ENGINEERING CHANGE NOTICE

Page 1 of 2

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Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
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13a. Description of Change

13b. Design Baseline Document? [] Yes [X] No

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14a. Justification (mark one)

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14b. Justification Details

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

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ENGINEERING CHANGE NOTICE

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16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
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19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

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

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

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21. Approvals

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Design Authority			Design Agent		
Cog. Eng. T.A. Hu	Albert Hu	5-21-97	PE		
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Safety			Design		
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N.W. Kirch	N.W. Kirch	5/22/97			

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Double-Shell Tank 241-AP-105

T. A. Hu
Lockheed Martin Hanford Corp., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-AP-105. This report supports the requirements of the Tri-Party Agreement Milestone M-44-05.

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Tank Characterization Report for Double-Shell Tank 241-AP-105

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Project Hanford Management Contractor for the
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LIST OF TERMS

AA	atomic absorption
AEA	alpha energy analysis
ANOVA	analysis of variance
Btu/hr	British thermal units per hour
CERCLA	*Comprehensive Environmental Response Compensation and Liability Act of 1980*
Ci	curies
Ci/g	curies per gram
Ci/L	curies per liter
cm	centimeters
CVAA	cold vapor atomic absorption
df	degrees of freedom
DN	dilute noncomplexed waste
DQO	data quality objectives
DSC	differential scanning calorimetry
DSSF	double-shell slurry feed
EDTA	ethylenediaminetetraacetic acid
ESP	Environmental Simulation Program
FIC	Food Instrument Corporation
ft	feet
g	gram
GC	gas chromatography
GC/MS	gas chromatograph/mass spectrometer
GEA	gamma energy analysis
g/L	grams per liter
g/mL	grams per milliliter
HEDTA	N-(2-hydroxyethyl)ethylenediaminetriacetic acid
HDW	Hanford defined waste
IC	ion chromatography
ICP	inductively coupled plasma
in.	inch
J/g	joules per gram
kg	kilograms
kgal	kilogallons
kg/L	kilograms per liter
kL	kiloliters
LEL	lower explosive limit
LFL	lower flammability limit
LL	lower limit
LS	liquid scintillation
m	meters
M	moles per liter

LIST OF TERMS (Continued)

mg/L	milligrams per liter
mL	milliliters
mm	millimeters
NA	not analyzed
N/A	not available
n/a	not applicable
nCi/g	nanocuries per gram
NR	not reported
PCN	partially concentrated non-complexed waste
pH	hydrogen potential
PHMC	Project Hanford Management Contractor
PNL	Pacific Northwest Laboratory
ppm	parts per million
QC	quality control
R	ratio between feed flow rate and slurry flow rate
REML	restricted maximum likelihood estimation
RPD	relative percent difference
SACS	Surveillance Analysis Computer System
SpG	specific gravity
SVOA	semi-volatile organic analysis
TC	total carbon
TCR	tank characterization report
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TID	tentatively identified compounds
TOC	total organic carbon
TRU	transuranic
TSAP	Tank 241-AP-105 Grab Sampling and Analysis Plan
TWRS	Tank Waste Remediation System
UL	upper limit
VOA	volatile organic analysis
vol%	volume percent
W	watts
WHC	Westinghouse Hanford Company
W/Ci	watts per curie
wt%	weight percent
°C	degrees Celsius
°F	degrees Fahrenheit
μCi/g	microcuries per gram
μCi/L	microcuries per liter
μCi/mL	microcuries per milliliter

LIST OF TERMS (Continued)

μeq/g	microequivalents per gram
μg	micrograms
μg C/mL	micrograms carbon per milliliter
μg/g	micrograms per gram
μg/L	micrograms per liter
μg/m	micrograms per meter
μg/mL	micrograms per milliliter

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1.0 INTRODUCTION

One of the major functions of the Tank Waste Remediation System (TWRS) is to characterize wastes in support of waste management and disposal activities at the Hanford Site. Analytical data from sampling and analysis, along with other available information about a tank, are compiled and maintained in a tank characterization report (TCR). This report and its appendixes serve as the TCR for double-shell tank 241-AP-105. The objectives of this report are: 1) to use characterization data in response to technical issues associated with 241-AP-105 waste; and 2) to provide a standard characterization of this waste in terms of a best-basis inventory estimate. The response to technical issues is summarized in Section 2.0, and the best-basis inventory estimate is presented in Section 3.0. Recommendations regarding safety status and additional sampling needs are provided in Section 4.0. Supporting data and information are contained in the appendixes. This report also supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1996) milestone M-44-05.

