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Tank Characterization Report for ~~Single~~ Double-Shell Tank 241-AY-101

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Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-AY-101. This report supports the requirements of the Tri-Party Agreement Milestone M-44-09.

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Tank Characterization Report for Double-Shell Tank 241-AY-101

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EXECUTIVE SUMMARY

This characterization report summarizes the available information on the historical uses, current status, and sampling and analysis results of waste contained in double-shell underground storage tank 241-AY-101. This report supports the requirements of *Hanford Federal Facility Agreement and Consent Order* Milestone M-44-09 (Ecology et al. 1996).

This report summarizes the collection and analysis of grab samples acquired in February 1996. The sampling was performed to satisfy requirements listed in *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995), the *Data Quality Objectives for Tank Farm Waste Compatibility Program* (Fowler 1995), and the *242-A Evaporator/Liquid Effluent Retention Facility* Data Quality Objectives (Von Bargen 1995).

Tank 241-AY-101 is one of two double-shell tanks located in the Hanford 200 East Area 241-AY Tank Farm, which is part of the Aging Waste Facilities that include the 241-AZ Tank Farm. These tanks were used to store high-level, first-cycle solvent extraction, or aging, wastes from the Plutonium-Uranium Extraction (PUREX) Plant. Tank 241-AY-101 went into service in the second quarter of 1971 when it received high-level waste from B Plant and high-level waste from PUREX. Multiple transfers involving many different waste types occurred during the next 25 years, including most recently the addition of complexed saltwell pumping waste from 200 East Area single-shell tanks ending in the third quarter of 1995. The only changes in the tank contents since that time are losses of water by evaporation.

A description of tank 241-AY-101 and its status are presented in Table ES-1, and a plan view schematic and profile are provided in Figure ES-1. The tank has an operating capacity of 3,785 kL (1,000 kgal), and as of February 29, 1996 contains an estimated 3,543 kL (936 kgal) of dilute, complexed waste. Of this total volume, 3,229 kL (853 kgal) are estimated to be supernatant, and 314 kL (83 kgal) to be sludge. The sludge contains an estimated 8 kL (2 kgal) of drainable interstitial liquid (Hanlon 1996).

The tank currently contains mostly supernatant liquid (which contains a minor amount of concentrated supernatant solids waste) over sludge consisting of several thin layers of solids including: sludge waste from the strontium recovery operations in B Plant , cesium recovery waste from B Plant, B Plant low-level waste, an unknown waste layer, and B Plant high-level waste expected to be on the tank bottom (Agnew 1996b). The small amount of sludge present makes distinction of these layers difficult with the available sampling methods. The current tank contents are classified as dilute, complexed. Tank 241-AY-101 is active, categorized as sound, and not on any Watch List.

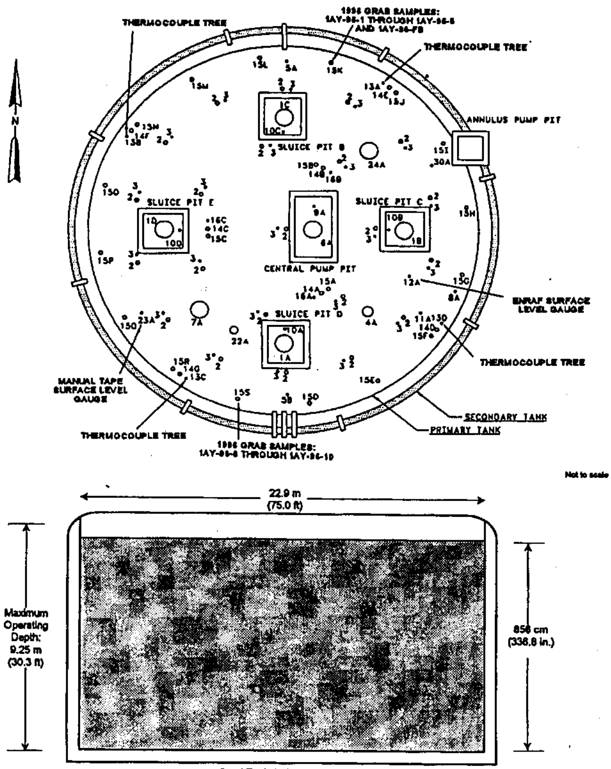
Table ES-1. Description and Status of Tank 241-AY-101.

TANK DESCRIPTION	
Type	Double-shell
Constructed	1968/1970
In-service	Second quarter 1971
Diameter	22.9 m (75.0 ft)
Operating depth	9.25 m (30.33 ft)
Capacity	3,785 kL (1,000 kgal)
Bottom shape	Flat
Ventilation	Active
TANK STATUS	
Waste classification	Dilute, complexed
Total waste volume[1]	3,543 kL (936 kgal)
Sludge volume	314 kL (83 kgal)
Supernatant volume	3,229 kL (853 kgal)
Drainable interstitial liquid volume	8 kL (2 kgal)
Waste surface level (June 13, 1996)	856 cm (336.84 in.)
Temperature (January 1995 to July 1996)	Sludge: 27 °C (81 °F) to 40.6 °C (105 °F) Supernatant: 18 °C (64 °F) to 24 °C (76 °F)
Integrity	Sound
Watch List	None
SAMPLING DATES	
Grab samples and tank headspace flammability	February 1996
SERVICE STATUS	
In service	1971 to Present

Note:

[1]This is an active tank. Waste volumes stated were at approximately the time of sampling.

Figure ES-1. Profile of Tank 241-AY-101.



Total Tank Volume: 3,785 kL (1,000 kgal)
Current Waste Volume (February 1996): 3,543 kL (936 kgal)
Supernatant Volume (February 1996): 3,229 kL (853 kgal)
Sludge Volume (February 1996): 314 kL (83 kgal)

This report summarizes the collection and analysis of ten grab samples acquired during the period February 20-28, 1996 and reported in the *Final Report for Tank 241-AY-101, Grab Samples 1AY-96-1 Through 1AY-96-10 and 1AY-96-FB* (Esch 1996). Grab samples 1AY-96-1 through 1AY-96-5, and the field blank, 1AY-96-FB, were obtained from riser 15K, and grab samples 1AY-96-6 through 1AY-96-10 were obtained from riser 15S. The sampling event was performed to satisfy requirements listed in the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995), the *Data Quality Objectives for Tank Farms Waste Compatibility Program* (Fowler 1995), and the *242-A Evaporator/Liquid Effluent Retention Facility Data Quality Objectives* (Von Bargen 1995). The sampling and analyses were performed in accordance with the *Tank 241-AY-101 Grab Sampling and Analysis Plan* (Thompson 1996).

The safety screening data quality objective (DQO) required analyses for fuel content using differential scanning calorimetry (DSC), weight percent water by thermogravimetric analysis (TGA), total alpha activity through alpha proportional counting, bulk density measurement by centrifugation, and a visual check for the presence of an organic layer. In addition, the safety screening DQO required a determination of the flammability of the tank headspace gases. To satisfy this requirement, the flammability was measured as a percentage of the lower flammability limit (LFL) using a combustible gas meter.

The waste compatibility DQO required analyses for net energy, weight percent water, density, and the check for an organic layer, as well as total inorganic carbon (TIC), total organic carbon (TOC), pH, and selected cations, anions, and radionuclides. The evaporator

DQO required the analyses for ammonia and acetone for the campaign needs of the 242-A Evaporator for fiscal year 1997.

To evaluate tank safety, comparisons were made between the analytical results and the decision criteria thresholds defined in the safety screening and waste compatibility DQOs. All results for DSC and TOC in the following discussion are on a dry weight basis.

Two of the eight supernatant grab samples showed small exotherms. The largest single result had a change in enthalpy of -80.21 J/g, and the largest upper limit to a one-sided 95 percent confidence interval, on the mean, was -104.8 J/g.

The two sludge samples were centrifuged and selected analyses were performed on the centrifuged solid and centrifuged liquid samples. The upper centrifuged solid samples yielded a mean enthalpy change of -195.55 J/g and an upper limit to a one-sided 95 percent confidence interval, on the mean, of -200.3 J/g. No exotherm was observed from the centrifuged solids from the lower sample. One of the two centrifuged liquid samples yielded a mean exothermic reaction with a dry weight basis change in enthalpy of -701.75 J/g and an upper limit to a one-sided 95 percent confidence interval, on the mean, of -1,076.5 J/g. These centrifuged liquid results exceeded the safety screening DQO decision criteria threshold of -480 J/g. The wet weight basis energetics results were much less than the decision threshold, and the sample had a weight percent water content in excess of 80 percent (Esch 1996). A propagating exothermic reaction cannot occur unless the weight percent water results are below 17 percent (Turner et al. 1995). All individual percent water results were well above this level, with means of 84.4 percent and 55.8 percent for the supernatant and sludge layers, respectively; therefore, exothermic reactions are not a safety concern.

Cyanide and TOC analyses were performed, as required by the safety screening DQO and the compatibility DQO, on the centrifuged liquid sample with exothermic reactions in excess of the decision threshold. The cyanide result of 23.70 μg/mL was below its decision threshold of 39,000 μg/mL. The TOC mean (dry weight basis) of 19,700 μg C/mL and the upper limit to a one-sided 95 percent confidence interval, on the mean, of 25,000 μg C/mL were below the safety screening DQO decision criteria threshold of 30,000 μg C/mL, and account for the exotherms with the exception of the one centrifuged liquid analysis.

All total alpha activity values were below the safety screening DQO decision thresholds of 61.5 μCi/mL for supernatant samples and 41 μCi/g for sludge samples. The overall means for the total alpha activity in the supernatant and sludge layers were 0.04 μCi/mL and 3.12 μCi/g, respectively. The highest supernatant and sludge upper limit to a one-sided 95 percent confidence interval, on the mean, were 0.08 μCi/mL and 6.4 μCi/g, respectively.

Visual inspection of the samples revealed no separable organic layers. Finally, the concentration of flammable gases in the tank headspace was measured at 0 percent of the LFL, compared with the decision threshold of 25 percent of the LFL (Esch 1996).

The estimated tank heat load based on the analytical results was 9,870 W (33,700 Btu/hr), below the tank operating specification limit of 205,000 W (700,000 Btu/hr) (Fowler 1995).

The most recent tank temperature information available indicated that between January 1995 and July 1996, the mean temperature for the sludge was 33 °C (92 °F), with a minimum of 27 °C (81 °F), and a maximum of 40.6 °C (105 °F). Over the same time period, the mean temperature of the supernatant was 21 °C (70 °F), with a minimum of 18 °C (64 °F), and a maximum of 24 °C (76 °F). The tank upper temperature shows seasonal variation from year to year.

The waste compatibility DQO safety requirements pertaining to the mixing of wastes transferred from different sources were met regarding the exotherm/endotherm ratio, criticality, and flammable gas accumulation. Of the operational and safety compatibility requirements addressed, the minimum concentration of hydroxide required for corrosion control was not met. All grab sample means (primary and duplicate) for hydroxide and the overall supernatant mean of < 0.007 M were below the minimum required level for hydroxide of 0.01 M. The waste compatibility DQO also required an operations analysis for non-routine transfers before they are approved, and several decision criteria apply. The analytical mean for TRU (transuranic) elements was below the decision threshold, allowing the waste to be transferred to a non-TRU tank, provided enough hydroxide exists in the receiver tank waste to ensure that the receiver tank meets corrosion control criteria after the transfer. The heat load level based on analyses was well below the tank operation specification limit. The phosphate concentration at 1.2×10^{-2} $\underline{M}$ was below the 0.1-$\underline{M}$ limit for concern about mixing with wastes that would cause crystallization and plugging of equipment.

The only evaporator DQO analyses required in addition to those for other DQOs were for ammonia and acetone. The ammonia results were far below the upper limit. The acetone results are not yet available, but will be included in a revised report.

According to the criteria established by the safety screening, waste compatibility, and evaporator DQOs, all analytical results except hydroxide met the specifications for a "safe" tank. The low hydroxide concentrations are an operational safety concern for corrosion of tank carbon steel components. No immediate further sampling is required for hydroxyl determination based on a review of the corrosion implications of the hydroxyl, nitrate and nitrite concentrations. Steps being considered to meet the corrosion concern include transfer of the supernatant liquid to a caustic-rich tank, caustic addition to the residue, and routine sampling.

Table ES-2 provides concentration and inventory estimates for the major analytes and analytes of concern based on the 1996 grab sample analyses.

Table ES-2. Chemical Data Summary for Tank 241-AY-101.[1] (2 sheets)

Analyte	Sludge Data			Supernatant Data			Tank Projected Inventory
	Overall Mean	RSD (Mean)	Projected Inventory	Overall Mean	RSD (Mean)	Projected Inventory	
METALS:	$\mu g/g$	%	kg[3]	$\mu g/mL$	%	kg	kg[4]
Aluminum	59,000	4.4	15,800	< 12.1	N/A	< 39.1	15,800
Calcium	3,290	7.5	983	--	--	--	983
Chromium	1,780	4.4	491	105	1.6	339	830
Iron	15,700	1.6	4,210	< 12.0	N/A	< 38.7	4,250
Lanthanum	2,850	3.1	852	--	--	--	852
Manganese	2,580	3.2	692	< 2.39	N/A	< 7.72	700
Phosphorus	5,280	1.6	1,578	--	--	--	1,578
Silicon	1,210	9.7	362	< 12.0	n/a	< 38.7	401
Sodium	79,600	4.3	28,100	51,900	1.1	1.68E+05	1.96E+05
Sulfur	1,190	1.7	486	--	--	--	486
AMMONIA/ANIONS	$\mu g/g$[6]	%	kg	$\mu g/mL$	%	kg	kg
Ammonia	---	---	---	25.2	9.4	81.4	81.4
Nitrate	---	---	---	26,000	2.2	84,000	84,000
Nitrite	---	---	---	35,300	2.6	1.14E+05	1.14E+05
Phosphate	---	---	---	1,150	22.5	3,710	3,710
Sulfate	---	---	---	5,870	3.3	19,000	19,000
RADIONUCLIDES	$\mu Ci/g$	%	Ci	$\mu Ci/mL$	%	Ci	Ci
Total alpha	3.12[5]	1.6	1,270	0.0441	4.1	142	1,410
^{241}Am	---	---	---	0.00491	19.9	15.9	15.9
^{137}Cs	85.6	7.6	34,200	86.4	1.1	2.79E+05	3.13E+05
$^{239/240}Pu$	---	---	---	0.0364	14.4	118	118

Table ES-2. Chemical Data Summary for Tank 241-AY-101.[1] (2 sheets)

Analyte	Sludge Data			Supernatant Data			Tank
	Overall Mean	RSD (Mean)	Projected Inventory	Overall Mean	RSD (Mean)	Projected Inventory	Projected Inventory
RADIONUCLIDES	**μCi/g**	**%**	**Ci**	**μCi/mL**	**%**	**Ci**	**Ci**
$^{89/90}Sr$	4,610	1.8	1.24E+06	1.89	3.8	6,100	1.25E+06
CARBON	**μg C/mL**	**%**	**kg C**	**μg C/mL**	**%**	**kg C**	**kg C**
TIC	---	---	---	6,860	2.4	22,200	22,200
TOC	3,730	4.3	N/A[2]	6,850	11.7	22,100	24,000
PHYSICAL PROPERTIES		**%**	**kg**		**%**		**kg**
pH	---	---	N/A	9.77	0.1	N/A	N/A
SpG/Bulk density	1.30 g/mL	1.6	N/A	1.08	0.2	N/A	N/A
Weight percent water	55.8 %	28.1	2.28E+05	84.4 %	0.1	2.94E+06	3.17E+06
Volume percent solids	65.7 %	1.2	N/A	---	---	N/A	N/A

Notes:

N/A = not applicable
SpG = specific gravity
RSD = relative standard deviation

[1]Esch (1996)
[2]The projected inventory was not calculated due to lack of centrifuged solids data. The mean concentration in column 2 is centrifuged liquid data.
[3]Calculation based on 314 kL (89 kgal) of sludge and a measured density of 1.3 g/mL.
[4]Calculation based on 3,229 kL (853 kgal) of supernatant and a measured density of 1.08 g/mL.
[5]Sludge mean total alpha is the sum of the acid digested centrifuged solid mean (4.66 μCi/g) at its 0.6565 weighting factor and the centrifuged liquid mean at its weighting factor of 0.3435 corrected for a 1.03-g/mL specific gravity.
[6]Not measured at this time. Comparable data exist for December 1994 sample.

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LIST OF TERMS

ANOVA	analysis of variance
B	high level waste from B Plant
BL	B Plant low level waste
Btu/hr	British thermal units per hour
Ci	curies
Ci/g	curies per gram
Ci/L	curies per liter
cm	centimeters
CSR	cesium recovery waste
DQO	data quality objective
DSC	differential scanning calorimetry
ft	feet
FIC	Food Instrument Corporation
g	grams
g/L	grams per liter
g/mL	grams per milliliter
GEA	gamma energy analysis
HDW	Hanford Defined Waste
HTCE	Historical Tank Content Estimate
in.	inches
IC	ion chromatography
ICP	inductively coupled plasma spectroscopy
J/g	joules per gram
kg	kilograms
kg C	kilograms of carbon
kgal	kilogallons
kL	kiloliters
LEL	lower explosive limit
LFL	lower flammability limit
m	meters
M	moles per liter
mL	milliliters
mm	millimeters
mR/hr	milliroentgens per hour
NFPA	National Fire Protection Association
ppm	parts per million
PUREX	Plutonium-Uranium Extraction
QC	quality control
RPD	relative percent difference

LIST OF TERMS (Continued)

RSD	relative standard deviation
SAP	sampling and analysis plan
SpG	specific gravity
SRR	strontium recovery operations waste (B Plant)
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TLM	Tank Layer Model
TOC	total organic carbon
TRU	transuranic
W	watts
WSTRS	Waste Status and Transaction Record Summary
wt%	weight percent
°C	degrees Celsius
°F	degrees Fahrenheit
μeq/g	microequivalent per gram
μg C/g	micrograms carbon per gram
μg C/mL	micrograms carbon per milliliter
μCi/g	microcuries per gram
μCi/mL	microcuries per milliliter
μg/g	micrograms per gram
μg/mL	micrograms per milliliter
μm	micrometers
ΔH	enthalpy change
%	percent

1.0 INTRODUCTION

This tank characterization report presents an overview of double-shell tank 241-AY-101 and its waste contents. It provides estimated concentrations and inventories for the waste components based on the latest sampling and analysis activities, in combination with background tank information.

The characterization of tank 241-AY-101 is based on the results of ten grab samples taken in February 1996. The integrated requirements for analyses and decision criteria thresholds for the three DQOs can be found in the *Tank 241-AY-101 Grab Sampling and Analysis Plan* (Thompson 1996). This sampling and analysis event was completed to provide information for the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995), the *Data Quality Objectives for Tank Farms Waste Compatibility Program* (Fowler 1995), and the *242-A Evaporator/Liquid Effluent Retention Facility Data Quality Objectives* (Von Bargen 1995). The results of three historical sampling events are given in Appendix B, although the data do not represent the current tank contents and are not used as the basis for any safety decisions.

Tank 241-AY-101 remains in service and may continue to transfer or receive waste after caustic mitigation activities are complete. Consequently, the composition of the tank waste will change depending on the waste types received and shipped. The analyte concentrations reported in this document reflect the best available estimates of the current tank contents based on the analytical data and historical models to February 1996. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* Milestone M-44-09 (Ecology et al. 1996).

1.1 PURPOSE

The purpose of this report is to summarize the information about the use and contents of tank 241-AY-101. Where possible, this information will be used to assess issues associated with safety, operations, environmental, and process development activities. This report also serves as a reference point for more detailed information concerning tank 241-AY-101.

1.2 SCOPE

The objective of the 1996 sampling event for tank 241-AY-101 was to characterize the waste through analyses specified in the safety screening, waste compatibility, and evaporator data quality objectives (DQOs). In accordance with these requirements, which were specified in the sampling and analysis plan (SAP) (Thompson 1996), the following analyses were performed: differential scanning calorimetry (DSC) to evaluate fuel level and energetics; thermogravimetric analysis (TGA) to determine moisture content; total alpha activity analysis to evaluate criticality potential; specific gravity (bulk density for solid samples); total inorganic carbon (TIC) and total organic carbon (TOC); cyanide; hydroxide; pH; ammonia; ^{137}Cs, ^{90}Sr, ^{241}Am, $^{239/240}$Pu; metals by inductively coupled plasma spectroscopy (ICP); anions by ion chromatography (IC); and volume percent solids by centrifugation. The full suite of ICP analytes for one sample and ^{60}Co by gamma energy analysis (GEA) for several samples were obtained on an opportunistic basis in accordance with Kristofzski (1995). In addition to these analyses conducted on the grab samples, the tank headspace was sampled for the presence of flammable gases in accordance with the safety screening DQO.

