,135	623 to 1,140	900	0.0686	1,130
	Sample 90-0640	910				
	Sample 89-0977	969				
	Sample 90-0716	965				
	Sample 90-1257	623				
	Sample 90-1279	909				
	Sample 90-4180	785				

Table A-5. Tank 241-B-110 Analytical Data: Total Organic Carbon

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Mean	RSD	Projected Inventory
Physical Property		µg/g	µg/g	µg/g		kg
IC.w.TOC	Sample 89-0621	419	301 to 426	381	0.0608	480
	Sample 90-0640	320				
	Sample 89-0977	329				
	Sample 90-0716	426				
	Sample 90-1257	301				
	Sample 90-1279	442				
	Sample 90-4180	432				

Table A-6. Tank 241-B-110 Analytical Data: Volatile Organics

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

Table A-7. Tank 241-B-110 Analytical Data: Semivolatile Organic

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