1.1 SCOPE

Characterization information presented in this report originated from sample analyses and known historical sources. Although the data quality objectives (DQOs) required that technical issues be resolved using results from recent sampling events, other information could be used to support (or challenge) conclusions derived from these results. Historical information for tank 241-AP-105, provided in Appendix A, includes surveillance information, records pertaining to waste transfers and tank operations, and expected tank contents derived from a process knowledge model.

Based on waste transfer records ending on January 31, 1997, two sampling events best characterize current waste contained in tank 241-AP-105. The March 1993 grab sampling provides the most appropriate sample results of organic, inorganic and radionuclide analyses for the liquid portion of the bottom 583 kL (154 kgal) of sludge/solid waste, and an August/September 1996 grab sampling provides analytical results for the top 3,660 kL (967 kgal) of supernatant waste in the tank. The March 1993 sampling event was conducted to evaluate whether the concentrated waste in tank 241-AP-105 can be disposed of via grout with respect to regulator and plant operating constraints (Welsh 1994). Based on the September 1995 in-tank video, an estimate of 337 kL (89 kgal) of waste solids in the tank bottom was calculated. Composition of the waste solids was estimated (see Appendix D) using the Environmental Simulation program (OLI Systems, Inc. 1996). The August/September 1996 grab sampling event (Schreiber 1996) was conducted in support of Evaporator Campaign 97-1. The analytical results (Miller 1997) address issues of tank safety screening, evaporation operations, and associated waste compatibility. The recent sampling events listed in Table 1-1 are summarized in Appendix B.

Table 1-1. Summary of Recent Grab Sampling Events.

Sampling Events (Sample Dates)	Riser Location	Sample Depth	Phase	Recovery (%)
August/September 1996 grab sampling (Aug. 29 - Sept. 3, 1996)	Riser 1, at 330°	587 cm	Liquid	100
	Riser 1, at 90°	221 cm		
		688 cm		
		1,041 cm		
March 1993 grab sampling (Mar. 10 - Mar. 14, 1993)	Riser 1, at 90°	704 cm	Liquid/solid	100
		457 cm		
		338 cm		
		43 cm		
	Riser 1, at 210°	655 cm		
		561 cm		
		373 cm		
		165 cm		
	Riser 1, at 330°	724 cm		
		516 cm		
		292 cm		
		107 cm		

The statistical analysis and numerical manipulation of data used in issue resolution are reported in Appendix C. Appendix D contains the evaluation to establish the best basis for the inventory estimate for this evaluation. A bibliography that resulted from an in-depth literature search of all known information sources applicable to tank 241-AP-105 and its respective waste types is contained in Appendix E. The reports listed in Appendix E may be found in the Lockheed Martin Hanford Corporation Tank Characterization and Safety Resource Center.

1.2 TANK BACKGROUND

Tank 241-AP-105 is one of eight double-shell tanks located in the 200 East Area AP Tank Farm on the Hanford Site. These tanks have a capacities of 4,390 kL (1,160 kgal) and diameters of 22.9 m (75 ft), and were constructed with a primary carbon steel liner, a secondary carbon steel liner, and a reinforced concrete shell. Tank 241-AP-105 went into service in the third quarter of 1986 when it received 64 kL (17 kgal) of flush water. Between 1986 and the first quarter of 1989, several waste transfers occurred, mainly flush water and diluted non-complexed supernatant.

On February 5, 1989, the tank was essentially empty; on February 25, 1989, it received 1,082 kL (286 kgal) of double-shell slurry feed directly from the 242-A Evaporator. This transfer is believed to be the main source of solid material presently in the tank bottom. In the third quarter of 1989, 1,344 kL (355 kgal) of dilute non-complexed supernatant was received from tank 241-AP-106. After this transfer, and before the next waste transfer occurred on the third quarter of 1995, the tank waste volume was 3,149 kL (832 kgal). The volume dropped to 3,089 kL (816 kgal) because of evaporation.

The tank was grab sampled in March 1993. On August 29, 1995, 2,498 kL (660 kgal) of supernatant was transferred to tank 241-AP-101, leaving 591 kL (156 kgal) of waste (about 142 cm [56 in.] in depth) in the tank. An in-tank video was taken on September 27, 1995. Based on the exposed solids shown in the video and the condition of the transferred waste (White 1996), an estimate of waste solids was made. Tank waste solids were estimated to be 284 kL (75 kgal) with the balance being liquid (Appendix D). The liquid grab samples taken in 1993 from depths of 43 cm and 107 cm (17 in. and 42 in.) will be used to characterize the liquid portion of this waste. Analytical results are not available for the solid portion of the waste.