2.0 HISTORICAL TANK INFORMATION

This section describes tank 241-AY-101 based on historical information. The first part details the current condition of the tank. This is followed by discussions of the tank's design, transfer history, and the process sources that contributed to the tank waste, including an estimate of the current contents based on the process history. Events that may be related to tank safety issues, such as potentially hazardous tank contents or off-normal operating temperatures, are included. The final part summarizes available surveillance data for the tank. Solid and liquid level data are used to determine tank integrity (leaks) and to provide clues to internal activity in the solid layers of the tank. Temperature data are provided to evaluate the heat generating characteristics of the waste.

2.1 TANK STATUS

As of February 29, 1996, tank 241-AY-101 contained an estimated 3,543 kL (936 kgal) of waste classified as dilute, complexed (Hanlon 1996). Liquid waste volume was estimated using a combination of a Food Instrument Corporation (FIC) gauge and manual tape. The FIC gauge was replaced by a manual ENRAF[1] gauge in March 1996. Liquid level measurements are taken daily using manual tape and manual ENRAF™ gauge. Solid waste volume was last estimated using a sludge level measurement device on February 2, 1987. The amounts of various waste phases existing in the tank are presented in Table 2-1.

Table 2-1. Estimated Tank Contents.[1]

Waste Form	Estimated Volume	
	kL	kgal
Total waste	3,543	936
Supernatant liquid	3,229	853
Sludge	314	83
Saltcake	0	0
Drainable interstitial liquid	8	2
Drainable liquid remaining	3,237	855
Pumpable liquid remaining	3,229	853

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

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

Tank 241-AY-101 is categorized as sound and is not on any Watch List. This tank is actively ventilated. All monitoring systems were in compliance with documented standards as of February 29, 1996 (Hanlon 1996).

2.2 TANK DESIGN AND BACKGROUND

The 241-AY Tank Farm was constructed from 1968 to 1970 in the 200 East Area as part of the Aging Waste Facilities, which include the 241-AZ Tank Farm. The 241-AY Tank Farm contains two double-shell tanks, each with a capacity of 3,785 kL (1,000 kgal), a diameter of 22.9 m (75.0 ft), and an operating depth of 9.25 m (30.33 ft). Tank 241-AY-101 began receiving waste in April 1971. These aging waste tanks were designed to hold boiling waste with a maximum design temperature of 177 °C (350 °F) for sludge and 127 °C (260 °F) for liquid (Brevick et al. 1995). The tanks in the AY Tank Farm have process pipelines (supply nozzles) penetrating their sides (Leach and Stahl 1993).

Tank 241-AY-101 was constructed with a primary carbon steel liner (heat-treated and stress-relieved), a secondary carbon steel liner (not heat-treated), and a reinforced concrete shell. The bottom of the primary liner is 9.5 mm (0.375 in.) thick, the lower portion of the sides is 19 mm (0.75 in.) thick, the upper portion of the sides is 13 mm (0.5 in.) thick, and the dome liner is 9.5 mm (0.375 in.) thick. The secondary liner is 6.35 mm (0.25 in.) thick. The concrete walls are 457 mm (1.5 ft) thick and the dome is 381 mm (1.25 ft) thick (Zama 1967). The tank has a flat bottom. The bottoms of the primary and secondary liners are separated by an insulating concrete layer. There is a grid of drain slots in both the insulating concrete layer and the concrete foundation beneath the secondary steel liner. The function of the grid in the concrete between the primary and secondary liners is to allow air circulation for cooling and to drain any leakage from the primary tank to leak detectors in the annulus. The grid's function in the foundation is to collect any waste that may leak from the tank and divert it to the leak detection well (Leach and Stahl 1993).

Tank 241-AY-101 has 98 risers ranging in diameter from 50 mm (2 in.) to 1.1 m (42 in.) that provide access to the tank and 28 risers that provide access to the annulus. Table 2-2 shows numbers, diameters, and descriptions of the risers (annular risers not included). A plan view that depicts the riser configuration is shown as Figure 2-1. Risers 5A and 5B (each 100 mm [4 in.] in diameter) and risers 15A, 15G, 15K, 15M, and 15O (each 150 mm [6 in.] in diameter) are available for use (Lipnicki 1995). A tank cross-section showing the approximate waste level, along with a schematic of the tank equipment, is shown in Figure 2-2.

Table 2-2. Tank 241-AY-101 Risers.[1,2,3,4,5] (3 sheets)

Riser Number	Diameter (in.)	Description and Comments
1A	34	Sluice pit D
1b	34	Sluice pit C
1c	34	Sluice pit B
1d	34	Sluice pit E
2	6	22 - Air circulators
3	3/4	22 - Temperature elements
4a	20	Tank ventilation
5a	4	Tank pressure
5b	4	Spare
6a	42	Pump pit
7a	42	Steam coil heater
8a	2	Condensate addition
9a	4	Pump pit drain
10a	3	Sluice pit d drain
10b	3	Sluice pit c drain
10c	3	Sluice pit b drain
10d	3	Sluice pit e drain
11a	4	Leak detection pit drain
12a	4	Liquid level indicator & alarm
13a	4	Thermocouple tree
13b	4	Thermocouple tree
13c	4	Thermocouple tree
13d	4	Thermocouple tree
14a	6	Dry well
14b	6	Dry well
14c	6	Dry well

Table 2-2. Tank 241-AY-101 Risers.[1,2,3,4,5] (3 sheets)

Riser Number	Diameter (in.)	Description and Comments
14d	6	Dry well
14e	6	Dry well
14f	6	Dry well
14g	6	Dry well
15a	6	Spare
15b	6	Sludge measuring port
15c	6	Sludge measuring port
15d	6	Sludge measuring port w/ magnehelix
15e	6	Ap/Cp (12 in. Cvr) -sludge measuring port
15f	6	Sludge measuring port
15g	6	Spare
15h	6	Sludge measuring port
15i	6	Spare
15j	6	Sludge measuring port
15k	6	Spare
15l	6	Sludge measuring port
15m	6	Spare
15n	6	Sludge measuring port
15o	6	Spare
15p	6	Sludge measuring port
15q	6	Spare
15r	6	Sludge measuring port
15s	6	Spare
16a	4	Sludge temperature element
16b	4	Sludge temperature element
16c	4	Sludge temperature element

Table 2-2. Tank 241-AY-101 Risers.[1,2,3,4,5] (3 sheets)

Riser Number	Diameter (in.)	Description and Comments
22a	16	Level indicating transmitter
23a	4	Liquid level indicator
24a	42	Spare
28	4	Product spare nozzle
27	4	3 - Product supply nozzles
30a	4	Annulus pump discharge

Notes:

[1]Salazar (1994)

[2]Tran (1993)

[3]Vitro Hanford Engineering Services (1971)

[4]Zama (1967)

[5]If a discrepancy existed between the documents and the drawings, the drawings took precedence. No engineering change notices were written against the referenced drawings.

Figure 2-1. Riser Configuration for Tank 241-AY-101.

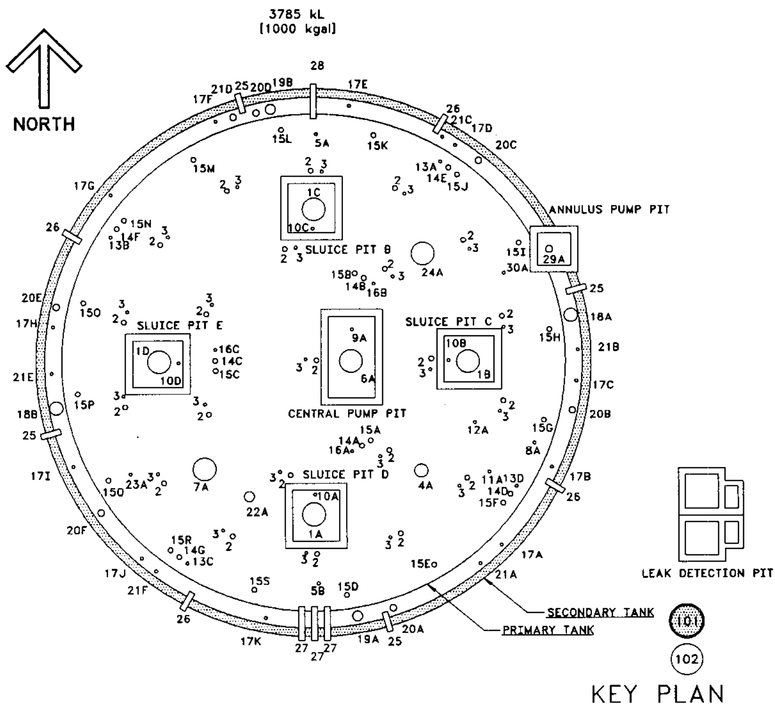
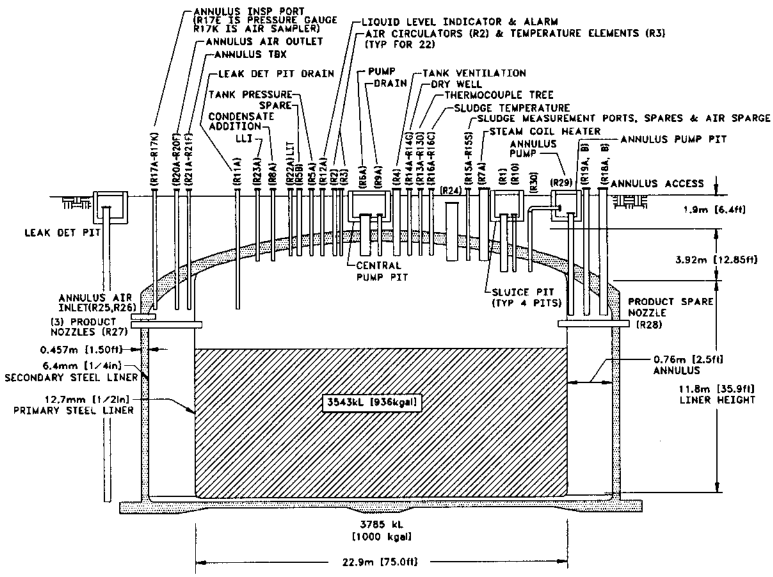


Figure 2-2. Tank 241-AY-101 Cross-Section.



2.3 PROCESS KNOWLEDGE

These sections present the history of waste transfers for tank 241-AY-101. The major transfers involving tank 241-AY-101 receiving waste are presented in Section 2.3.1 and Table 2-3. Section 2.3.2 describes the historical estimation of the tank's waste contents.

2.3.1 Waste Transfer History

Waste was initially added to tank 241-AY-101 in April 1971 with the addition of high-level waste from B Plant (B). A small amount of high-level waste from PUREX and a significant amount of the same type of waste from tank 241-A-106 were added in the second quarter of 1971. Tank 241-AY-101 continued to receive B and PUREX waste, and excess amounts were transferred to tank 241-A-106 through the fourth quarter of 1971. During the fourth quarter of 1971, a small amount of strontium recovery waste from B Plant (SRR) was added to tank 241-AY-101 from the AR Vault, as well as PUREX waste from tank 241-A-106.

Small transfers to the AX Vault occurred during the fourth quarter of 1974 and the second quarter of 1975, followed by the addition of SRR during the second quarter of 1975. The waste in the tank was categorized as aging tank waste during the third quarter of 1976. Waste was sent to tank 241-C-105 from the fourth quarter of 1977 until the second quarter of 1978, when waste in tank 241-AY-101 was reduced to nearly one tenth of the total capacity. Non-complexed waste was then received and returned to and from tank 241-A-102. This action most likely occurred during 242-A Evaporator operations from the second quarter of 1978 until the third quarter of 1980. Also during the first quarter of 1980, complexed concentrate waste was transferred from tank 241-A-103 to tank 241-AY-101. Tank 241-AX-102 sent complex concentrate waste to tank 241-AY-101 during the second and third quarters of 1980.

Beginning in the first quarter of 1981 and continuing until the third quarter of 1984, tank 241-AY-101 received both complexed and non-complexed waste from cesium processing in B Plant. During the third quarter of 1981, tank 241-AY-101 sent waste out to tank 241-AW-104, and in the fourth quarter of 1982, to tank 241-AW-102. Tank 241-AY-101 also received and sent waste to tank 241-AZ-102 during the fourth quarter of 1983, and the first quarter of 1984. Waste was sent to tank 241-AW-102 during the first and second quarter of 1984. A small addition of dilute non-complexed waste from miscellaneous PUREX waste streams was added to tank 241-AY-101 during the final quarter of 1984.

During the fourth quarter of 1984 and the first and second quarters of 1985, tank 241-AY-101 began receiving dilute complexed waste from strontium processing in B Plant. Also, an addition of waste from tank 241-AW-102 occurred in the first quarter of 1985. Minor water additions were shown during the span of cesium and strontium processing waste inputs. The last addition of dilute, complexed waste from cesium processing in B Plant was received by tank 241-AY-101 during the third quarter of 1985.

In the second and third quarters of 1986, tank 241-AY-101 received dilute, complexed waste from vessel clean-outs in B Plant, and liquid waste from the saltwell pumping of tank 241-B-103 in the third quarter of 1986. Small volumes of water and unknown liquid additions were reported from the fourth quarter of 1986 to the present. Most of these changes can be attributed to measurement variations and small evaporation losses; typically, each addition was less than 0.3% of tank capacity.

The 242-A Evaporator sent a small amount of complexed saltwell liquid waste to tank 241-AY-101 during the fourth quarter of 1991. Tank 241-AY-101 also received laboratory waste additions originating from the 300 and 400 Areas during the fourth quarter of 1991 and the first quarter of 1993. After receiving saltwell pumped liquid from tank 241-TY-101, the last noted waste addition to tank 241-AY-101 was laboratory waste addition during the first quarter of 1993.

Table 2-3. Summary of Tank 241-AY-101 Waste Input History.[1,2] (2 sheets)

Transfer Source	Waste Type Received	Time Period	Estimated Waste Volume	
			kL	kgal
B Plant	B Plant high-level waste	1971 - 1972	10,899	2,879
241-A-106	PUREX high-level waste	1971 - 1973	2,040	539
A Plant (PUREX)	PUREX high-level waste	1971	53	14
AR Vault	Slurried PUREX sludge waste from strontium recovery in B Plant	1972, 1975	79	21
241-A-102	Non-complexed evaporator feed waste	1978 - 1980	2,109	557
241-A-103, 241-AX-102	Complexed concentrate waste	1980	2,324	614
B Plant	Dilute, non-complexed waste from B Plant cesium processing	1981	769	203
B Plant	Dilute, complexed waste from B Plant cesium processing	1983 -1984	2,703	714
241-AZ-104	Dilute, non-complexed waste from PUREX miscellaneous streams	1983 - 1984	2,718	718

Table 2-3. Summary of Tank 241-AY-101 Waste Input History.[1,2] (2 sheets)

Transfer Source	Waste Type Received	Time Period	Estimated Waste Volume	
			kL	kgal
A Plant (PUREX)	Dilute, non-complexed waste from PUREX miscellaneous streams	1984	11	3
B Plant	Dilute, complexed waste from B Plant strontium processing	1984 - 1985	492	130
241-AW-102	Dilute, non-complexed waste	1985	83	22
B Plant	Dilute, complexed waste from B Plant vessel clean-out	1986	68	18
241-B-103	Liquid from single-shell tank saltwell pumping	1986	121	32
B Plant	Dilute, non-complexed waste from B Plant vessel clean-out	1988	38	10
Unknown	Unknown waste addition	1991 - 1994	15	4
242-A	Complexed saltwell liquid	1991	57	15
300 and 400 Areas	Dilute, non-complexed laboratory wastes	1991, 1993	51	15
241-TY-101	Liquid from single-shell tank saltwell pumping	1992	83	22
200 East Area	Complexed saltwell liquid, flush water	1994, 1995	397	105

Notes:

[1]Waste volumes and types are best estimates based on historical data.

[2]Agnew et al. (1996b)

Since January 1, 1994, about 261 kL (69 kgal) of liquid attributed to evaporation have been removed from the tank. During this same period 397 kL (105 kgal) of water and complexed saltwell waste from 200 East Area single-shell tanks have been added to the tank. The effect is a net addition of 136 kL (36 kgal) of liquid to the tank. This concludes the discussion of mechanical transfers used as a basis for estimating tank content.

2.3.2 Historical Estimation of Tank Contents

The following is an estimate of the contents for tank 241-AY-101 as of January 1, 1994 based on historical transfer data. The historical data used for the estimate are from the *Waste Status and Transaction Record Summary for the Southeast Quadrant* (WSTRS) (Agnew et al. 1996b), and the *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev 3* (Agnew et al. 1996a). The Hanford Defined Waste (HDW) Model Rev. 3 document contains the HDW list, the Tank Layer Model (TLM), and the HTCE. The HTCE predictions have not been validated, and thus should be used with caution. The WSTRS is a compilation of available waste transfer and volume status data. The HDW provides the assumed typical compositions for 50 waste types. In most cases, the available data are incomplete, reducing the reliability of the transfer data and modeling results. The TLM uses the WSTRS data to model the waste deposition processes and, using additional data from the HDW (which introduces more variability), generates an estimate of the tank contents. These predictions require further evaluation.

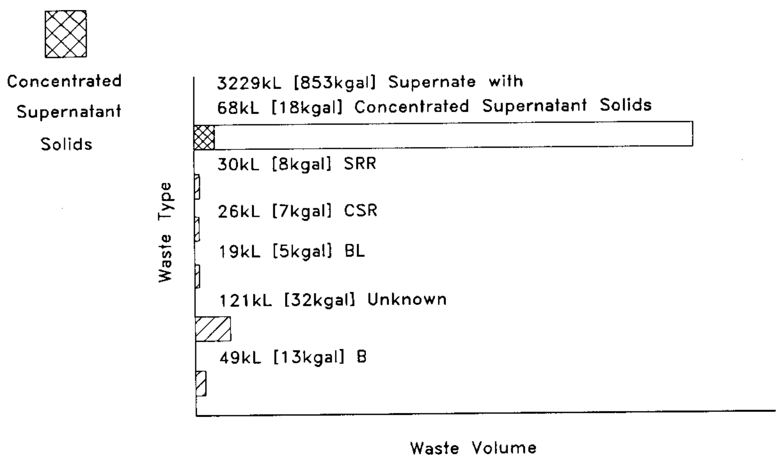
Agnew et al. (1996a) estimates that tank 241-AY-101 contains 3,543 kL (936 kgal) of waste comprised of (from the bottom up) a 49-kL (13-kgal) layer of B waste, a 121-kL (32-kgal) layer of unknown waste, a 19-kL (5-kgal) layer of B Plant low-level (BL) waste, a 26-kL (7-kgal) layer of cesium recovery (CSR) waste from B Plant, a 30-kL (8-kgal) solids layer of PUREX sludge from SRR waste, and 68 kL (18 kgal) of concentrated supernatant solids waste. The estimated supernatant liquid layer is 3,225 kL (853 kgal). The supernatant solids were derived from salt slurry generated from the 242-A Evaporator. Figure 2-3 is a graphical representation of the estimated waste types and volumes for each tank layer.

The B layer should contain large concentrations (>1 weight percent) of sodium, aluminum, iron, hydroxide, silicates, and uranium, and lesser concentrations (between 0.1 and 1 weight percent) of nitrite, carbonate, calcium, and sulfate. Significant concentrations of ^{90}Sr and ^{137}Cs in the B layer should create a large amount of radiological activity.

The BL layer should contain large concentrations (>1 weight percent) of sodium, hydroxide, aluminum, iron, nickel, silicate and nitrite, and between 0.1 and 1 weight percent carbonate and calcium. The amount of ^{90}Sr radioactivity should be about 0.1 of that in the B layer, and no ^{137}Cs should be present.

The unknown layer is assumed to be similar to the B and BL layers in chemical composition.

Figure 2-3. Tank Layer Model for Tank 241-AY-101.



The CSR layer should contain >1 weight percent of sodium, hydroxide, nitrate, nitrite, calcium, carbonate, and silicate, and between 0.1 and 1 weight percent of aluminum, iron, and sulfate.

Sodium, hydroxide, uranium, iron, nitrite, carbonate, silicate, and various organic analytes at concentrations above 1 weight percent should dominate the SRR layer with concentrations between 0.1 and 1 weight percent of calcium, sulfate, citrate and ammonia. High radioactivity in this layer is contributed by ^{90}Sr. The strontium content is as much as two orders of magnitude higher than wastes from which strontium has been recovered.

The combined supernatant inventories are expected to include > 1 wt% sodium, hydroxide, nitrate, and nitrite. Concentrations from 0.1 to 1.0 wt% are expected for aluminum, carbonate, phosphate, sulfate, chloride, and various organic species (Agnew 1996a, p. E-172, SMM Composite Inventory Estimates). Radioactivity is expected to be low (< 50 μCi/g ^{137}Cs and ^{90}Sr).

Table 2-4 is a historical estimate of the overall waste constituents and concentrations in the tank.

2.4 SURVEILLANCE DATA

Tank 241-AY-101 surveillance consists of surface level measurements (liquid and solid), temperature monitoring inside the tank (waste and headspace), and leak detection well monitoring for radioactive liquids outside the primary tank. The data provide the basis for determining tank integrity.

Solid surface level measurements will provide an indication of the physical changes and consistency of the solid layers of a tank. Leak detection systems within the annulus of the tank will detect leaks from the primary tank and indicate action needed to prevent leaks to the soil.

2.4.1 Surface Level Readings

Tank 241-AY-101 waste surface level is monitored daily with a manual tape and a manual ENRAF™ gauge. The June 13, 1996 recorded manual tape measurement was 8.57 m (337.25 in.), and 8.56 m (336.84 in.) for the ENRAF™ gauge. Because this is an active tank, the surface level is continually subject to change. A representation of the volume measurements is presented as a level history graph in Figure 2-4.

Table 2-4. Tank 241-AY-101 Historical Tank Content Estimate.[1,2] (2 sheets)

Total Inventory Estimate			
Physical Properties			
Total Waste	3.91E+06 kg (936 kgal)		
Heat Load	14,500 W (49,400 Btu/hr)		
Bulk Density	1.17 g/mL		
Water wt%	74.3		
TOC wt% C (wet)	1.20		
Chemical Constituents	**M**	**μg/g**	**kg[3]**
Na^{+}	3.57	70,000	2.73E+05
Al^{3+}	0.396	9,110	35,600
Fe^{3+} (total Fe)	0.0455	2,170	8,460
Cr^{3+}	0.0156	694	2,710
Bi^{3+}	1.81E-04	32.3	126
La^{3+}	3.56E-06	0.422	1.65
Hg^{2+}	1.52E-06	0.260	1.02
Zr (as $ZrO(OH)_2$)	1.03E-06	8.00	31.3
Pb^{2+}	2.02E-04	35.6	139
Ni^{2+}	0.0112	560	2,190
Sr^{2+}	1.19E-06	0.0889	0.347
Mn^{4+}	0.00201	94.0	367
Ca^{2+}	0.0259	886	3,460
K^{+}	0.0167	557	2,180
OH^{-}	2.08	30,100	1.18E+05
$NO3^{-}$	1.14	60,500	2.36E+05
$NO2^{-}$	0.665	26,100	1.02E+05
$CO3^{2-}$	0.203	10,400	40,600
$PO4^{3-}$	0.0169	1,370	5,340

Table 2-4. Tank 241-AY-101 Historical Tank Content Estimate.[1,2] (2 sheets)

Chemical Constituents	M	μg/g	kg[3]
$SO4^{2-}$	0.0944	7,740	30,300
Si (as SiO_3^{2-})	0.0997	2,390	9,340
F^-	0.0105	170	666
Cl^-	0.0613	1,850	7,250
$C_6H_5O_7^{3-}$	0.0142	2,290	8,940
$EDTA^{4-}$	0.0281	6,900	27,000
$HEDTA^{3-}$	0.0554	13,000	50,600
$glycolate^-$	0.0689	4,410	17,200
$acetate^-$	0.00232	117	456
$oxalate^{2-}$	3.05E-06	0.229	0.895
DBP	0.00929	1,290	5,020
butanol	0.00920	582	2,270
NH_3	0.0178	258	1,010
$Fe(CN)_6^{4-}$	0	0	0
Radiological Constituents	**Ci/L**	**μCi/g**	**Ci[3]**
Pu		0.354	23.1 (kg)
U	2.57E-02 (M)	5,210 (μg/g)	20,400 (kg)
Cs	0.0589	50.2	196000
Sr	0.603	515	2010000

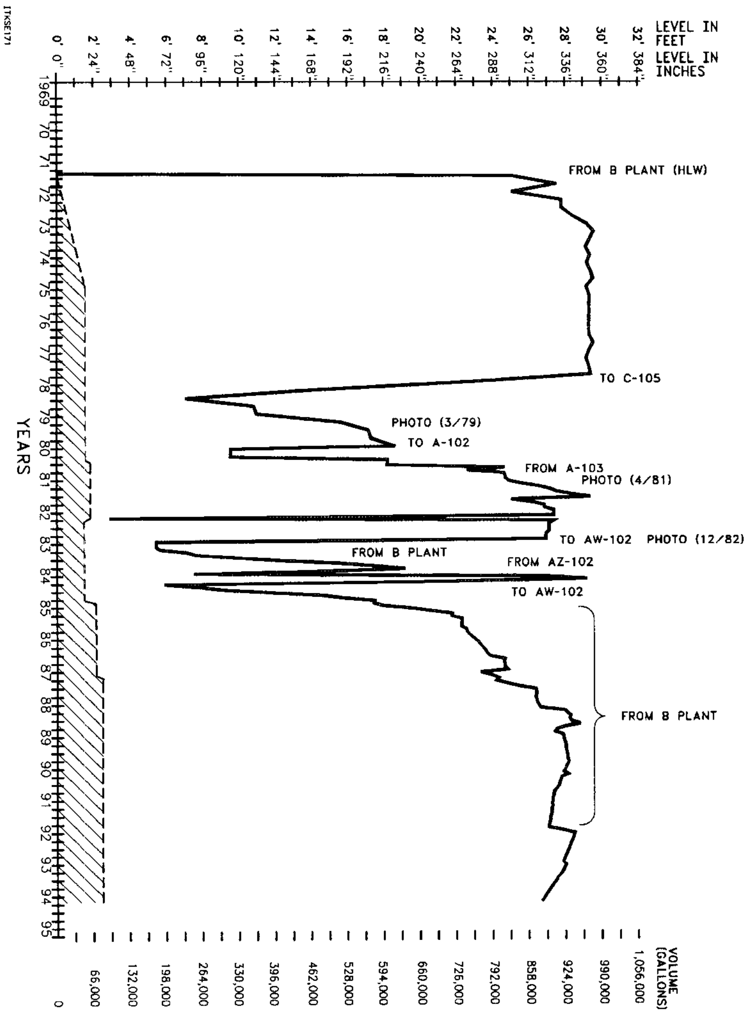
Notes:

[1]Agnew et al. (1996a)

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

[3]Differences appear to exist between these inventories and the inventories calculated from the two sets of concentrations.

Figure 2-4. Tank 241-AY-101 Level History.



2.4.2 Internal Tank Temperatures

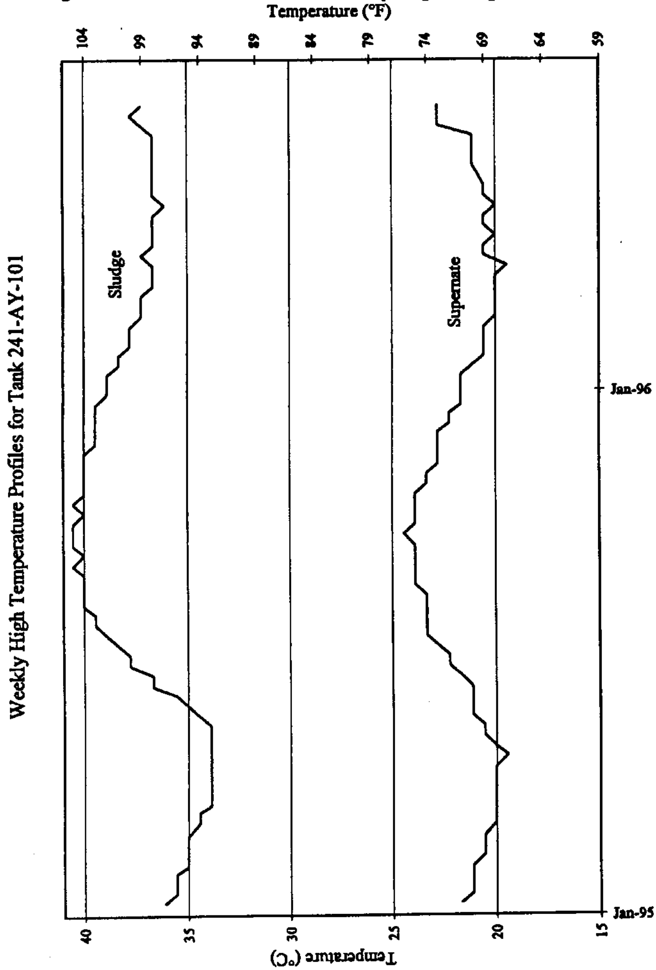
Tank 241-AY-101 has 22 air lift circulators, and 37 thermocouples attached at known elevations to 7 thermocouple trees. The thermocouple trees are located in risers 13A, B, C, and D, and 16A, B, and C. The thermocouple trees in risers 16A, B, and C are for sludge temperature measurement only, while the thermocouple trees in risers 13A, B, C, and D are used for both supernatant and sludge temperature measurements. Data from the eight thermocouples that were in service on the thermocouple trees were analyzed for this report.

Temperature data were obtained from the Surveillance Analysis Computer System database for the period between January 1995 and July 1996 (WHC 1996). The average temperature from January 1995 to July 1996 for the sludge was 33 °C (92 °F), the minimum temperature was 27 °C (81 °F), and the maximum temperature was 40.5 °C (105 °F). For the same period, the average temperature of the supernatant was 21 °C (70 °F), the minimum temperature was 18 °C (64 °F), and the maximum temperature was 24 °C (76 °F). On July 22, 1996, the sludge had a high temperature of 37 °C (99 °F) measured under riser 16B and a low of 31 °C (87 °F) measured under risers 13A and D. On the same date, the supernatant had a high temperature of 23 °C (73 °F) measured under riser 13D and a low of 21 °C (70 °F) measured under riser 13A. A graph of the weekly high temperatures for both the sludge and supernatant can be found in Figure 2-5. Plots of the individual thermocouple readings for tank 241-AY-101 can be found in the supporting documents for the HTCE (Brevick et al. 1995). Seasonal variation in temperature is the only discernable trend in the available data.

2.4.3 Tank 241-AY-101 Photographs

The December 1982 photographic montage of the tank 241-AY-101 lacks clarity and is hazy. The waste is deep in the tank and appears to be a dark liquid. The tank contained approximately 681.4 kL (180 kgal) of waste at that time. Many transfers have taken place since the photographs were taken. Therefore, the montage is not representative of the current waste appearance and is not included.

Figure 2-5. Tank 241-AY-101 Weekly High Temperature Plot.



3.0 TANK SAMPLING OVERVIEW

This section describes the February 1996 sampling and analysis event for tank 241-AY-101. Ten grab samples and a field blank were taken to satisfy the requirements of the safety screening DQO (Dukelow et al. 1995) and waste compatibility DQO (Fowler 1995). Additional analyses were requested for the 242-A Evaporator DQO (Von Bargen 1995) by a memorandum (Campbell 1995) identifying the 242-A Evaporator campaign needs for fiscal year 1997. The sampling and analysis were performed in accordance with the sampling and analysis plan (SAP) (Thompson 1996). Further discussions of the sampling and analysis procedures can be found in the *Tank Characterization Reference Guide* (DeLorenzo et al. 1994).

Table 3-1 summarizes the sampling mode, applicable DQOs, and sampling and analysis requirements for the 1996 sampling event.

Table 3-1. Integrated Data Quality Objective Requirements for Tank 241-AY-101.[1] (2 sheets)

Sampling Event	Applicable DQOs	Sampling Requirements	Analytical Requirements
February 1996 grab sampling	Safety screening (Dukelow et al. 1995)	Vertical profiles from two widely spaced risers. Flammability taken from tank headspace.	▸ Energetics ▸ Moisture content ▸ Total alpha activity ▸ Density ▸ Visual check for organic layer ▸ Headspace gas flammability
	Waste Compatibility (Fowler 1995)	Grab samples from different depths	▸ Energetics ▸ Moisture content ▸ Visual check for organic layer ▸ Metals by ICP ▸ Anions by IC ▸ Radionuclides ▸ TIC, TOC ▸ Hydroxide ▸ Specific gravity ▸ pH ▸ Percent solids
	Evaporator (Von Bargen 1995)	Grab samples from different depths	▸ Ammonia[2] ▸ Acetone[2]

Note:

[1]Thompson (1996)

[2]Campbell (1995) (Additional analyses beyond those met by the safety screening and compatibility requirements)

3.1 DESCRIPTION OF SAMPLING EVENT

Ten grab samples and one field blank were collected by the bottle-on-a-string method from tank 241-AY-101 in February 1996. Three supernatant and two sludge samples were collected from riser 15K on February 20 and 21, 1996, and assigned sample numbers 1AY-96-1 to 1AY-96-5. Five supernatant samples were collected from riser 15S on February 28, 1996, and assigned sample numbers 1AY-96-6 to 1AY-96-10. A field blank, sample number 1AY-96-FB, was also obtained from riser 15K. All samples were received by the Westinghouse Hanford Company 222-S Laboratory the day after they were collected.

Prior to the grab sampling event, the tank headspace vapors were sampled within the headspace through risers 15K and 15S and analyzed for the presence of flammable gases as required by the safety screening DQO.

3.2 SAMPLE HANDLING

The samples were shipped to the Westinghouse Hanford Company 222-S Laboratory for subsampling and analysis. The sampling bottles were 120 mL in size, and full recovery was obtained from all samples.

All samples were visually inspected for color, clarity, solids content, and the presence of an organic layer. The sludge samples were described as brown and opaque, the eight supernatant samples were all described as yellow and clear, and the field blank was colorless and clear. The radiation dose rate on contact was also measured.

Approximately 100 mL of sample in each of the eight 120-mL supernatant sample bottles was subdivided as follows: two 20-mL unfiltered subsamples were separated for safety screening and compatibility analyses, and 60 mL were archived.

The two sludge samples were too dark to perform the visual volume percent solids measurement. Therefore, the percent solids was approximated. To separate the solids from the liquids in the two sludge samples, they were first shaken vigorously to obtain thorough mixing, and then poured into centrifuge cones. Solid pieces resembling small solid fragments or shards remained in the sample bottles after transferring the samples to centrifuge cones. Sludge sample 1AY-96-4 had about 39 g of the "shard" material that did not pour out of the sample bottle. This material was archived for possible future analysis. Sludge sample 1AY-96-5 did not have enough of the shard material remaining in the sample jar to save. Subsamples for analysis and archive were created from both the centrifuged solids and the decanted liquid portions.

Table 3-2 presents a description of the grab samples.

Table 3-2. Grab Sample Description.[1]

Customer ID	Laboratory ID	Sample Elevation[2] m (in.)	Color/ Clarity	Solids	Dose Rate on Contact mR/hr
Riser 15K					
1AY-96-1	S96T001205	8.38 (330)	yellow/clear	None	150
1AY-96-2	S96T001206	3.94 (155)	yellow/clear	None	250
1AY-96-3	S96T001207	1.02 (40)	yellow/clear	None	200
1AY-96-4	S96T001271	0.64 (25)	brown/opaque	~ 80%	800
1AY-96-5	S96T001272	0.84 (33)	brown/opaque	~ 80%	1,500
1AY-96-FB	S96T001208	N/A	none/clear	None	< 0.5
Riser 15S					
1AY-96-6	S96T001353	8.38 (330)	yellow/clear	None	250
1AY-96-7	S96T001354	3.94 (155)	yellow/clear	None	250
1AY-96-8	S96T001355	1.02 (40)	yellow/clear	None	250
1AY-96-9	S96T001365	0.64 (25)	yellow/clear	< 1%	900
1AY-96-10	S96T001366	0.61 (24)	yellow/clear	< 1%	300

Notes:
ID = identification

[1]Esch (1996)
[2]Sample elevation is the distance from the tank bottom to the mouth of the sample bottle.

3.3 SAMPLE ANALYSIS

The grab samples were analyzed for both safety screening evaluation and waste compatibility assessment, and in accordance with the operations requirements in Campbell (1995).
As noted in Table 3-1, the safety screening DQO required analyses for energetics by DSC, moisture content by TGA, fissile content by total alpha analysis, and specific gravity (bulk density for the solids samples). In addition to the grab samples, the tank headspace flammability was measured in the field by means of a combustible gas meter through both risers 15K and 15S prior to sampling. Results of the headspace sampling are discussed in Section 4.1.3 of this report.

All of the analyses on liquid samples were performed on direct samples. The solid sample from 1AY-96-4 was fusion digested for total alpha analysis, and the solid sample from 1AY-96-5 was acid digested for total alpha, ICP, GEA, and ^{90}Sr analyses.

The centrifuged liquid DSC results from sample 1AY-96-4 exceeded the decision criteria threshold per the safety screening DQO. Therefore, TOC by persulfate coulometry and cyanide by distillation analyses were performed as secondary analytes.

The analyses required by the waste compatibility DQO were included among the primary safety screening analytes as well as the following: TIC and TOC by furnace oxidation (liquids); hydroxide by potentiometric titration; pH; ^{137}Cs by GEA; ^{90}Sr by beta proportional counting; ^{241}Am and $^{239/240}Pu$ by alpha proportional counting; metals by ICP; anions by IC; and centrifugation for volume percent solids.

In addition to the analyses requested in the SAP, opportunistic ICP and GEA (^{60}Co) analyses (Kristofzski 1995) were run on sample 1AY-96-5 because of the unusually high dose rates (Esch 1996).

Ammonia and acetone analyses were requested by Campbell (1995). Ammonia was analyzed by ion selective electrode. The acetone analysis, though requested in the SAP, has not yet been performed and will be reported in a revision to Esch (1996).

Laboratory quality control (QC) checks included, where appropriate, laboratory control standards, matrix spikes, duplicate analyses, and blanks. An assessment of the QC procedures and data is presented in Section 5.1.2 of this report.

All reported analyses were performed according to approved laboratory procedures. A list of the sample numbers and applicable analyses is presented in Table 3-3. Table 3-4 displays the analytical procedures by title and number. No deviations or modifications were noted by the laboratory.