In August 1996, 3,660 kL (967 kgal) of dilute, non-complexed supernatant was added to tank 241-AP-105 from tank 241-AN-101. Three days after this transfer, a grab sampling event was conducted. These August/September grab samples will be used to characterize the top 3,660 kL (967 kgal) of supernatant.

A description of tank 241-AP-105 is summarized in Table 1-2. As of January 31, 1997, the tank contains an estimated 4,243 kL (1,121 kgal) of dilute, non-complexed waste (Hanlon 1997) and is actively ventilated. The tank is categorized as sound and is not on the Watch List (Public Law 101-510).

Table 1-2. Description of Tank 241-AP-105.[1]

TANK DESCRIPTION	
Type	Double-shell
Constructed	1983 - 1986
In service	1986
Diameter	22.9 m (75.0 ft)
Operating depth	10.7 m (35.2 ft)
Capacity	4,390 kL (1,160 kgal)
Bottom shape	Flat
Ventilation	Active
TANK STATUS	
Waste classification	Dilute non-complexed
Total waste volume (January 31, 1997)[2]	4,243 kL (1,121 kgal)
Supernatant volume[3]	3,906 kL (1,032 kgal)
Saltcake volume[3]	337 kL (89 kgal)
Sludge volume[3]	0 kL (0 kgal)
Waste surface level (January 31, 1997)	10.35 m (407.6 in.) to 10.36 m (407.7 in.)
Temperature (July 1989 to January 1997)	13 °C (55 °F) to 43.9 °C (111 °F)
Integrity	Sound
Watch List	None
SAMPLING DATE	
Grab samples	March 1993
Grab samples	August 29-September 3 1996
SERVICE STATUS	
In service	1986 - present

Notes:

[1]This is an active tank; any new waste transfer will change the data presented in this table.

[2]Waste volume is estimated from surface-level measurements.

[3]Waste volume is different from Hanlon (1997) report because it was estimated with the aid of the September 1995 in-tank video (See Appendix D).

2.0 RESPONSE TO TECHNICAL ISSUES

Several technical issues have been identified for tank 241-AP-105 and summarized in *Tank Waste Characterization Basis* (Brown et al. 1996). The technical issues are:

Safety screening:

- Does the waste pose or contribute to any recognized potential safety problems?

Vapor screening:

- Are there hazardous storage conditions or regulatory compliance issues associated with gases and vapors in the tank or does the headspace exceed 25 percent of the lower flammability limit (LFL), and does an organic solvent pool exist that may cause a fire or ignition of organic solvents in entrained waste solids?

Evaporator Operations:

- Are there safety, operational process control and environmental compliance problems with the waste in feed candidate tank 241-AP-105 that could inhibit the evaporation operation?

Waste compatibility:

- Are there safety and/or operational problems that may be encountered when transferring and commingling 241-AP-105 supernatant with waste being stored in another double-shell tank?

These issues can be evaluated through the DQO process (Banning 1996), which provides a systematic planning tool for determining the type, quantity, and quality of data needed to support a decision. The applicable data quality objectives for the above issues are: *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995); *242-A Evaporator/Liquid Effluent Retention Facility Data Quality Objectives* (Von Bargen 1995) and *Data Quality Objectives for the Tank Farms Waste Compatibility Program* (Fowler 1995). The evaporator and waste compatibility DQOs are primarily applicable to the top supernatant waste in support of Evaporator Campaign 97-1. The requirements of the safety screening DQO will be evaluated for the entire tank contents.

Tank 241-AP-105 Grab Sampling and Analysis Plan (TSAP) (Schreiber 1996) integrates all applicable DQOs and describes the types of sampling and analysis used to address the identified issues. Data from the recent analysis of 1996 grab samples (Miller 1997), tank headspace flammability measurements based on the TSAP (Schreiber 1996), analytical results from 1993 sampling event (Welsh 1994), and available historical information and modeling results, provide the basis to respond to these issues. This response is detailed in the following sections.

As mentioned above, the 1996 grab samples represent the top layer of supernatant waste in tank 241-AP-105 (3,660 kL [967 kgal]), and the 1993 sampling results can be used to characterize the liquid portion of the bottom 583 kL (154 kgal) of liquid/solid waste. Appendix B provides sample and analysis data for the tank; however, no analytical results are available to evaluate the solid waste in the tank bottom.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-AP-105 for potential safety problems are documented in *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995). These potential safety problems are exothermic conditions in the waste, flammable gases in the waste and/or tank headspace, and criticality conditions in the waste. Each of these conditions is addressed separately below and summarized in Table 2-1.