Table 3-3. Sample Analysis Summary.[1] (2 sheets)

Customer ID	Laboratory ID	Analyses
1AY-96-1	S96T001201	DSC, TGA, TIC, TOC, ICP, IC, pH, OH^-, SpG, NH_3
	S96T001263	^{137}Cs, $^{239/240}Pu$, ^{90}Sr, ^{241}Am, total alpha activity
	S96T001267	Archive
1AY-96-2	S96T001202	DSC, TGA, TIC, TOC, ICP, IC, pH, OH^-, SpG, NH_3
	S96T001264	^{137}Cs, $^{239/240}Pu$, ^{90}Sr, ^{241}Am, total alpha activity
	S96T001268	Archive
1AY-96-3	S96T001203	DSC, TGA, TIC, TOC, ICP, IC, pH, OH^-, SpG, NH_3
	S96T001265	^{137}Cs, $^{239/240}Pu$, ^{90}Sr, ^{241}Am, total alpha activity
	S96T001269	Archive
1AY-96-4	S96T001271 (sludge)	Volume percent solids, bulk density
	S96T001377 (sludge)	Archive
	S96T001273 (solid)	Archive
	S96T001275 (solid)	DSC, TGA, bulk density
	S96T001313 (solid)	Total alpha activity
	S96T001315 (liquid)	Archive
	S96T001317 (liquid)	DSC, TGA, bulk density, total alpha activity, TOC, cyanide
1AY-96-5	S96T001272 (sludge)	Volume percent solids, bulk density
	S96T001274 (solid)	Archive
	S96T003465 (solid)	DSC, TGA
	S96T003467 (solid)	ICP, GEA, ^{90}Sr, total alpha activity
	S96T001316 (liquid)	Archive
	S96T001318 (liquid)	DSC, TGA, bulk density, total alpha activity

Table 3-3. Sample Analysis Summary.[1] (2 sheets)

Customer ID	Laboratory ID	Analyses
1AY-96-6	S96T001356	DSC, TGA, TIC, TOC, IC, pH, OH^-, SpG, NH_3
	S96T001359	^{137}Cs, $^{239/240}Pu$, ^{90}Sr, ^{241}Am, total alpha activity
	S96T001362	Archive
1AY-96-7	S96T001357	DSC, TGA, TIC, TOC, ICP, IC, pH, OH^-, SpG, NH_3
	S96T001360	^{137}Cs, $^{239/240}Pu$, ^{90}Sr, ^{241}Am, total alpha activity
	S96T001363	Archive
1AY-96-8	S96T001358	DSC, TGA, TIC, TOC, ICP, IC, pH, OH^-, SpG, NH_3
	S96T001361	^{137}Cs, $^{239/240}Pu$, ^{90}Sr, ^{241}Am, total alpha activity
	S96T001364	Archive
1AY-96-9	S96T001519	DSC, TGA, TIC, ICP, IC, pH, SpG, NH_3
	S96T001521	^{137}Cs, $^{239/240}Pu$, ^{90}Sr, ^{241}Am, total alpha activity, TOC
	S96T002162	OH^-
	S96T001373	Archive
1AY-96-10	S96T001520	DSC, TGA, TIC, TOC, ICP, IC, pH, SpG, NH_3
	S96T001522	^{137}Cs, $^{239/240}Pu$, ^{90}Sr, ^{241}Am, total alpha activity
	S96T002163	OH^-
	S96T001374	Archive
1AY-96-FB	S96T001208	DSC, TGA, TIC, TOC, ICP, IC, pH, OH^-, SpG, NH_3, ^{137}Cs, $^{239/240}Pu$, ^{90}Sr, ^{241}Am, total alpha activity Archive
Vapor tests in tank headspace	N/A	Combustible gas meter readings for flammable gas

Note:

[1]Esch (1996)

Table 3-4. Analytical Procedures.[1] (2 sheets)

Analysis	Instrument	Preparation Procedure	Analytical Procedure[2]
Energetics by DSC	Mettler™	N/A	LA-514-113, Rev. C-1
	Perkin-Elmer™	N/A	LA-514-114, Rev. C-1
Percent water by TGA	Mettler™	N/A	LA-560-112, Rev. B-1
	Perkin-Elmer™	N/A	LA-514-114, Rev. C-1
Total alpha activity	Alpha proportional counter	Liquids: N/A Solids: fusion digest per LA-549-141, Rev. F-0; acid digest per LA-505-159, Rev. D-0	LA-508-101, Rev. D-2
Bulk density	N/A	N/A	LO-160-103, Rev. B-0
Specific gravity	N/A	N/A	LA-510-112, Rev. C-3
pH	N/A	N/A	LA-212-106, Rev. A-0
NH_3	Ion-selective electrode	N/A	LA-631-001, Rev. B-2
CN^-	Distillation	N/A	LA-695-102, Rev. E-0
OH^-	Titration	N/A	LA-211-102, Rev C-0
ICP	Inductively coupled plasma spectrometer	Liquids: N/A Solids: LA-505-159, Rev. D-0	LA-505-161, Rev. B-0 LA-505-151, Rev. D-3
IC	Ion chromatograph	N/A	LA-533-105, Rev. D-1
TIC	Acid coulometry	N/A	LA-622-102, Rev. C-0
TOC	Furnace Oxidation	N/A	LA-344-105, Rev. C-0
	Persulfate coulometry	N/A	LA-342-100, Rev. D-0
GEA	Gamma detector spectrometer	Liquids: N/A Solids: LA-505-159, Rev. D-0	LA-548-121, Rev. E-0
^{90}Sr	Separation and counting	Liquids: N/A Solids: LA-505-159, Rev. D-0	LA-220-101, Rev. D-1

Table 3-4. Analytical Procedures.[1] (2 sheets)

Analysis	Instrument	Preparation Procedure	Analytical Procedure[2]
^{241}Am	N/A	N/A	LA-953-103, Rev. B-0
$^{239/240}$Pu	N/A	N/A	LA-943-128, Rev. A-1
Flammable Gas	Combustible gas meter	N/A	WHC-IP-030, IH 1.4 and IH 2.1

Notes:

Rev. = revision

Mettler™ is a registered trademark of Mettler Electronics, Anaheim, California.

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

[1]Esch (1996)
[2]Procedures listed are internal procedures of Westinghouse Hanford Company, Richland, Washington.

3.4 PREVIOUS SAMPLING EVENTS

Prior to the 1996 sampling event, the most recent supernatant samplings occurred in 1994 and 1988, and the most recent sludge sampling occurred in 1985. Given the active process history of tank 241-AY-101 since these samplings, the analytical results from these events do not represent the current contents of the tank. The results of earlier samples are included for information only. The 1994 inorganic carbon analyses were reported to be low by a factor of 100 because of dilution factor errors (Herting 1996).

3.4.1 Description of Previous Supernatant Sampling Events

Two grab samples were taken from the tank on December 29, 1994 and the results of analysis were reported (Herting 1996). Analytical results on the sludge retrieved are included in the analytical comparisons in this report.

Three supernatant samples were reported on October 19, 1994 in Vogel (1994). The samples were received at the 222-S Laboratory on October 3, 1994. The samples were retrieved in 125-mL bottles, and were described as clear, amber in color, and having less than 1 percent solids. The analytical results are given in Table B-1.

Two supernatant samples were reported on July 20, 1988 in Edrington (1988). Sample R-8371 was analyzed, and sample R-8754 was archived without analysis. Neither the date of sample retrieval nor date of analysis is given. A description of the technique or procedure used to obtain the sample, or information concerning the sampled riser and sample depth, was not available. A sample of the supernatant was analyzed, and a representative aliquot of sample R-8371 was centrifuged, and the centrate analyzed. The solids were dissolved in a series of acids, and the acid washes analyzed. Remaining solids were submitted for X-ray diffraction and X-ray fluorescence analysis. The analytical results are given in Table B-2.

3.4.2 Description of Historical Sludge and Supernatant Sampling Event

Two samples were received on February 28, 1985 and reported in (Bratzel 1985). Sample R3641 was supernatant liquid taken 4.5 m (15 ft) from the bottom of the tank, and sample R3642 was sludge taken from the bottom of the tank. A description of the technique or procedure used to obtain the samples or information concerning the sampled riser was not available. The supernatant sample was centrifuged and the liquids were analyzed. The sludge sample was mixed and centrifuged, and the solids were dried and re-dissolved in acid. The analytical results are given in Table B-3.

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4.0 ANALYTICAL RESULTS

Section 4.0 summarizes the analytical results associated with the 1996 sampling of tank 241-AY-101. The sampling and analysis parameters governing this event were integrated by and described in the SAP (Thompson 1996). Sample breakdown and analysis of the ten grab samples and field blank were performed at the Westinghouse Hanford Company 222-S Laboratory.

Data locations for this tank characterization report are displayed in Table 4-1. Appendix B contains the historical sampling results. The complete analytical data set can be found in Appendix A. Only analyte overall means are reported in Section 4.0.

Table 4-1. Analytical Data Presentation Tables.

Data Type	Tabulated Location
Chemical data summary	Tables 4-2
Exothermic DSC data summary	Table 4-3
Headspace flammability results	Table 4-4
Comprehensive analytical data	Appendix A
Historical sampling data	Appendix B

4.1 DATA PRESENTATION

The analytical results from the 1996 sampling of tank 241-AY-101 were reported in the *Final Report for Tank 241-AY-101, Grab Samples 1AY-96-1 Through 1AY-96-10 and 1AY-96-FB* (Esch 1996) and have been summarized in Section 4.1. Sections 4.1.1, 4.1.2, and 4.1.3, include the chemical data, the physical data, and the headspace flammability results, respectively.

4.1.1 Chemical Data Summary

Table 4-2 includes the overall mean concentration estimates and inventories for tank 241-AY-101. Data from the ten grab samples were combined according to waste phase to derive overall means for all analytes except DSC, which does not require calculation of a mean. The information contained in Table 4-2 was taken from the Appendix A tables. The sludge data in Table 4-2 include those analytes found at concentrations greater than 1,000 $\mu g/g$ in the centrifuged solids from the sample 1-AY-96-5 taken at an elevation of 84 cm (33 in.).

The first column of Table 4-2 contains the name of the analyte, and the second and fifth columns contain the overall mean estimates for the sludge and supernatant layers, respectively. If solids information was available for a given analyte, then the sludge mean was estimated by weighting the centrifuged liquid and centrifuged solid portions according to the volume percent solids measurement of 65.65 percent. For centrifuged solid analytes with no centrifuged liquid results, the supernatant mean for that analyte was used in the weighting scheme because the centrifuged liquid data and supernatant data for weight percent water, total alpha activity, and specific gravity were very similar. The overall means for the supernatant layer were calculated as an average of the eight supernatant sampling results. For more detail on how the means were calculated, refer to appendix A.

When 50 percent or more of the individual primary and duplicate measurements had detected results, the overall mean was reported as a detected value. Conversely, when greater than half of the individual primary and duplicate measurements had nondetected results, the overall mean was reported as a nondetected value.

The third and sixth columns display the relative standard deviation (RSD) of the mean, defined as the standard deviation of the mean divided by the mean, multiplied by 100. The RSDs were determined by fitting a one-way analysis of variance (ANOVA) model to the data, and were computed only for those analytes that had "detected" means.

The projected inventories for the sludge layer are listed in column four, and were obtained by multiplying the overall mean weight concentration by the total sludge volume of 314 kL (83 kgal), the sludge density of 1.30 g/mL, and the appropriate conversion factors. The projected inventories for the supernatant layer are listed in column seven, and were obtained by multiplying the overall mean volume concentration by the total supernatant volume of 3,229 kL (853 kgal), and the appropriate conversion factors. Column eight contains the total projected tank inventory, which is the sum of columns four and seven. The TIC, ^{241}Am and $^{239/240}Pu$ projected inventories are for supernatant values only.

Table 4-2. Chemical Data Summary for Tank 241-AY-101.[1] (3 sheets)

Analyte	Sludge Data			Supernatant Data			Tank Projected Inventory
	Overall Mean	RSD (Mean)	Projected Inventory	Overall Mean	RSD (Mean)	Projected Inventory	
METALS	µg/g	%	kg	µg/mL	%	kg	kg
Aluminum	59,000	4.4	15,800	< 12.1	N/A	< 39.1	15,800
Calcium	3,290	7.5	983	---	---	---	983
Chromium	1,780	4.4	532	105	1.6	339	871
Iron	15,700	1.6	4,693	< 12.0	N/A	< 38.7	4,732
Lanthanum	2,850	3.1	852	---	---	---	852
Magnesium	1,290	2.3	386	---	---	---	386
Manganese	2,580	3.2	771	< 2.39	N/A	< 7.72	771
Neodymium	1,300	2.4	389	---	---	---	389
Nickel	295	7.3	88	59.0	2.6	191	279
Phosphorus	5,280	1.6	1,578	---	---	---	1,578
Silicon	1,210	9.7	362	< 12.0	N/A	< 38.7	401
Sodium	79,600	4.3	23,793	51,900	1.1	1.68E+05	1.96E+05
Sulfur	1,190	1.7	486	---	---	---	486
AMMONIA/ANIONS	µg/g	%	kg	µg/mL	%	kg	kg
Ammonia	---	---	---	25.2	9.4	81.4	81.4
Chloride	---	---	---	636	4.2	2,050	2,050
Cyanide	23.7	12.7	N/A[2]	---	---	---	N/A
Fluoride	---	---	---	174	4.9	562	562
Hydroxide	---	---	---	< 125	N/A	< 404	< 404

Table 4-2. Chemical Data Summary for Tank 241-AY-101.[1] (3 sheets)

Analyte	Sludge Data			Supernatant Data			Tank Projected Inventory
	Overall Mean	RSD (Mean)	Projected Inventory	Overall Mean	RSD (Mean)	Projected Inventory	
AMMONIA/ANIONS (Cont'd)	**μg/g**	**%**	**kg**	**μg/mL**	**%**	**kg**	**kg**
Nitrate	---	---	---	26,000	2.2	84,000	84,000
Nitrite	---	---	---	35,300	2.6	1.14E+05	1.14E+05
Phosphate	---	---	---	1,150	22.5	3,710	3,710
Sulfate	---	---	---	5,870	3.3	19,000	19,000
RADIONUCLIDES	**μCi/g**	**%**	**Ci**	**μCi/mL**	**%**	**Ci**	**Ci**
Total alpha	3.12	1.6	1,270	0.0441	4.1	142	1,410
^{241}Am	---	---	---	0.00491	19.9	15.9	15.9
^{137}Cs	85.6	7.6	34,200	86.4	1.1	2.79E+05	3.13E+05
^{60}Co	< 2.23	N/A	< 601	0.0263	1.8	84.9	686
$^{239/240}$Pu	---	---	---	0.0364	14.4	118	118
$^{89/90}$Sr	4,610	1.8	1.24E+06	1.89	3.8	6,100	1.25E+06
CARBON	**μg C/mL**	**%**	**kg C**	**μg C/mL**	**%**	**kg C**	**kg C**
TIC	---	---	---	6,860	2.4	22,200	22,200
TOC	3,730	4.3	N/A[2]	6,850	11.7	22,100	22,100

Table 4-2. Chemical Data Summary for Tank 241-AY-101.[1] (3 sheets)

Analyte	Sludge Data			Supernatant Data			Tank Projected Inventory
	Overall Mean	RSD (Mean)	Projected Inventory	Overall Mean	RSD (Mean)	Projected Inventory	
PHYSICAL PROPERTIES		%	kg		%		kg
pH	---	---	N/A	9.77	0.1	N/A	N/A
SpG/Bulk density, g/mL	1.30	1.6	N/A	1.08	0.2	N/A	N/A
Weight percent water	55.8 %	28.1	2.28E+05	84.4 %	0.1	2.94E+06	3.17E+06
Volume percent solids	65.7 %	1.2	N/A	---	---	N/A	N/A

Notes:

N/A = not applicable.

[1]Esch (1996)

[2]The projected inventory was not calculated due to lack of solids data. The mean concentration in column 2 is centrifuged liquid data.

4.1.2 Physical Data Summary

Thermal analyses and specific gravity/density were performed on the tank 241-AY-101 grab samples to satisfy the requirements of the safety screening DQO (Dukelow et al. 1995) and the waste compatibility DQO (Fowler 1995). Measurements for pH and volume percent solids were required by the waste compatibility DQO only.

4.1.2.1 Thermogravimetric Analysis. During TGA analysis, the mass of a sample is measured while its temperature is increased at a constant rate. Nitrogen is passed over the sample during the heating to remove any released gases. Any decrease in the weight of a sample represents a loss of gaseous matter from the sample either through evaporation or through a reaction that forms gas phase products. The moisture content is estimated by assuming that all TGA sample weight loss up to a certain temperature (typically 150 to 200 °C [302 to 392 °F]) is due to water evaporation. Thermogravimetric analysis was performed on homogenized solid samples and directly on drainable liquids.

The TGA results for tank 241-AY-101 are presented in Table A-55. All samples exhibited a large weight loss between ambient temperature and 170 °C (338 °F). Again, this weight loss was attributed to the evaporation of water. The overall weight percent water mean for the supernatant contents of the tank was 84.4 percent. This is consistent with low TOC and supernatant specific gravity of 1.08. The mean for the centrifuged liquids was 82.9 percent, the mean for the centrifuged solids was 41.6 percent, and the overall sludge mean using the weighting factors described earlier was 55.8 percent.

4.1.2.2 Differential Scanning Calorimetry. During a DSC analysis, heat absorbed or emitted by a substance is measured while the temperature of the substance is increased at a constant rate. While the substance is being heated, nitrogen is passed over the waste material to remove any gases being released. The onset temperature for an endothermic event (characterized by or causing the absorption of heat) or an exothermic event (characterized by or causing the release of heat) is determined graphically. The DSC results (wet basis) are presented in Appendix A in Table A-56. The peak temperature and maximum enthalpy changes are given for each sample.

Table 4-3 lists all of the samples that had one or more exothermic reactions recorded. The following results are given on a dry weight basis. The only sample to exceed the safety screening decision criteria threshold of -480 J/g was the liquid from the centrifuged sludge sample located in riser 15K at 64 cm (25 in.) from the tank bottom. The highest individual result from this sample was -761.10 J/g and the upper limit to a one-sided 95 percent confidence interval, on the mean, was -1,076.5 J/g. The 81 wt% water is nearly five times the 17 percent minimum water content safety threshold. All other samples with exothermic reactions had upper limits to a one-sided 95 percent confidence interval, on the mean, less than half of the decision threshold (Esch 1996).

Table 4-3. Exothermic DSC Results and 95 Percent Confidence Interval Upper Limits.

Sample Number[1]	Riser	Elevation (in. From tank Bottom)	Run	Wet Wt. Δ H	Sample Wt% Water	Dry Wt. Δ H[2]	Dry Wt. Mean	95 % Confidence Interval Upper Limits (Dry Wt.)
Supernatant				J/g	%	J/g	J/g	J/g
1519	15S	25	1	-7.600	83.84	-47.06	-47.06	-47.06
			2	-7.600		-47.06		
1520		24	1	0.00	84.78	0.00	-26.7	-104.8
			2	-12.20		-80.21		
			3	0.00		0.00		
Centrifuged Liquids				J/g	%	J/g	J/g	J/g
1317	15K	25	1	-144	81.04	-761.10	-701.75	-1,076.5
			2	-121.8		-642.40		
Centrifuged Solids				J/g	%	J/g	J/g	J/g
1275	15K	25	1	-105.0	64.47	-196.30	-195.55	-200.3
			2	-104.3		-194.80		

Notes:

ΔH = Change in enthalpy (negative sign denotes an exothermic reaction)

[1]All numbers in the sample number column are preceded by "S96T00".

[2]The dry weight results in column seven are calculated by using the wet weight results in column five and the weight percent water results in column six according to the following equation:

$$\frac{\text{X J/g (wet weight)}}{1-\text{(weight percent water/100)}} = \text{X J/g dry weight.}$$

4.1.2.3 Density/specific gravity. Density/specific gravity measurements were performed on all waste phases. The overall supernatant mean was 1.08 g/mL, and the overall sludge mean was 1.30 g/mL. The centrifuged liquid mean was 1.03 g/mL, while the centrifuged solid mean was 1.45 g/mL. The results are presented in Table A-57.

4.1.3 Headspace Flammability Screening Results

As requested in the SAP (Thompson 1996) and required by the safety screening DQO (Dukelow et al. 1995), prior to grab sampling, the headspace of tank 241-AY-101 was sampled and analyzed for the presence of flammable gases. Although the SAP indicated that the results were to be reported as a percentage of the lower flammability limit (LFL), the instrumentation used to collect the data reported the results as a percentage of the lower explosive limit (LEL). Because the National Fire Protection Association (NFPA) defines the terms LFL and LEL identically, the two terms may be used interchangeably (NFPA 1995). The results were 0 percent of the LFL, well below the 25 percent decision threshold. In addition, the concentration of oxygen gas, ammonia gas, and total organic carbon vapors were determined. The results are presented in Table 4-4.

Table 4-4. Headspace Flammability Screening for Tank 241-AY-101.[1]

Vapor Characteristic Measured	Riser 15K	Riser 15S
Tank headspace flammability as a percent of the LEL	0.0 %	0.0 %
Volume percent oxygen gas	20.0 %	21.0 %
Concentration of ammonia gas	5 ppm	0 ppm
Concentration of total organic carbon vapor	0 ppm	0 ppm

Note:
[1]Esch (1996)

4.1.4 Sludge Sample Results from 1994 Sample

The December 1994 grab sample results are reported in Herting (1996), and key results for the sludge are summarized in Table 4-5.

Table 4-5. Analytical Results December 1994 Sludge Sample.[1]

Analyte	Unit	Mean
SpG	g/mL	1.38
TGA	% H_2O	44.5
TOC	μg C/g	3,050
TIC	μg C/g	4,250
Aluminum	μg/g	50,200
Chromium	μg/g	650
Iron	μg/g	12,050
Manganese	μg/g	2,050
Nitrate	μg/g	9,350
Nitrite	μg/g	23,500
Phosphate	μg/g	300
Sodium	μg/g	87,800
Sulfate	μg/g	3,200

Note:
[1]Herting (1996)

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5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

The purpose of this chapter is to discuss the overall quality and consistency of the sampling results for tank 241-AY-101, and to assess and compare these results against historical information and program requirements.

5.1 ASSESSMENT OF SAMPLING AND ANALYTICAL RESULTS

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

5.1.1 Field Observations

The safety screening DQO (Dukelow et al. 1995) required vertical profiles (or elevations) of the waste from at least two widely spaced risers. This requirement was fulfilled, allowing a spatial examination of the analyte concentrations. Sample recovery was 100 percent for all samples. The SAP (Thompson 1996) specified that three supernatant samples and two sludge samples would be taken from riser 15S, but visual inspection revealed less than 1 percent settled solids in the bottom two grab samples; the samples were expected to be sludge. As a result, the laboratory was directed to analyze the samples from riser 15S as supernatant samples (Esch 1996). No further anomalies were noted.

5.1.2 Quality Control Assessment

The usual quality control assessment includes an evaluation of the appropriate standard recoveries, matrix spike recoveries, duplicate analyses, and method blanks that are performed in conjunction with the chemical analyses. All of the pertinent quality control tests were conducted on the 1996 grab samples, allowing a full assessment regarding the accuracy and precision of the data. The SAP specified the criteria for all liquid analyses identified as primary by the three governing DQOs. The SAP also specified the criteria for the secondary TOC and cyanide analyses on the centrifuged solid sample.

The standard and spike recovery results provide an estimate of the accuracy of the analysis. If a standard or spike recovery is above or below the given criterion, then the analytical results may be biased high or low, respectively. All standard recoveries were within the defined criteria with one exception. One of five ^{241}Am results was slightly below the limit. However, the total alpha activity standard was within the laboratory criteria (Thompson 1996). Uranium had one of eight spike recoveries slightly below the criterion. This was attributed to sample results below the detection limit. Nitrite had one of five spikes just above the QC criteria. This was likely due to the high nitrite concentration in the sample (Esch 1996). Ammonia, TIC, and TOC each had one spike recovery slightly outside the criteria. The deviations from QC criteria are not believed to be substantial enough to compromise data quality.

Analytical precision is estimated by the relative percent difference (RPD), which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times one hundred. One of the four DSC samples with exothermic reactions had an RPD of 200 percent. A triplicate analyses conducted on that sample yielded no exotherm. Due to the interpretive nature of the DSC analysis, it is difficult to clearly identify small exotherms. In this case, the rise in the baseline for the duplicate analysis was large enough to integrate as an exotherm. The change in baseline for the sample and triplicate analyses was not large enough to identify any exotherms (Esch 1996).

Total alpha activity analysis had one of the eight supernatant RPDs above the criterion, probably due to low sample activities and self-adsorption on the sample mount. Reruns were not requested because of the low activities.

The RPD for the cyanide analysis was slightly above the criterion, but no rerun was requested because the results were far below the decision criteria threshold (Esch 1996). One of eight fluoride RPDs was also just above the criterion, due to an interferant during the IC analysis, possibly an organic acid.

One of eight $^{239/240}Pu$ RPDs was just above the criterion, due to the low activity of the sample. The one high RPD for uranium was due to sample results less than two times the detection limit.

Finally, the preparation blanks and field blank results for several analytes were above the detection limit. However, the level of analyte concentration in the blanks was inconsequential when compared to the sample results (Esch 1996). Typical detected results for the blanks were much less than 0.1% of the sample results. Thus, the low level of indicated contamination did not impact data quality for any of the analytes.

In summary, practically all of the QC results for both the primary and secondary analytes were within the boundaries specified in the SAP. The few discrepancies noted in Appendix A do not impact either the validity or the use of the data.

5.1.3 Data Consistency Checks

The comparison of results from different analytical methods can help to assess the consistency and quality of the data. The quantity of supernatant data available enabled the comparison of total alpha activity with the activities of the individual alpha emitters, as well as the calculation of mass and charge balances. Some of the usual consistency checks were not possible given the limited scope of the analyses.

5.1.3.1 Comparison of Results from Different Analytical Methods. The following data consistency check compares the results from two different analytical methods. A close correlation between the two methods strengthens the credibility of both results, whereas a poor correlation brings the reliability of the data into question. The analytical mean results were taken from the Table 4-2 supernatant data.

The total alpha activity mean was compared to the sum of the means of the individual alpha emitters in Table 5-1. The sum of the activities of the individual alpha emitters was determined by adding the ^{241}Am and $^{239/240}$Pu mean activities. The activities of the two methods compared well, yielding a ratio of 0.94 total alpha observed.

Table 5-1. Comparison of the Total Alpha Activity with the Sum of the Individual Activities.

Analyte	Overall Mean (μCi/g)
^{241}Am	0.00491
$^{239/240}$Pu	0.0364
Sum of alpha emitters	0.0413
Total alpha activity	0.0441
Ratio	0.94

5.1.3.2 Mass and Charge Balance. The principle objective in performing mass and charge balances is to determine if the measurements were consistent. Considering the quantity of data available, the mass and charge balance could only be conducted on the supernatant data. In calculating the balances, only those analytes listed in Table 4-2 that were detected at a concentration of 1,000 μg/g or greater were considered for the supernate mass balance.

Because sodium was the only supernatant analyte with a concentration above 1,000 μg/g, all positive charge was attributed to the sodium cation (Table 5-2). The acetate and carbonate data were derived from the total organic carbon and total inorganic carbon analyses, respectively. The anionic analytes listed in Table 5-3 were assumed to be present as sodium salts and thus expected to balance the positive charge exhibited by the cations. The concentrations of sodium in Table 5-2, the anions in Table 5-3, and the weight percent water estimate were ultimately used to calculate the mass balance. The uncertainty estimates (RSDs) associated with each analyte are also given in the tables. The uncertainty estimates for the cation and anion totals, as well as the overall uncertainty given in Table 5-4, were computed by propagation of errors techniques (Nuclear Regulatory Commission 1988).

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

Mass balance = % Water + 0.0001 x {Total Analyte Concentration}
= % Water + 0.0001 x {$[Na^+]$ + $[C_2H_3O_2^-]$ + $[CO_3^{2-}]$ + $[NO_3^-]$ + $[NO_2^-]$ + $[PO_4^{3-}]$ + $[SO_4^{2-}]$}.

The total analyte concentrations calculated from the above equation is 159,000 μg/g. The mean weight percent water obtained from thermogravimetric analysis reported in Table 4-2 is 84.4 percent, or 844,000 μg/g. The mass balance resulting from adding the percent water to the total analyte concentration is 100.3 percent (Table 5-4).

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

Total cations = $[Na^+]/23.0 = 2{,}090$ μeq/g

Total anions = $[C_2H_3O_2^-]/59.0 + [CO_3^{2-}]/30.0 + [NO_3^-]/62.0 + [NO_2^-]/46.0 + [PO_4^{3-}]/31.7 + [SO_4^{2-}]/48.1 = 2{,}570$ μeq/g.

The charge balance obtained by dividing the sum of the positive charge by the sum of the negative charge was 0.81.

In summary, the above calculations yield reasonable mass balance values close to 100 percent for the mass balance. The charge balance ratio of 0.81 cations to anions with an RSD of 2.3% is outside the range expected.

Table 5-2. Cation Mass and Charge Data.

Analyte	Concentration μg/g	Assumed Species	Concentration of Assumed Species μg/g	RSD (Mean) %	Charge μeq/g
Sodium	48,100	Na^+	48,100	1.1	2,090
Total			48,100	1.1	2,090

Table 5-3. Anion Mass and Charge Data.

Analyte	Concentration µg/g	Assumed Species	Concentration of Assumed Species µg/g	RSD (Mean) %	Charge µeq/g
TIC	6,350	CO_3^{2-}	31,800	2.4	1,060
TOC	6,340	$C_2H_3O_2^-$	15,600	11.7	264
Nitrate	24,100	NO_3^-	24,100	2.2	389
Nitrite	32,700	NO_2^-	32,700	2.6	711
Phosphate	1,060	PO_4^{3-}	1,060	22.5	33.4
Sulfate	5,440	SO_4^{2-}	5,440	3.3	113
Total			111,000	2.0	2,570

Table 5-4. Mass Balance Totals.

Totals	Concentrations µg/g	RSD (Mean) %
Cation Total (from Table 5-2)	48,100	1.1
Anion Total (from Table 5-3)	111,000	2.0
Water	844,000	0.1
Grand Total	1,000,000	0.2

5.2 COMPARISON OF PREVIOUS SAMPLING EVENT WITH CURRENT ANALYTICAL RESULTS

As mentioned in Sections 3-4, the most recent supernatant sampling events took place in 1988 and 1994. Examining Table 2-3 and Section 2.3.1, it can be seen that a number of transfers occurred after 1988. Many more small transfers and adjustments not specifically listed occurred during the period from January 1, 1994 to the present. Post-1993 transfer data indicate that about 261 kL (69 kgal) of liquid have been removed from the tank and 397 kL (105 kgal) of water and complexed saltwell waste have been added to the tank.

Although the precise sampling date of the 1994 data is not known, it probably occurred shortly before the laboratory received the samples on October 3, 1994. Analytical results from the 1994 and 1996 events are shown in Table 5-5. The 1996 chemical composition is very different from the 1994 analyses. This difference has been attributed to a dilution calculation error in subsequent reports (Herting 1996). An operational sample taken on December 30, 1994 was analyzed for anions for a corrosion study (Rollison 1995). All of the results for anions were much closer to the 1996 results.

The most recent previous solids sampling from the sludge layer took place in 1985, and may represent the current sludge content. The estimated sludge volume in 1985 was 269 kL (71 kgal) (Brevick et al. 1995), with a waste depth of approximately 65 cm (25.6 in.). Hanlon (1996) estimates the tank content at 314 kL (83 kgal) of sludge currently in the tank, approximately 76 cm (29.9 in.) deep.

Because the elevation of sludge sample 1AY-96-4 was 64 cm (25 in.), this sample may be representative of the sludge that was present in the tank in 1985. However, only safety screening DQO analyses were conducted on the 1996 sludge from this depth, while only metals and radionuclides were analyzed for the 1985 event. The other 1996 sludge sample, 1AY-96-5, was taken 84 cm (33 in.) from the tank bottom, several inches above the estimated 1985 sludge depth.

Comparable results for the December 1994 and 1996 samples are shown in Table 5-6. Where the same analytes were reported, results correlate well.

5.3 TANK WASTE PROFILE

Hanlon (1996) reports that the 856 cm (336.84 in.) of waste in tank 241-AY-101 contains 3,229 kL (853 kgal) of supernatant overlaying 314 kL (83 kgal) of sludge. The sludge layer includes 8 kL (2 kgal) of drainable interstitial liquid. The TLM estimates are similar to those of Hanlon (1996), but the sludge layer is divided into several sub-layers based on the specific waste type, and includes 68 kL (18 kgal) of concentrated supernatant solids as part of the sludge (see Figure 2-3). The supernatant observed during extrusions was consistently yellow and clear, while the two solids samples were both brown and opaque (See Table 3-2). As expected, the waste in the tank is vertically heterogeneous on a macro scale in that two waste phases are present.

A one-way ANOVA statistical model was fit to the 1996 grab sample supernatant data. The results from this model can be used to judge the variability in analyte concentrations between the eight different sampling locations from which supernatant samples were obtained.

Table 5-5. Comparison of Supernatant Data from the 1994 and 1996 Sampling Events.

Analyte	1994 Analytical Result[1]	1996 Analytical Result[2]
METALS	μg/mL	μg/mL
Aluminum	< 1.00	< 12.1
Iron	< 1.00	< 12.0
Sodium	48,300	51,900
AMMONIA/ANIONS	μg/mL	μg/mL
Ammonia	73.2	25.2
Chloride	5.72	636
Fluoride	1.96	174
Nitrate	207	26,000
Nitrite	373	35,300
Phosphate	17.1	1,150
Sulfate	59.4	5,870
RADIONUCLIDES	μCi/mL	μCi/mL
^{241}Am	< 0.0152	0.00491
^{137}Cs	101	86.4
$^{239/240}$Pu	0.0198	0.0364
^{90}Sr	2.42	1.89 ($^{89/90}$Sr)
CARBON	μg C/mL	μg C/mL
TIC	6,990	6,860
TOC	3,380	6,850
PHYSICAL PROPERTIES		
pH	9.49	9.77
Specific gravity	1.10 g/mL	1.08 g/mL
Weight percent water	85.4 %	84.4 %

Notes:

[1]Vogel (1994)
[2]Esch (1996)

Inorganic carbon (IC) analyses are reported to have been low by a factor of 100 because of a dilution error.

Table 5-6. Comparison of Centrifuged Solids Data from the 1994 and 1996 Sampling Events. (2 sheets)

Analyte	1994 Result[1]	1996 Result[2]
METALS	**µg/g**	**µg/g**
Aluminum	50,200	59,000
Barium	NR	258
Cadmium	NR	23.0
Calcium	NR	3,290
Chromium	650	1,780
Copper	NR	38.7
Iron	12,050	15,700
Lanthanum	NR	2,850
Magnesium	NR	1,290
Manganese	2,050	2,580
Molybdenum	NR	< 40.0
Nickel	NR	295
Lead	NR	793
Silicon	NR	1,210
Uranium	NR	< 400
Zinc	NR	84.6
Zirconium	NR	< 7.99
RADIONUCLIDES	**µCi/g**	**µCi/g**
^{137}Cs	99	85.6
$^{89+90}Sr$	4,220[3]	4,610

Notes:

[1]Herting (1996)
[2]Esch (1996)
[3]Reported as ^{90}Sr

The ANOVA model was fit to the analytical data for a given analyte provided 50 percent or more of the individual primary and duplicate measurements were above the detection limit.

The p-value, from the ANOVA models, is compared to a standard significance level ($\alpha = 0.05$). If it is less than 0.05, then the analyte means are significantly different from each other. The p-values for analytes with some nondetected results are approximations. In the following paragraph the p-values are in parentheses.

Of the 22 analytes statistically analyzed, five did not show significant concentration differences between the eight locations: uranium (0.354), ^{60}Co (0.860), pH (0.075), specific gravity (0.240), and weight percent water (0.206). The analytes that showed significant concentration differences between locations are: chromium, nickel, ammonia, chloride, nitrate, nitrite, phosphate, sulfate, TOC, ^{241}Am, $^{239/240}$Pu, and $^{89/90}$Sr with p-values < 0.001, and sodium (0.025), fluoride (0.028), TIC (0.002), ^{137}Cs (0.010), and total alpha activity (0.029) had p-values greater than 0.001.

In summary, the Hanlon (1996) estimates, the TLM, and the visual descriptions of the samples all indicated vertical heterogeneity in that distinct supernatant and sludge waste phases are present. The tank layer model indicates that the sludge layer consists of several different waste types; grab samples are not designed to distinguish between waste layers. Despite the uniform appearance of the supernatant grab samples, the statistical results of the supernatant waste indicate vertical heterogeneity, with 17 of the 22 analytes showing significant concentration differences between locations.

5.4 COMPARISON OF TRANSFER HISTORY WITH ANALYTICAL RESULTS

The HTCE estimates of the tank contents are compared with the analytical results from the 1996 sampling event in Table 5-7. The HTCE values are generated using a combination of several data sources, as described in Section 2.3.2. Each of these data sources contains assumptions and/or other factors (such as transfers of an unknown waste type into the tank) that may impact the modeled concentrations presented in the HTCE. The HTCE values have not been validated; these values are presented for information only. For this comparison, the

Table 5-7. Comparison of HTCE with the 1996 Analytical Results for Tank 241-AY-101. (2 sheets)

Analyte	HTCE Estimate[1]	1996 Total Inventory Estimate[2]
METALS	**kg**	**kg**
Aluminum	35,600	15,800
Chromium	2,710	830
Iron	8,460	4,250
Manganese	367	700
Nickel	2,190	278
Silicon	9,340	365
Sodium	2.73E+05	1.96E+05
Uranium	20,400	1,130
ANIONS	**kg**	**kg**
Ammonia	1,010	81.4
Chloride	7,250	2,050
Fluoride	666	562
Nitrate	2.36E+05	84,000
Nitrite	1.02E+05	1.14E+05
Phosphate	5,340	3,710
Sulfate	30,300	19,000
RADIONUCLIDES	**Ci**	**Ci**
Total alpha activity[3]	1,420 (Pu)	1,410
^{137}Cs	1.96E+05 (Cs)	3.13E+05
$^{89/90}$Sr	2.01E+06 (Sr)	1.25E+06
CARBON	**kg C**	**kg C**
Total inorganic carbon	8,120	22,200
Total organic carbon	12,000	22,100
PHYSICAL PROPERTIES		
Weight percent water	74.3 wt%	Supernatant = 84.4 wt% Sludge = 55.8 wt%
Density	1.17 g/mL	Supernatant = 1.08 g/mL Sludge = 1.30 g/mL

Notes:

[1]Agnew et al. (1996a). Data are not validated; use with caution.

[2]Esch (1996)

[3]The total alpha activity projected inventory rather than the $^{239/240}$Pu estimate was compared with the HTCE plutonium estimate because the latter represented the supernatant only.

total projected inventory estimates from column eight of Table 4-2 and column four of Table 2-4 were used. The results compared fairly well.

5.5 EVALUATION OF PROGRAM REQUIREMENTS

The 1996 grab sampling event was governed by three DQOs; the safety screening DQO (Dukelow et al. 1995), the waste compatibility DQO (Fowler 1995), and the evaporator DQO (Von Bargen 1995). The following sections include discussion of each issue identified in the DQOs, the analyses performed to evaluate those issues, and the analytical results from the 1996 grab sampling event.

5.5.1 Safety Evaluation

The safety screening DQO requirement that vertical profiles of the waste be obtained from at least two widely spaced risers was met. No sludge was recovered from one of the risers sampled even though a complete vertical profile was sampled. Either there was not sludge at this location or the sampler failed to recover sludge.

Of the six primary analyses required by this DQO, three have decision criteria thresholds which, if exceeded, could warrant further investigation to evaluate tank safety. These three analyses include DSC to evaluate the fuel content, total alpha activity to determine the criticality potential, and a determination of the flammability of the gases in the tank headspace. Also, the liquid samples must be visually inspected for the presence of an organic layer.

Table 5-8 lists the safety issue, applicable primary decision variables, the decision criteria thresholds, and the analytical results from the 1996 core sampling event required by the safety screening DQO. This table shows that all decision criteria were met for the 1996 samples except DSC analyses. Further comparisons were required to assess whether exothermic reactions are a safety concern.

To investigate the relationship between DSC and the TOC content, the DSC dry weight results for those subsegments that had exothermic reactions are compared with the corresponding dry weight TOC results and the TOC energy equivalents in Table 5-9. The organics present are sufficient to account for the exotherms found in the supernatant, but not the liquids centrifuged from sludge.

Table 5-8. Decision Variables and Criteria for the Safety Screening Data Quality Objective.

Safety Issue	Primary Decision Variable	Decision Criteria Threshold	Analytical Results
Ferrocyanide/ Organics	Total fuel content[1]	-480 J/g	Highest exothermic reaction = -761.10 J/g. Highest 95 % confidence interval upper limit = -1,076.5 J/g.[2]
Organics	Total organic carbon[1,3,4]	30,000 μg C/mL	Mean = 19,700 μg C/mL 95 % confidence interval upper limit = 25,000 μg C/mL.[5]
Ferrocyanide	Total cyanide[6]	39,000 μg/mL	Mean = 23.70 μg/mL
Criticality	Total alpha activity	Liquids: 61.5 μCi/mL Sludge: 41 μCi/g	Liquid mean = 0.0441 μCi/mL Sludge mean = 3.12 μCi/g.
Flammable gas	Flammable gas	25 % of the LFL	0 % of the LFL

Notes:

[1]All decision criteria thresholds and analytical results are given as dry weight values.

[2]Both of these results were obtained from the liquid centrifuged from the sludge sample from riser 15K, elevation 64 cm (25 in.). These results are not representative of tank configuration and are inconsistent with all other analyses. Triplicate result did not verify this single set of results.

[3]All decision criteria thresholds for TOC were based on the fuel value of sodium acetate.

[4]TOC was required by the safety screening DQO only for the liquid centrifuged from the sludge sample from riser 15K, elevation 64 cm (25 in.), due to the exothermic reaction with a change in enthalpy greater than -480 J/g.

[5]This 95 percent confidence interval upper limit for TOC was obtained for liquid from the sludge sample from riser 15K, elevation 64 cm (25 in.).

[6]Cyanide was required by the safety screening DQO only for the centrifuged liquid sample from riser 15K, elevation 64 cm (25 in.), because the TOC measurement alone did not account for the exothermic reaction with a change in enthalpy greater than -480 J/g.

Table 5-9. Comparison of DSC Analytical Results with TOC Energy Equivalents (Dry Weight Basis).

Sample Number[1]	Riser	Elevation (in. from Tank Bottom)	Run	TOC Analytical Result	TOC Energy Equivalent	DSC Analytical Result[1]
Supernatant				μg C/g	J/g	J/g
1521/1519	15S	25	1	18,800	238	47.06
			2	19,500	246	47.06
1520		24	1	21,600	273	0.00
			2	22,100	279	80.21
			3	---[2]	---[2]	0.00
Centrifuged Liquids				μg C/g	J/g	J/g
1317	15K	25	1	20,500	259	761.10
			2	18,800	238	642.40
Centrifuged Solids				μg C/g	J/g	J/g
1275	15K	25	1	---[3]	---[3]	196.30
			2	---[3]	---[3]	194.80

Notes:

[1]The negative sign indicating an enthalpy change involving an exothermic reaction was not included because total energy in J/g is being compared between the DSC and TOC results.

[2]Triplicate runs were not conducted on any of the TOC samples.

[3]TOC analyses were not required by the safety screening DQO in the absence of an exothermic reaction with a change in enthalpy greater than -480 J/g, nor was it required by the waste compatibility DQO for solid samples.

The TOC data were converted to their energy equivalent using the following equation (Buckley et al. 1995).

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

The 632 J/g value represents the energy equivalent of 5 weight percent TOC, based on a sodium acetate average energetics standard. Assuming that all of the TOC is present as sodium acetate may bias the calculation.

As with the analysis for TOC on the centrifuged liquid sample from riser 15K, elevation 64 cm (25 in.), cyanide analysis was also required on this sample by the safety screening DQO in an attempt to account for the large exothermic reaction. The analytical result of 23.70 μg/mL in the liquid centrifuged from sludge was far below the decision threshold of 39,000 μg/mL and does not contribute significantly to the observed fuel content based on DSC analysis.

The supernatant weight percent water mean was 84.4 percent and the overall sludge mean was 55.8 percent. Because all means and individual values were above 17 weight percent, the DSC results showing exothermic reactions with a change in enthalpy greater than the decision threshold of -480 J/g and TOC results over 30,000 μg C/mL were not a safety concern. The samples of supernatant with the highest TOC concentrations showed no DSC exotherm. This is not explained by the data gathered but is often the result of other phenomena for high moisture content samples.

Another factor in assessing tank safety is the heat generation from radioactive decay and temperature increase of the waste. The derived estimate based on the 1996 analytical results was 9,870 W (33,700 Btu/hr) (Table 5-10), while the HTCE prediction was 14,500 W (49,400 Btu/hr). Both estimates were well below the 205,000-W (700,000-Btu/hr) design specification for tank 241-AY-101 (Fowler 1995). There is seasonal variation in tank temperatures and no discernable upward trend from year to year. Heat generated in the tank is being dissipated.

Table 5-10. Tank 241-AY-101 Estimated Heat Load.

Radionuclide	Ci	Watts
^{241}Am	15.9	0.522
^{137}Cs	3.13E+05	1,480
^{60}Co	686	10.6
$^{239/240}$Pu	118	3.60
$^{89/90}$Sr	1.25E+06	8,380
Total		9,870

5.5.2 Waste Compatibility Evaluation

In accordance with Fowler (1995), tank 241-AY-101 was analyzed to assess the safety and operational implications of commingling the wastes in the tank with the double-shell tank systems. Safety considerations included energetics, criticality, flammable gas generation and accumulation, corrosion and leakage, and unwanted chemical reactions. Operational considerations included TRU segregation, heat load limits of the receiving tank, plugged pipelines and equipment, and complexant waste segregation. The potential chemical reactivity of the waste in a variety of different situations and the tendency of the waste to plug piping and equipment were not within the scope of this report.

5.5.2.1 Safety Decision Rules Evaluation. Table 5-11 presents the analyses used to evaluate the waste in terms of the safety considerations. The primary decision variable, the decision criteria threshold, and the supernatant analytical results from the 1996 grab sampling event, are listed for each safety issue. Based on the analytical results the decision criteria for safety screening issues were met. Of the operational safety issues, the low hydroxyl concentration was below the minimum limit.

The waste compatibility DQO specifies three waste composition limits to control corrosion (Table 5-11). The corrosivity of the waste must be controlled to prolong the life of the tanks' carbon steel components. The limits for corrosion protection as stated in the waste compatibility DQO are based on the receiving tank temperature and the concentrations of corrosion-inhibiting chemicals such as sodium hydroxide added to the waste and salts of nitrate and nitrite contained in it.

The limits given in Table 5-11 apply to tanks with operating temperatures of > 100 °C (212 °F). The tank temperature is below 45 °C (113 °F) now. Tank AY-101 was designed to handle boiling wastes and heat loads up to 205,000 W (700,000 Btu/hr). The analytical results from the 1996 grab samples for nitrate and nitrite both met the criteria listed, but the mean hydroxide concentration was below the acceptable level for corrosion control. The individual grab sample means for hydroxide were also all below the acceptable concentration.

The second decision rule states that no high-level waste will be accepted for transfer to a tank identified as a Watch List tank without U. S. Department of Energy approval. The final decision rule states that potential chemical compatibility hazards are to be identified prior to acceptance of waste into any double-shell tank, and the source wastes shall be categorized according to a compatibility matrix specified in Fowler (1995).

Table 5-11. Safety Decision Variables and Criteria for the Waste Compatibility Data Quality Objective.

Safety Issue	Primary Decision Variable	Decision Criteria Threshold	Analytical Result
Energetics/ organic layer	Total fuel content/ organic layer	1.0 exotherm/endotherm ratio Presence of organic layer	Criteria met. < 1.0 for all ratios No organic layer
Criticality	$^{239/240}Pu$	0.800 μCi/mL[1]	Criteria met. 0.0364 μCi/mL
Flammable gas accumulation	Waste density	Density < 1.3 g/mL	Criteria met. 1.08 g/mL
Corrosion[2]	Concentration of nitrate, hydroxide, and nitrite	$[NO_3^-] \leq 1.0$ M; and 0.01 M $\leq [OH^-] \leq 5.0$ M; and 0.011 M $\leq [NO_2^-] \leq 5.5$ M	Criteria not met $[OH]^-$ below spec. $[NO_3^-] = 0.419$ M $[OH^-] < 0.00735$ M $[NO_2^-] = 0.767$ M

Notes:

[1]Although the actual decision criterion listed in the DQO was 0.013 g/L, $^{239/240}Pu$ was measured in μCi/ml. To convert the notification limit for $^{239/240}Pu$ into the same units as those used by the laboratory, it was assumed that all alpha decay originated from ^{239}Pu . Using the specific activity of ^{239}Pu (0.0615 Ci/g), the decision criterion may be converted to 0.800 μCi/ml as shown:

$$\left(\frac{0.013\ g}{L}\right)\left(\frac{1\ L}{10^3\ mL}\right)\left(\frac{0.0615\ Ci}{1\ g}\right)\left(\frac{10^6\ \mu Ci}{1\ Ci}\right) = 0.800\ \frac{\mu Ci}{mL}.$$

[2]These criteria apply for receiving tank operating temperatures of > 100 °C (212 °F).

5.5.2.2 Operations Decision Rules Evaluation. The waste compatibility program requires a formal operations analysis of non-routine transfers before they are approved. Several criteria are applicable when evaluating the feasibility of a waste transfer between tanks: the segregation of TRU and non-TRU waste, avoiding excess heat generation, high phosphate waste, complexant waste segregation, tank waste type, and waste pumpability. Three of these criteria are listed and compared to the analytical results in Table 5-12. The analytical results for transuranics, heat load, and phosphate were all well below the decision criteria threshold.

Table 5-12. Waste Compatibility Operations Decision Rules.

Operations Issue	Primary Decision Variable	Decision Criteria Threshold	Mean Analytical Result
Transuranics	TRU elements: (^{241}Am), ($^{239/240}$Pu)	0.1 μCi/g (TRU)	Criteria met. 0.0382 μCi/g[1]
Heat load	Heat generation rate	205,000 W (700,000 Btu/hr)	Criteria met. 9,870 W (33,700 Btu/hr)
High phosphate waste	(PO_4^{-3})	0.1<u>M</u> (PO_4^{-3})	Criteria met. 0.0121 <u>M</u>

Note:

[1]The analytical mean result of 0.0413 μCi/mL was converted to 0.0382 μCi/g by dividing by the supernatant density of 1.08 g/mL.

The last three operations issues cannot be addressed using analytical results. They are outside the scope of this report.

5.5.3 Evaporator Evaluation

Campbell (1995) requested ammonia and acetone analyses of the supernatant for tank 241-AY-101 per Section 7.1.4 of the evaporator DQO (Von Bargen 1995). The supernatant from this tank is a candidate for waste volume reduction through concentration using the 242-A Evaporator in fiscal year 1997. Issues associated with evaporator operation include tank waste compatibility, criticality, presence of a separable organic layer, radioactive source term, ammonia content, waste designation for double-shell tanks, energetics, and organic content. In order to assess the suitability of the waste for volume reduction and to predict the characteristics of the concentrated product, selected constituents of the waste were measured.

Ammonia levels have no specific limit, but are controlled such that the process condensate contains < 5,000 μg/mL of ammonia. This limit is derived from the WAC-173-303-100 (Ecology 1991) limit for extremely hazardous waste of 1 weight percent, or 10,000 μg/mL. Assuming a 50 percent volume reduction and 100 percent carryover of ammonia through the evaporator, ammonia is controlled to 5,000 μg/mL or less in the feed tank. The mean analytical result for ammonia based on the 1996 grab samples was 25.2 μg/mL, more than two orders of magnitude below the limit. Ammonia results may be biased low because of losses from the high pH samples.

Acetone results are not available at this time. The results will be included in a revision to Esch (1996) and this document after analysis has been completed.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The waste in tank 241-AY-101 was grab sampled in February 1996 and analyzed in accordance with the safety screening, waste compatibility, and evaporator DQOs. The safety issues evaluated included energetics to determine the fuel content, TOC and cyanide to determine their contribution to the total fuel content, weight percent water, total alpha activity to assess criticality, and flammable gas concentration. The waste compatibility DQO required ICP, IC, hydroxide, radionuclides, and several additional analyses in an attempt to identify potential safety and operational problems that may be encountered when mixing waste from two different sources. Ammonia was also analyzed in accordance with the evaporator DQO to help assess the suitability of the waste for volume reduction via the 242-A Evaporator. All samples were analyzed at the Westinghouse Hanford Company 222-S Analytical Chemistry Laboratory.

Regarding the safety evaluation, comparisons were made between the analytical results and the decision criteria thresholds listed in the safety screening, waste compatibility, and evaporator DQOs. All of the following DSC and TOC values are given on a dry weight basis.

The only grab sample to exceed the safety screening DQO decision criteria threshold of -480 J/g was the liquid centrifuged from the sludge sample from riser 15K, elevation 64 cm (25 in.). The sample mean from this location was -701.75 J/g, and the upper limit to a one-sided 95 percent confidence interval, on the mean, was -1,076.5 J/g. The highest upper limit to a one-sided 95 percent confidence interval on the mean for the centrifuged solids and supernatant portions was -200.3 J/g and -104.8, respectively (Esch 1996). Analyses for cyanide and TOC were required by the safety screening DQO on the centrifuged liquid portion that had the DSC result over the decision threshold. The cyanide sample mean from this segment portion was 23.70 μg/mL, well below the decision threshold of 39,000 μg/mL. The results for TOC were below the decision threshold of 30,000 μg C/g, with a sample mean of 18,240 μg C/g (19,700 μg C/mL) and the upper limit to a one-sided 95 percent confidence interval on the mean was 23,150 μg C/g (25,000 μg C/mL).

Assuming the TOC results were acetate, the observed energetics for the liquid centrifuged from sludge sample are not fully explained. The TOC analyses were conducted on the eight supernatant samples in accordance with the waste compatibility DQO. All the individual supernatant sample results were above the 30,000-μg C/mL safety screening decision threshold, with an overall mean of 40,600 μg C/g (43,900 μg C/mL) and an upper limit to a one-sided 95 percent confidence interval on the mean of 66,500 μg C/g (72,200 μg C/mL). From a safety viewpoint, however, this should not be a concern because a propagating exothermic reaction can only occur when the water content is below 17 wt% (Turner et al. 1995).

None of the individual sample results showed a water content below 17 wt%. The overall supernatant and sludge water content means were 84.4 percent and 55.8 percent, respectively.

The total alpha activity safety screening decision criteria thresholds are 61.5 μCi/mL for liquid samples and 41 μCi/g for solid samples. The mean concentration for the supernatant samples was 0.0441 μCi/mL and the upper limit to a one-sided 95 percent confidence interval on the mean was 0.081 μCi/mL. For the sludge layer, the mean was 3.12 μCi/g and the highest 95 percent confidence interval upper limit was 6.4 μCi/g. All total alpha activity values were thus far below their safety screening thresholds (Esch 1996).

A visual inspection of the grab samples revealed no separable organic layers.

The flammability of the gas in the tank headspace is an additional safety screening DQO consideration. The decision threshold is that any flammable gas present must be below 25 percent of the LFL. The analytical results were 0 percent of the LFL. Flammable gas is not a safety concern in this tank.

Based on analytical results, the estimated tank heat load was 9,870 W (33,700 Btu/hr), while the HTCE prediction was 14,500 W (49,400 Btu/hr). Both estimates were well below the 205,000-W (700,000-Btu/hr) design specification for tank 241-AY-101 (Fowler 1995) and below the 11,700-kW limit that separates low-heat and high-heat tanks.

The waste compatibility DQO had several safety criteria pertaining to the mixing of wastes transferred from different sources. The requirements regarding the exotherm/endotherm ratio, criticality, and flammable gas accumulation were all satisfactorily met. However, the requirement regarding corrosion limits was not met for the hydroxide concentration. The overall supernatant mean of < 0.00735 M was below the minimum required level of 0.01 M, as were all of the grab sample means.

The waste compatibility DQO also required an operations analysis of non-routine transfers before they are approved, and several decision criteria apply. The analytical mean for TRU elements was below the decision threshold, therefore the waste may be transferred to a non-TRU tank. The heat load level was well below the tank operation specification limit, and the phosphate concentration was below the level that would cause crystallization and plugging of equipment. Three other operational criteria were not comparable to analytical data, and were thus beyond the scope of this report.

The only evaporator DQO analyses required were for ammonia and acetone. The ammonia results were far below the estimated upper limit, and the acetone results have not yet been conducted but will be included in a later report.

According to the criteria established in the safety screening, waste compatibility, and evaporator DQOs, all analytical results met the specifications for a "safe" tank. The low hydroxide concentration is an operational safety criterion; in combination with the nitrate and nitrite at the prevailing temperatures, it is an immediate corrosion concern, with steps including transfer of supernatant liquid to another caustic-rich tank, increased sampling, and caustic addition being considered.

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7.0 REFERENCES

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

Agnew, S. F., P. Baca, R. A. Corbin, T. B. Duran, and K. A. Jurgensen, 1996b, *Waste Status and Transaction Record Summary for the Southeast Quadrant*, WHC-SD-WM-TI-689, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Bratzel, D. R., 1985, *Characterization of Complexant Concentrate Solids from Tanks 107-AN, 102-AN, and 101-AY*, (internal letter 65453-85-053 to J. N. Appel, March 14), Rockwell Hanford Company, Richland, Washington.

Brevick, C. H., L. A. Gaddis, and S. D. Consort, 1995, *Supporting Document for the Historical Tank Content Estimate for AY Tank Farm*, WHC-SD-WM-ER-317, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Buckley, L. L., H. Babad, S. M. Blacker, and K. S. Redus, 1995, *Data Quality Objective to Support Resolution of the Organic Fuel Rich Tank Safety Issue*, WHC-SD-WM-DQO-006, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Campbell, T. T., 1995, *Additional Analyses for 241-AY-101 Characterization*, (internal memorandum 77310-96-000 to J. G. Kristofzski, December 4), Westinghouse Hanford Company, Richland, Washington.

DeLorenzo, D. S., A. T. DiCenso, D. B. Hiller, K. W. Johnson, J. H. Rutherford, D. J. Smith, and B. C. Simpson, 1994, *Tank Characterization Reference Guide*, WHC-SD-WM-TI-648, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Ecology, 1991, *Dangerous Waste Regulations*, Chapter 170-303, Washington State Department of Ecology, Olympia, Washington.

Ecology, EPA, and DOE, 1996, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Edrington, R. S., 1988, *Report on Characterization of 101-AY Tank Samples*, (internal letter 12221-PCL888-169 to L. M. Bergmann, July 20), Westinghouse Hanford Company, Richland, Washington.

Esch, R. A., 1996, *Final Report for Tank 241-AY-101, Grab Samples 1AY-96-1 Through 1AY-96-10 and 1AY-96-FB*, WHC-SD-WM-178, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Fowler, K. D., 1995, *Data Quality Objectives for Tank Farms Waste Compatibility Program*, WHC-SD-WM-DQO-001, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B. M., 1996, *Waste Tank Summary Report for Month Ending February 29, 1996*, WHC-EP-0182-95, Westinghouse Hanford Company, Richland, Washington.

Herting, D. L., 1996, *Characterization of Sludge Sample from Tank 241-AY-101*, (internal letter 75764-PCS96-016 to J. M. Jones, February 27), Westinghouse Hanford Company, Richland, Washington.

Kristofzski, J. G., 1995, *Directions for Opportunistic Analyses*, (letter 75310-95-103 to Distribution, September 13), Westinghouse Hanford Company, Richland, Washington.

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

Lipnicki, J., 1995, *Waste Tank Risers Available for Sampling*, WHC-SD-WM-TI-710, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

NFPA, 1995, *National Fire Codes*, Vol. 10, Section 115, "Laser Fire Protection," National Fire Prevention Association, Quincy, Massachusetts.

Nuclear Regulatory Commission, 1988, *Statistical Methods for Nuclear Materials Management*, NUREG-CR-4604, PNL-5849, C. A. Bennett and W. M. Bowen (eds.), U. S. Government Printing Office, Washington D. C., 20013-7082.

Rollison, M. D., 1995, *Results for Tank 241-AY-101, Grab Samples*, (internal memo 8E480-95-003 to J. M. Jones, February 2), Westinghouse Hanford Company, Richland, Washington.

Salazar, B. E., 1994, *Double-Shell Underground Waste Storage Tanks Riser Survey*, WHC-SD-RE-TI-093, Rev. 4, Westinghouse Hanford Company, Richland, Washington.

Thompson, R. R., 1996, *Tank 241-AY-101 Grab Sampling and Analysis Plan*, WHC-SD-WM-TSAP-066, Rev. 2-A, Westinghouse Hanford Company, Richland, Washington.

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

Turner, D. A., H. Babad, L. L. Buckley, and J. E. Meacham, 1995, *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue*, WHC-SD-WM-DQO-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Vitro Hanford Engineering Services, 1971, *Dome Plan Penetration Tank-101-AY, 241-AY*, Drawing H-2-34689, Rev. 0, ICF Kaiser Hanford Company, Richland, Washington.

Vogel, R. E., 1994, *Results for Tank 241-AY-101*, (internal memorandum 8E480-94-108 to J. M. Jones, October 19), Westinghouse Hanford Company, Richland, Washington.

Von Bargen, B. H., 1995, *242-A Evaporator/Liquid Effluent Retention Facility Data Quality Objectives*, WHC-SD-WM-DQO-014, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1996, Surveillance Analysis Computer System database, June 14, 1996, Tank Farm Surveillance Engineering, Westinghouse Hanford Company, Richland, Washington.

Zama, R. P., December 1967, *Tank Elevation & Details, 241-AY*, Drawing H-2-64449, Rev. 6, Vitro Hanford Engineering Services, Richland, Washington.

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APPENDIX A

ANALYTICAL RESULTS FROM 1996 GRAB SAMPLING OF DOUBLE-SHELL TANK 241-AY-101

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A.0 ANALYTICAL RESULTS FROM 1996 GRAB SAMPLING OF DOUBLE-SHELL TANK 241-AY-101

A.1 INTRODUCTION

Appendix A reports the chemical, radiochemical, and physical characteristics of tank 241-AY-101 in table form and in terms of the specific concentrations of metals, ions, radionuclides, and physical properties.

Each data table lists the following: laboratory sample identification, sample location (riser/elevation), an original and duplicate result for each sample, a sample mean, an overall mean for the tank in which all locations are averaged equally, an RSD (mean), and a projected tank inventory. The projected tank inventory column is not applicable to the weight percent water, DSC, specific gravity/density, pH, or volume percent solids data. The data are listed in standard notation for values greater than 0.001 and less than 100,000. Values outside these limits are listed in scientific notation.

The tables are numbered A-1 through A-59. A description of the units and symbols used in the analyte tables and the references used in compiling the analytical data (Esch 1996) are found in the List of Terms and Section 7.0, respectively. For a description of the sampling event and information on sampling rationale and locations, see Section 3.0.

A.2 ANALYTE TABLE DESCRIPTION

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

Column two specifies the riser from which the sample was removed, and column three gives the elevation from the bottom of the tank from which the sample was removed.

The Result and Duplicate columns are self-explanatory. The "Sample Mean" column is the average of the result and duplicate values. If the result and duplicate values were both nondetected or detected, then the mean is expressed as a nondetected or detected value, respectively. If one of the two values is nondetected and one is detected, the sample mean is expressed as a detected result.

The overall (or analyte concentration) means for the waste in tank 241-AY-101 are given in column seven (column nine for weight percent water), and were calculated as follows:

The individual sample and duplicate pairs were first averaged to obtain a sample mean. Overall means for analytes from the sludge portion of the tank contents were essentially calculated as arithmetic averages based on location; varying amounts of information were available for the different analytes. To obtain overall sludge mean for total alpha and weight percent water, the mean for each waste phase was multiplied by a weighting factor obtained from the volume percent solids measurement. The centrifuged solids mean was multiplied by the volume percent solids mean value of 0.6565, and the centrifuged liquids mean was multiplied by 0.3435 with appropriate conversion to weight-based units.

The calculated sludge mean for total alpha is illustrated in the following equation:

$$(0.6565)\left[\frac{4.66\ \mu Ci\ cent.\ solid}{g}\right] + (0.3435)\left[\frac{0.168\ \mu Ci\ cent.\ liquid}{mL}\right]\left[\frac{1\ mL}{1.03\ g}\right] = 3.12\ \frac{\mu Ci}{g}.$$

The overall mean for a given analyte for the eight supernatant samples was obtained by taking an average of the eight sample means (locations). This approach was taken rather than an equal weighting of risers for two reasons. First, five supernatant samples were available from one riser and only three were available from the other, creating spatial imbalance to any riser concentration estimate. Second, an initial ANOVA calculation revealed very few analyte concentration differences between the two risers. This indicated that there was little justification for a weighted mean.

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

The RSD (mean), in column eight, was computed by fitting a one-way ANOVA model to the data. If the overall mean for a given analyte was "detected," then an RSD (mean) was also calculated for that analyte using all available data. If nondetected values are used as quantitative results, the mean concentrations, inventory estimates and RSD (mean) are raised. The magnitude of the bias cannot be estimated.

The projected inventories, given in column nine, were calculated in different ways depending on the waste phase and the amount of information available for a given analyte. For the supernatant samples, the inventory was obtained as the product of the overall analyte concentration mean, the volume of tank supernatant waste (3,229 kL [853 kgal]), and the appropriate conversion factors.

For the sludge layer, the eight primary ICP analytes and three radionuclides (excluding total alpha activity) from riser 15K, elevation 84 cm (33 in.), had a centrifuged solid mean, but no centrifuged liquid mean. Based on the similarity of analytical results between the centrifuged liquids and supernatant samples for total alpha activity, weight percent water, and specific gravity, the centrifuged solid mean for these ICP and radionuclide analytes with their supernatant results were averaged to estimate the sludge inventory with appropriate factors applied to keep consistent units.

The four quality control parameters assessed on the tank 241-AY-101 samples were standard recoveries, spike recoveries, duplicate analyses (RPDs), and blanks. These were summarized in Section 5.1.2. More specific information is provided in the following appendix tables. Sample and duplicate pairs in which any of the QC parameters were outside their specified limits are superscripted in column 6 as follows:

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

Table A-1. Tank 241-AY-101 Analytical Results: Aluminum.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	< 20.1	< 20.1	< 20.1	< 12.1	N/A	< 39.1
S96T001202		155	< 20.1	< 20.1	< 20.1			
S96T001203		40	< 20.1	< 20.1	< 20.1			
S96T001356	15S	330	5.28	5.65	5.465			
S96T001357		155	5.6	< 5.05	5.325			
S96T001358		40	5.88	5.27	5.575			
S96T001519		25	< 10.1	< 10.1	< 10.1			
S96T001520		24	< 10.1	< 10.1	< 10.1			
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	61,700	56,300	59,000	59,000	4.4	15,800

Table A-2. Tank 241-AY-101 Analytical Results: Antimony.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	42.6	106	74.3[QC:e]	74.3	74.4	303

Table A-3. Tank 241-AY-101 Analytical Results: Arsenic.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	< 64.5	< 95.2	< 79.85	< 79.9	N/A	< 32.6

Table A-4. Tank 241-AY-101 Analytical Results: Barium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	269	246	257.5	258	4.7	77

Table A-5. Tank 241-AY-101 Analytical Results: Beryllium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	< 3.23	< 4.76	< 3.995	< 4.00	N/A	1.63

Table A-6. Tank 241-AY-101 Analytical Results: Bismuth.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	< 64.5	< 95.2	< 79.85	< 79.9	N/A	< 32.6

Table A-7. Tank 241-AY-101 Analytical Results: Boron.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	264	202	233[QC:e]	233	15.4	70

Table A-8. Tank 241-AY-101 Analytical Results: Cadmium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	23.6	22.4	23.0	23.0	2.7	9.4

Table A-9. Tank 241-AY-101 Analytical Results: Calcium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	3,520	3,060	3,290	3,290	7.5	983

Table A-10. Tank 241-AY-101 Analytical Results: Cerium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	299	323	311	311	4.0	93

Table A-11. Tank 241-AY-101 Analytical Results: Chromium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	110	111	110.5	105	1.6	339
S96T001202		155	111	110	110.5			
S96T001203		40	111	105	108			
S96T001356	15S	330	99.1	97.4	98.25			
S96T001357		155	101	100	100.5			
S96T001358		40	99.3	100	99.65			
S96T001519		25	107	106	106.5			
S96T001520		24	107	104	105.5			
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	1,850	1,700	1,775	1,780	4.4	532

Table A-12. Tank 241-AY-101 Analytical Results: Cobalt.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	< 12.9	< 19	< 15.95	< 16.0	N/A	< 6.53

Table A-13. Tank 241-AY-101 Analytical Results: Copper.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	38.3	39	38.65	38.7	0.9	15.8

Table A-14. Tank 241-AY-101 Analytical Results: Iron.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	< 20.1	< 20.1	< 20.1	< 12.0	N/A	< 38.7
S96T001202		155	< 20.1	< 20.1	< 20.1			
S96T001203		40	< 20.1	< 20.1	< 20.1			
S96T001356	15S	330	< 5.05	< 5.05	< 5.05			
S96T001357		155	< 5.05	< 5.05	< 5.05			
S96T001358		40	< 5.05	< 5.05	< 5.05			
S96T001519		25	< 10.1	< 10.1	< 10.1			
S96T001520		24	< 10.1	< 10.1	< 10.1			
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	15,900	15,400	15,650	15,700	1.6	4,693

Table A-15. Tank 241-AY-101 Analytical Results: Lanthanum.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	2,940	2,760	2,850	2,850	3.1	852

Table A-16. Tank 241-AY-101 Analytical Results: Lead.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	803	783	793	793	1.3	237

Table A-17. Tank 241-AY-101 Analytical Results: Lithium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	< 6.45	< 9.52	< 7.985	< 7.99	N/A	< 3.26

Table A-18. Tank 241-AY-101 Analytical Results: Magnesium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	1,320	1,260	1,290	1,290	2.3	386

Table A-19. Tank 241-AY-101 Analytical Results: Manganese.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	< 4.01	< 4.01	< 4.01	< 2.39	N/A	< 7.72
S96T001202		155	< 4.01	< 4.01	< 4.01			
S96T001203		40	< 4.01	< 4.01	< 4.01			
S96T001356	15S	330	< 1.01	< 1.01	< 1.01			
S96T001357		155	< 1.01	< 1.01	< 1.01			
S96T001358		40	< 1.01	< 1.01	< 1.01			
S96T001519		25	< 2.01	< 2.01	< 2.01			
S96T001520		24	< 2.01	< 2.01	< 2.01			
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	2,660	2,500	2,580	2,580	3.2	771

Table A-20. Tank 241-AY-101 Analytical Results: Molybdenum.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	< 32.3	< 47.6	< 39.95	< 40.0	N/A	< 16.3

Table A-21. Tank 241-AY-101 Analytical Results: Neodymium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	1,330	1,270	1,300	1,300	2.4	389

Table A-22. Tank 241-AY-101 Analytical Results: Nickel.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	60.6	63.5	62.05	59.0	2.6	191
S96T001202		155	65.2	63.8	64.5			
S96T001203		40	62.2	62.4	62.3			
S96T001356	15S	330	54.1	51.9	53			
S96T001357		155	55.9	55.4	55.65			
S96T001358		40	53.5	53.2	53.35			
S96T001519		25	62.4	59.8	61.1			
S96T001520		24	60.5	59.3	59.9			
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	315	275	295	295	7.3	88

Table A-23. Tank 241-AY-101 Analytical Results: Phosphorus.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	5,360	5,190	5,275	5,280	1.6	1,578

Table A-24. Tank 241-AY-101 Analytical Results: Potassium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	345	< 476	410.5	411	13.8	123

Table A-25. Tank 241-AY-101 Analytical Results: Samarium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	< 64.5	< 95.2	< 79.85	< 79.9	N/A	< 32.6

Table A-26. Tank 241-AY-101 Analytical Results: Selenium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	< 64.5	< 95.2	< 79.85	< 79.9	N/A	< 32.6

Table A-27. Tank 241-AY-101 Analytical Results: Silicon.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	< 20.1	< 20.1	< 20.1	< 12.0	N/A	< 38.7
S96T001202		155	< 20.1	< 20.1	< 20.1			
S96T001203		40	< 20.1	< 20.1	< 20.1			
S96T001356	15S	330	< 5.05	< 5.05	< 5.05			
S96T001357		155	< 5.05	< 5.05	< 5.05			
S96T001358		40	< 5.05	< 5.05	< 5.05			
S96T001519		25	< 10.1	< 10.1	< 10.1			
S96T001520		24	< 10.1	< 10.1	< 10.1			
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	1,340	1,080	1,210[QC:b,e]	1,210	9.7	362

Table A-28. Tank 241-AY-101 Analytical Results: Silver.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	731	566	648.5[QC:e]	649	14.6	194

Table A-29. Tank 241-AY-101 Analytical Results: Sodium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	54,200	52,900	53,550	51,900	1.1	1.68E+05
S96T001202		155	56,000	53,800	54,900			
S96T001203		40	53,000	51,400	52,200			
S96T001356	15S	330	50,900	50,200	50,550			
S96T001357		155	50,600	50,300	50,450			
S96T001358		40	50,900	51,200	51,050			
S96T001519		25	52,900	50,900	51,900			
S96T001520		24	51,600	49,400	50,500			
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	83,100	76,000	79,550	79,600	4.3	23,793

Table A-30. Tank 241-AY-101 Analytical Results: Strontium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	137	127	132	132	3.9	53.9

Table A-31. Tank 241-AY-101 Analytical Results: Sulfur.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	1,210	1,170	1,190	1,190	1.7	486

Table A-32. Tank 241-AY-101 Analytical Results: Thallium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	< 129	< 190	< 159.5	< 160	N/A	< 65.3

Table A-33. Tank 241-AY-101 Analytical Results: Titanium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	17.5	16.2	16.85	16.9	4.0	6.90

Table A-34. Tank 241-AY-101 Analytical Results: Uranium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	μg/mL	μg/mL	μg/mL	μg/mL	%	kg
S96T001201	15K	330	270	225	247.5	304	3.3	982
S96T001202		155	287	259	273[QC:e]			
S96T001203		40	248	365	306.5[QC:e]			
S96T001356	15S	330	307	322	314.5			
S96T001357		155	321	334	327.5			
S96T001358		40	311	328	319.5			
S96T001519		25	344	308	326			
S96T001520		24	336	298	317			
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	< 323	< 476	< 399.5	< 400	N/A	< 147

Table A-35. Tank 241-AY-101 Analytical Results: Vanadium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	μg/g	μg/g	μg/g	μg/g	%	kg
S96T003467	15K	33	< 32.3	< 47.6	< 39.95	< 40.0	N/A	< 16.3

Table A-36. Tank 241-AY-101 Analytical Results: Zinc.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	88.5	80.7	84.6	84.6	4.4	34.5

Table A-37. Tank 241-AY-101 Analytical Results: Zirconium.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Solids: acid digest		in.	µg/g	µg/g	µg/g	µg/g	%	kg
S96T003467	15K	33	< 6.45	< 9.52	< 7.985	< 7.99	N/A	< 3.26

Table A-38. Tank 241-AY-101 Analytical Results: Ammonia.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	19.9	19.7	19.8	25.2	9.4	81.4
S96T001202		155	32.5	28.2	30.35			
S96T001203		40	17	14.6	15.8			
S96T001356	15S	330	28.2	32.2	30.2			
S96T001357		155	19	N/A	19			
S96T001358		40	34.5	36.2	35.35			
S96T001519		25	26.1	24.4	25.25			
S96T001520		24	24.8	26	25.4[QC:c]			

Table A-39. Tank 241-AY-101 Analytical Results: Chloride.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	640	660	650	636	4.2	2,050
S96T001202		155	678	635	656.5			
S96T001203		40	568.9	522	545.45			
S96T001356	15S	330	481.8	538	509.9			
S96T001357		155	695.9	702	698.95			
S96T001358		40	724.8	760	742.4			
S96T001519		25	655.7	631	643.35			
S96T001520		24	649.8	628	638.9			

Table A-40. Tank 241-AY-101 Analytical Results: Cyanide.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Centrifuged Liquid		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001317	15K	33	20.7	26.7	23.7[QC:e]	23.7	12.7	N/A

Table A-41. Tank 241-AY-101 Analytical Results: Fluoride.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	143.3	155	149.15	174	4.9	562
S96T001202		155	158.1	151	154.55			
S96T001203		40	157.6	174	165.8			
S96T001356	15S	330	205.2	151	178.1[QC:e]			
S96T001357		155	192	197	194.5			
S96T001358		40	222	216	219			
S96T001519		25	164.2	139	151.6			
S96T001520		24	187.1	173	180.05			

Table A-42. Tank 241-AY-101 Analytical Results: Hydroxide.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	< 125	N/A	< 125	< 125	N/A	< 404
S96T001202		155	< 125	N/A	< 125			
S96T001203		40	< 125	N/A	< 125			
S96T001356	15S	330	< 125	N/A	< 125			
S96T001357		155	< 125	N/A	< 125			
S96T001358		40	< 125	N/A	< 125			
S96T002162		25	< 125	N/A	< 125			
S96T002163		24	< 125	N/A	< 125			

Table A-43. Tank 241-AY-101 Analytical Results: Nitrate.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	25,130	24,900	25,015	26,000	2.2	84,000
S96T001202		155	25,820	25,800	25,810			
S96T001203		40	27,460	27,500	27,480			
S96T001356	15S	330	27,420	27,400	27,410			
S96T001357		155	23,440	23,900	23,670			
S96T001358		40	27,770	28,000	27,885			
S96T001519		25	24,290	23,900	24,095			
S96T001520		24	26,370	26,100	26,235			

Table A-44. Tank 241-AY-101 Analytical Results: Nitrite.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	33,390	34,500	33,945	35,300	2.6	1.14E+05
S96T001202		155	34,170	34,500	34,335			
S96T001203		40	37,990	37,800	37,895			
S96T001356	15S	330	36,780	36,400	36,590			
S96T001357		155	31,610	31,600	31,605[QC:d]			
S96T001358		40	38,680	39,400	39,040			
S96T001519		25	32,380	33,200	32,790			
S96T001520		24	37,240	35,900	36,570			

Table A-45. Tank 241-AY-101 Analytical Results: Phosphate.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	828	875	851.5	1,150	22.5	3,710
S96T001202		155	1,114	1,010	1,062			
S96T001203		40	< 492.4	< 492	< 492.2			
S96T001356	15S	330	< 492.4	< 492	< 492.2			
S96T001357		155	2,186	2,170	2,178			
S96T001358		40	2,453	2,360	2,406.5			
S96T001519		25	826.3	814	820.15			
S96T001520		24	930.1	891	910.55			

Table A-46. Tank 241-AY-101 Analytical Results: Sulfate.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg/mL	µg/mL	µg/mL	µg/mL	%	kg
S96T001201	15K	330	5,679	5,610	5,644.5	5,870	3.3	19,000
S96T001202		155	5,837	5,780	5,808.5			
S96T001203		40	5,633	5,660	5,646.5			
S96T001356	15S	330	5,471	5,360	5,415.5			
S96T001357		155	5,998	6,150	6,074			
S96T001358		40	7,046	7,220	7,133			
S96T001519		25	5,546	5,390	5,468			
S96T001520		24	5,689	5,780	5,734.5			

Table A-47. Tank 241-AY-101 Analytical Results: Total Alpha Activity.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µCi/mL	µCi/mL	µCi/mL	µCi/mL	%	Ci
S96T001263	15K	330	0.0372	0.0358	0.0365	0.0441	4.1	142
S96T001264		155	0.0427	0.0429	0.0428			
S96T001265		40	0.04	0.0454	0.0427			
S96T001359	15S	330	0.0385	0.0404	0.03945			
S96T001360		155	0.0371	0.0488	0.04295[QC:e]			
S96T001361		40	0.0471	0.0474	0.04725[QC:b]			
S96T001521		25	0.0472	0.0512	0.0492			
S96T001522		24	0.0508	0.0533	0.05205			
Centrifuged Liquids		in.	µCi/mL	µCi/mL	µCi/mL	µCi/mL	%	Ci
S96T001318	15K	33	0.197	0.201	0.199	0.168[1]	18.3	1,270
S96T001317		25	0.138	0.137	0.1375			
Centrifuged Solids: fusion digest		in.	µCi/g	µCi/g	µCi/g	µCi/g	%	
S96T001313	15K	33	4.48	3.76	4.12	4.12[1]	8.7	
Centrifuged Solids: acid digest		in.	µCi/g	µCi/g	µCi/g	µCi/g	%	
S96T003467	15K	33	4.84	4.47	4.655	4.66	4.0	

Note:

[1]The overall sludge mean of 3.12 µCi/g was obtained by taking the acid digested centrifuged solid mean of 4.66 µCi/g (because it was larger than the fusion digested value), multiplying it by the weighting factor of 0.6565, and adding it to the centrifuged liquid value after weighting by the 0.3435 factor and dividing by the centrifuged liquid density of 1.03 g/mL.

Table A-48. Tank 241-AY-101 Analytical Results: Americium-241.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µCi/mL	µCi/mL	µCi/mL	µCi/mL	%	Ci
S96T001263	15K	330	0.00372	0.00394	0.00383	0.00491	19.9	15.9
S96T001264		155	0.0033	0.00356	0.00343			
S96T001265		40	0.00355	0.00338	0.003465			
S96T001359	15S	330	0.00329	0.00331	0.0033			
S96T001360		155	0.00313	0.00309	0.00311			
S96T001361		40	0.00335	0.00348	0.003415[QC:a]			
S96T001521		25	0.0102	0.00929	0.009745			
S96T001522		24	0.00991	0.00803	0.00897			

Table A-49. Tank 241-AY-101 Analytical Results: Cesium-137.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µCi/mL	µCi/mL	µCi/mL	µCi/mL	%	Ci
S96T001263	15K	330	86.7	86.2	86.45	86.4	1.1	2.79E+05
S96T001264		155	82	79.7	80.85			
S96T001265		40	86.9	87.2	87.05			
S96T001359	15S	330	91.5	87.9	89.7			
S96T001360		155	85.4	85.7	85.55			
S96T001361		40	88.2	86	87.1			
S96T001521		25	85.5	86.5	86			
S96T001522		24	86.7	90	88.35			
Centrifuged Solids: acid digest		in.	µCi/g	µCi/g	µCi/g	µCi/g	%	Ci
S96T003467	15K	33	91.61	79.5	85.555	85.6	7.6	34,200

Table A-50. Tank 241-AY-101 Analytical Results: Cobalt-60.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	μCi/mL	μCi/mL	μCi/mL	μCi/mL	%	Ci
S96T001263	15K	330	0.0238	0.0253	0.02455	0.0263	1.8	84.9
S96T001264		155	0.0281	0.0231	0.0256			
S96T001265		40	0.027	0.0267	0.02685			
S96T001359	15S	330	0.0278	0.0283	0.02805			
S96T001360		155	0.0248	0.0277	0.02625			
S96T001361		40	0.0263	0.0263	0.0263			
S96T001521		25	0.0241	0.0276	0.02585			
S96T001522		24	0.0241	0.0298	0.02695[QC:e]			
Centrifuged Solids: acid digest		in.	μCi/g	μCi/g	μCi/g	μCi/g	%	Ci
S96T003467	15K	33	< 1.886	< 2.57	< 2.228[QC:e]	< 2.23	N/A	< 601

Table A-51. Tank 241-AY-101 Analytical Results: Plutonium-239/240.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µCi/mL	µCi/mL	µCi/mL	µCi/mL	%	Ci
S96T001263	15K	330	0.0267	0.0269	0.0268	0.0364	14.4	118
S96T001264		155	0.0287	0.0287	0.0287			
S96T001265		40	0.0273	0.0268	0.02705			
S96T001359	15S	330	0.0264	0.0327	0.02955[QC:e]			
S96T001360		155	0.0271	0.0308	0.02895			
S96T001361		40	0.0297	0.0295	0.0296			
S96T001521		25	0.0629	0.0593	0.0611			
S96T001522		24	0.0595	0.0598	0.05965			

Table A-52. Tank 241-AY-101 Analytical Results: Strontium-89/90.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µCi/mL	µCi/mL	µCi/mL	µCi/mL	%	Ci
S96T001263	15K	330	1.82	1.8	1.81	1.89	3.8	6,100
S96T001264		155	1.85	1.86	1.855			
S96T001265		40	1.81	1.83	1.82			
S96T001359	15S	330	1.96	1.87	1.915			
S96T001360		155	1.91	1.86	1.885			
S96T001361		40	1.96	1.91	1.935			
S96T001521		25	2.34	2.3	2.32			
S96T001522		24	1.53	1.65	1.59			
Centrifuged Solids: acid digest		in.	µCi/g	µCi/g	µCi/g	µCi/g	%	Ci
S96T003467	15K	33	4,690	4,520	4,605	4,610	1.8	1.24E+06

Table A-53. Tank 241-AY-101 Analytical Results: Total Inorganic Carbon.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg C/mL	µg C/mL	µg C/mL	µg C/mL	%	kg C
S96T001201	15K	330	7,670	7,620	7,645	6,860	2.4	22,200
S96T001202		155	7,770	7,400	7,585			
S96T001203		40	6,580	6,500	6,540			
S96T001356	15S	330	6,350	6,940	6,645			
S96T001357		155	6,560	6,600	6,580			
S96T001358		40	6,670	6,670	6,670			
S96T001519		25	6,690	6,360	6,525[QC:d]			
S96T001520		24	6,770	6,540	6,655			

Table A-54. Tank 241-AY-101 Analytical Results: Total Organic Carbon.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)	Projected Inventory
Supernatant		in.	µg C/mL	µg C/mL	µg C/mL	µg C/mL	%	kg C
S96T001201	15K	330	7,980	7,270	7,625	6,850	11.7	22,100
S96T001202		155	8,220	7,850	8,035			
S96T001203		40	9,160	8,450	8,805			
S96T001356	15S	330	8,210	7,530	7,870			
S96T001357		155	8,540	7,650	8,095[QC:c]			
S96T001358		40	8,400	7,520	7,960			
S96T001521		25	3,030	3,150	3,090			
S96T001520		24	3,290	3,360	3,325			
Centrifuged Liquids		in.	µg C/mL	µg C/mL	µg C/mL	µg C/mL	%	kg C
S96T001317	15K	33	3,890	3,570	3,730	3,730	4.3	N/A

Table A-55. Tank 241-AY-101 Analytical Results: Weight Percent Water by TGA.

Sample Number	Sample Location	Sample Elevation	Result		Duplicate		Sample Mean	Overall Mean	RSD Mean	Projected Inventory
Supernatant		in.	% H_2O	Temp. Range (°C)	% H_2O	Temp. Range (°C)	% H_2O	% H_2O	%	kg
S96T001201[1]	15K	330	84.28	35 - 105	84.37	35 - 100	84.33	84.4	0.1	2.94E+06
S96T001202[1]		155	84.21	35 - 100	84.22	35 - 100	84.22			
S96T001203[1]		40	84.17	35 - 100	84.08	35 - 100	84.12			
S96T001356[1]	15S	330	84.40	35 - 100	84.15	35 - 105	84.28			
S96T001357[2]		155	84.93	24 - 167	84.83	22 - 164	84.88			
S96T001358[2]		40	83.87	33 - 162	84.84	22 - 160	84.36			
S96T001519[1]		25	83.91	35 - 105	83.78	35 - 105	83.84			
S96T001520[1]		24	84.30	35 - 110	85.27	35 - 140	84.78			
Centrifuged Liquids		in.	% H_2O	Temp. Range (°C)	% H_2O	Temp. Range (°C)	% H_2O	% H_2O	%	kg
S96T001318[1]	15K	33	84.70	35 - 140	84.97	35 - 135	84.84	82.9[3]	2.3	2.28E+05
S96T001317[1]		25	81.43	35 - 85	80.65	35 - 80	81.04			
Centrifuged Solids		in.	% H_2O	Temp. Range (°C)	% H_2O	Temp. Range (°C)	% H_2O	% H_2O	%	
S96T003465[1]	15K	33	35.65	35 - 85	37.77	35 - 120	36.71	41.6[3]	9.6	
S96T001275[1]		25	45.21	35 - 140	47.73	35 - 140	46.47			

Notes:

[1]Analysis performed on Mettler™ equipment.

[2]Analysis performed on Perkin-Elmer™ equipment.

[3]The overall sludge mean of 55.8 percent was obtained by combining the mean from the two waste phases using the weighting factor of 0.6565 for the centrifuged solids and 0.3435 for the centrifuged liquids.

Table A-56. Tank 241-AY-101 Analytical Results: Energetics by DSC. (2 sheets)

Sample Number	Sample Location	Sample Elevation		Sample Weight	Transition 1		Transition 2		Transition 3	
Supernatant		in.	Run	mg	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)
S96T001201[1]	15K	330	1	11.11	103.3	1,789	214.7	7.6	---	---
			2	12.96	103.3	1,570	214.8	5.9	---	---
S96T001202[1]		155	1	9.739	103.3	2,000	214.8	7.3	---	---
			2	14.43	103.3	1,430	214.8	7.8	---	---
S96T001203[1]		40	1	11.57	103.3	1,707	214.8	7.8	---	---
			2	8.642	105.3	1,897	214.8	8.7	---	---
S96T001356[1]	15S	330	1	11.59	105.3	1,498	214.8	5.7	---	---
			2	11.92	103.3	1,730	214.8	5.6	---	---
S96T001357[2]		155	1	12.67	113.4	1,971	---	---	---	---
			2	11.82	112.4	1,973	---	---	---	---
S96T001358[2]		40	1	24.84	117.7	1,995	---	---	---	---
			2	21.95	177.3	2,008	---	---	---	---
S96T001519[1]		25	1	14.25	99.3	1,453	214.6	6.1	396.6	-7.6
			2	13.44	103.3	1,238	214.6	5.8	408.7	-7.6

Table A-56. Tank 241-AY-101 Analytical Results: Energetics by DSC. (2 sheets)

Sample Number	Sample Location	Sample Elevation		Sample Weight	Transition 1		Transition 2		Transition 3	
Supernatant		in.	Run	mg	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)
S96T001520[1]		24	1	11.99	101.3	1,675	214.7	6.8	---	---
			2	26.46	103.3	920.7	214.6	6.1	404.8	-12.2[QC:e]
			3	12.71	101.3	1,561	214.7	5.3	---	---
Centrifuged Liquids		in.	Run	mg	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)
S96T001318[1]	15K	33	1	10.73	103.3	1,917	---	---	---	---
			2	10.37	101.3	1,921	---	---	---	---
S96T001317[1]		25	1	12.43	105.3	1,050	367.0	-144.3	---	---
			2	11.24	101.3	1,383	426.9	-121.8	---	---
Centrifuged Solids		in.	Run	mg	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)	Peak Temp. (°C)	ΔH (J/g)
S96T003465[1]	15K	33	1	19.78	109.3	790.0	267.7	237.4	---	---
			2	28.40	107.3	613.8	333.2	262.3	---	---
S96T001275[1]		25	1	40.13	101.3	766.1	267.2	174.8	350.9	-105.1
			2	31.23	103.3	842.9	269.6	151.0	340.9	-104.3

Notes:

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

[1]Analysis performed on Mettler™ equipment.
[2]Analysis performed on Perkin-Elmer™ equipment.

Table A-57. Tank 241-AY-101 Analytical Results: Bulk Density/Specific Gravity.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)
Supernatant		in.	g/mL	g/mL	g/mL	g/mL	%
S96T001201	15K	330	1.084	1.081	1.0825	1.08	0.2
S96T001202		155	1.076	1.075	1.0755		
S96T001203		40	1.077	1.070	1.0735		
S96T001356	15S	330	1.080	1.076	1.078		
S96T001357		155	1.079	1.073	1.076		
S96T001358		40	1.059	1.088	1.0735		
S96T001519		25	1.099	1.093	1.096		
S96T001520		24	1.081	1.073	1.077		
Centrifuged Liquids		in.	g/mL	g/mL	g/mL	g/mL	%
S96T001318	15K	33	1.000	N/A	1.000	1.03	3.4
S96T001317		25	1.050	N/A	1.050		
Centrifuged Solids		in.	g/mL	g/mL	g/mL	g/mL	%
S96T001275	15K	25	1.450	N/A	1.450	1.45	N/A
Sludge		in.	g/mL	g/mL	g/mL	g/mL	%
S96T001272	15K	33	1.280	N/A	1.280	1.30	1.6
S96T001271		25	1.310	N/A	1.310		

Table A-58. Tank 241-AY-101 Analytical Results: pH.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)
Supernatant		in.	unitless	unitless	unitless	unitless	%
S96T001201	15K	330	9.788	9.759	9.7735	9.77	0.1
S96T001202		155	9.762	9.759	9.7605		
S96T001203		40	9.765	9.759	9.762		
S96T001356	15S	330	9.761	9.753	9.757		
S96T001357		155	9.763	9.758	9.7605		
S96T001358		40	9.754	9.752	9.753		
S96T001519		25	9.81	9.77	9.79		
S96T001520		24	9.8	9.88	9.84		

Table A-59. Tank 241-AY-101 Analytical Results: Volume Percent Solids.

Sample Number	Riser Number	Sample Elevation	Result	Duplicate	Sample Mean	Overall Mean	RSD (Mean)
Sludge		in.	%	%	%	%	%
S96T001272	15K	33	66.20	N/A	66.20	65.7	1.2
S96T001271		25	65.10	N/A	65.10		

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APPENDIX B

ANALYTICAL RESULTS FROM HISTORICAL SAMPLING EVENTS FOR DOUBLE-SHELL TANK 241-AY-101

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B.0 ANALYTICAL RESULTS FROM HISTORICAL SAMPLING EVENTS FOR DOUBLE-SHELL TANK 241-AY-101

B.1 INTRODUCTION

Appendix B presents analytical results for the 1994 and 1988 historical supernatant sampling events in Tables B-1 and B-2, and the 1985 historical supernatant/sludge sampling event in Table B-3 for tank 241-AY-101. In the first half of Table B-3, column two gives the supernatant results and column four gives the centrifuged liquid results from the bottom sludge sample. The second half of the table gives the centrifuged solids results from the bottom sludge sample. A description of these events was provided in Section 3.4. As explained in that section and in Section 5.2, because of the active process history of the tank, these results may not be fully representative of the current tank contents. Thus, these data are presented primarily for informational purposes. Regardless, comparisons were made in Section 5.2 between the 1996 sampling results and the 1994 supernatant sampling and 1985 sludge sampling.

Table B-1. Analytical Results of 1994 Supernatant Sampling Event.[1]

Analyte	Analytical Result
METALS	**μg/mL**
Aluminum	< 1.00
Iron	< 1.00
Sodium	48,300
AMMONIA/ANIONS	**μg/mL**
Ammonia	73.2
Chloride	5.72
Fluoride	1.96
Nitrate	207
Nitrite	373
Phosphate	17.1
Sulfate	59.4
RADIONUCLIDES	**μCi/mL**
^{241}Am	< 0.0152
^{137}Cs	101
^{238}Pu	0.00465
$^{239/240}Pu$	0.0198
^{90}Sr	2.42

Table B-1. Analytical Results of 1994 Supernatant Sampling Event.[1]

Analyte	Analytical Result
CARBON	**μg C/mL**
TIC	6,990
TOC	3,380
PHYSICAL PROPERTIES	
pH	9.49
Specific gravity	1.10
Volume percent solids	< 2.00
Weight percent water	85.4
DSC: Sample 101-AY-4 DSC: Sample 101-AY-5	Exotherm: -254.0 J/g at 309.7 °C Exotherm: -95.2 J/g at 283.6 °C

Note:
[1]Vogel (1994)

Table B-2: Analytical Results of 1988 Supernatant Sampling Event.[1]

Physical Data				
Sample Weight	15.2 g			
Sample Volume	15.4 mL			
Sample color (supernatant)	Amber			
Sample color (solids)	Dark Brown			
Specific gravity (supernatant)	1.09			
Percent solids	10			
pH	12.1			
Chemical Analysis of Supernatant				
Analyte	**M**	**Molar %**	**g/L**	**Wt%**
Al(OH)	0.049	1.1	4.64	3.3
Cl	0.012	0.3	0.44	0.3
CO_3	0.306	7	18.36	27
F	0.04	0.9	0.76	0.5
OH	0.474	10.9	8.06	5.7
K	0.008	0.2	0.31	0.2
NH_3	0.164	3.8	2.79	2

Table B-2: Analytical Results of 1988 Supernatant Sampling Event.[1]

Chemical Analysis of Supernatant				
NO_2	0.295	6.8	13.57	9.5
NO_3	0.619	14.2	38.38	27
Na	1.95	44.8	44.83	31.5
PO_4	0.008	0.2	0.77	0.5
SO_4	0.052	1.2	4.83	3.4
TOC	0.372	8.6	4.47	3.1
Composition of Acid Washes (Centrifuged Solids)				
Analyte	**M**	**Molar %**	**g/L**	**Wt%**
Al	0.072	7.7	1.95	7.7
B	0.0021	0.2	0.02	0.1
Ba	0.0013	0.1	0.14	0.7
Ca	0.11	1.2	0.44	1.8
Ce	0.0012	0.1	0.17	0.7
Cr	0.018	1.9	0.94	3.6
Fe	0.12	12.8	6.7	26.8
La	0.015	1.6	2.08	8.3
Mn	0.012	2.2	1.16	4.6
Mg	0.03	3.2	0.73	2.9
Na	0.1	10.7	2.29	9
Nd	0.005	0.5	0.72	3.1
Ni	0.0023	0.2	0.14	0.5
PO_4	0.011	1.2	1.06	4.2
Pd	8.0E-04	0.1	0.09	0.3
Sr	8.0E-4	0.1	0.07	0.3
Zr	0.0027	0.3	0.24	1
TOC	0.52	55.7	6.26	24.6

Particle Size Analysis		
Analyte	**Lab Value**	**Lab Unit**
Mean Size	1.19	μm
Standard Deviation	3.64	μm

Note:
[1]Edrington (1988). The reliability of these data is questionable due to the lack of proper QC documentation.

Table B-3: Analytical Results of 1985 Supernatant and Sludge Sampling Event.[1]

Supernatant Analysis Results				
	Sample #R3641		Sample #R3642 Centrate	
Analyte	Lab Value	Lab Unit	Lab Value	Lab Unit
Al	0.0662	M	< 1.63E-04	M
Ba	5.08E-05	M	< 3.68E-05	M
Ca	0.00882	M	0.00443	M
Cd	8.99E-05	M	N/A	M
Cl	0.0146	M	0.0121	M
Cr	7.23E-04	M	6.54E-04	M
Cu	< 1.59E-04	M	< 4.77E-05	M
CO_3	0.229	M	0.329	M
F	< 0.0254	M	0.0323	M
Fe	3.44E-04	M	< 1.63E-04	M
K	< 0.0101	M	0.00811	M
La	5.69E-04	M	3.52E-04	M
Mg	0.00103	M	1.14E-04	M
Mn	< 0.0057	M	< 0.00368	M
Mo	< 0.00263	M	< 6.21E-04	M
Na	2.75	M	2.96	M
Ni	0.00103	M	0.00119	M
NO_2	0.245	M	0.199	M
NO_3	0.927	M	1.03	M
OH	0.301	M	0.881	M
Pb	< 3.36E-04	M	3.95E-04	M
PO_4	0.00889	M	0.00903	M
Si	< 0.00165	M	< 8.00E-04	M
SO_4	0.0769	M	0.0791	M
Zn	2.68E-04	M	< 7.72E-05	M
Zr	< 5.09E-04	M	< 5.09E-04	M
TOC	6.78	g/L	6.48	g/L
Settled Solids	0	Wt%	10	Wt%
Centrifuged Solids	< 0.1	Wt%	6.4	Wt%
Specific Gravity	1.11	g/mL	1.12	g/mL

Table B-3: Analytical Results of 1985 Supernatant and Sludge Sampling Event.[1]

Solids Analysis Results Sample #R3642		
Analyte	**Lab Value**	**Lab Unit**
Al	3.38	Wt%
Ba	0.37	Wt%
Ca	0.81	Wt%
Cd	< 0.016	Wt%
Cr	1.93	Wt%
Cu	0.026	Wt%
Fe	11.7	Wt%
La	1.87	Wt%
Mg	2.25	Wt%
Mn	2.91	Wt%
Mo	< 0.40	Wt%
Ni	0.16	Wt%
Pb	0.48	Wt%
Si	21.8	Wt%
U	2.26	Wt%
Zn	0.073	Wt%
Zr	0.62	Wt%
TOC	2.48	Wt%
Radiological Analysis		
Analyte	**Lab Value**	**Lab Unit**
^{137}Cs	520	μCi/g
$^{89+90}Sr$	11,000	μCi/g
Pu	6.34	μCi/g
Am	28	μCi/g
Physical Data		
Analyte	**Lab Value**	**Lab Value**
Settled Solids	10	Wt%
Centrifuged Solids	6.4	Wt%

Note:

[1]Bratzel (1985). The reliability of these data is questionable due to the lack of proper QC documentation.

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