2.1.1 Exothermic Conditions (Energetics)

The first requirement outlined in the safety screening DQO (Dukelow et al. 1995) is to ensure that there are not enough exothermic constituents (organic) to cause a safety hazard. Because of this requirement, energetics in the tank 241-AP-105 waste were evaluated. The threshold limit for energetics is 480 J/g on a dry weight basis. No exothermic reactions were detected in any of the 1996 grab samples taken from the top 3,660 kL (967 kgal) of supernatant (see Appendix C, Table 1-1).

No energetic analyses were performed for the 1993 grab sampling events. However, because organic compounds in waste are the primary sources of exothermic reactions, the total organic carbon (TOC) data will be used to evaluate the exothermic potential of the liquid portion of the bottom 156 kgal (41 kgal) of waste. The highest TOC value (dry weight basis) observed in the 1993 grab samples was 5,185 μg/g, well below the TOC notification limit of 30,000 μg/g specified in the safety screening DQO (Dukelow et al. 1995). Assuming the organics are sodium acetate, the equivalent exotherm energy of 5,185 μg/g TOC is 138.3 J/g, well below the energetic threshold limit. In addition, the average moisture content in this bottom sludge layer is 57.2 weight percent (see Table B3-4). With this low TOC concentration and high moisture content, the potential for an exothermic reaction is unlikely for the liquid portion of the bottom 583 kL (154 kgal) of solid/liquid waste.

Table 2-1. Summary of Safety Screening Results for Tank 241-AP-105.

Issue	Sub-Issue	Result
Safety screening	Fuel content/ energetics	No exotherms were observed in any sample from the top supernatant layer. Exotherms were not analyzed for the 1993 grab samples. However, based on TOC measurements, exothermic energy for the liquid portion of the bottom 583 kL (154 kgal) of solid/liquid waste is estimated to be no more than 138 J/g, well below the threshold value of 480 J/g. No analytical results were available for the bottom solid waste.
	Criticality	All results were well below 1 g/L ^{240}Pu or 61.5 μCi/mL for total alpha. No analytical results were available for the bottom solid waste.
	Flammable gas	0 percent of LFL in tank headspace

2.1.2 Flammable Gas

Vapor phase measurements, taken in the tank headspace before the grab samples on August 29 and September 3, 1996, indicated that no flammable gas was detected (0 percent of the LFL). Data from these vapor phase measurements are presented in Appendix B.

2.1.3 Criticality

The safety threshold limit for criticality is 1 g ^{239}Pu per liter of waste. The plutonium ($^{239/240}Pu$) concentration of all analyzed 1996 grab samples, which represents the top 3,660 kL (967 kgal) of supernatant layer, was less than 3.26E-06 g/L. For the liquid portion of the bottom solid/liquid layer, the highest plutonium concentration from 1993 grab samples was 2.57E-06 g/L. These analytical results and the 95 percent confidence upper limit on the mean for these samples (see Appendix C) are well below the threshold limit for criticality.

The potential for criticality can also be assessed from the total alpha activity data. Assuming that all alpha activity is from ^{239}Pu, the criticality threshold limit (1 g ^{239}Pu per liter of waste) was converted to 61.5 μCi/mL using the specific activity of 0.0615 Ci/g of ^{239}Pu. Total alpha activities for the 1996 grab samples were analyzed and were all well below the criticality threshold limit of 61.5 μCi/mL.

2.2 VAPOR SCREENING

The issues related to vapor screening are flammability, toxicity and organic solvent pool. The vapor data required to address toxicity and flammability are documented in the *Data Quality Objective for Tank Hazardous Vapor Safety Screening* (Osborne and Buckley 1995). The vapor data required to support to organic solvent screening issue are documented in the *Recommendation 93-5 Implementation Plan* (DOE-RL 1996).

2.2.1 Flammable Gas

This is the same requirement as the safety screening flammability requirement. As noted previously, flammable gas was not detected in the tank headspace before the 1996 grab sampling.

2.2.2 Toxicity

The hazardous vapor safety screening DQO requires the analysis of ammonia, carbon dioxide, carbon monoxide, nitric oxide, nitrous oxide, and nitrogen dioxide from a sample. The toxicity issue has been closed for all tanks (Hewitt 1996).

2.2.3 Organic Solvents Pool

A new DQO is being developed to address this organic issue. In the interim, tanks are to be sampled for total non-methane hydrocarbon to determine whether an organic extractant pool greater than 1 m^2 (10.8 ft^2) exists (Cash 1996). The purpose of this assessment is to ensure that an organic solvent pool fire or ignition of organic solvents cannot occur. Specific analysis for total non-methane hydrocarbon were not conducted and the issue is still outstanding.

2.3 EVAPORATOR EVALUATION

The top layer of supernatant waste in tank 241-AP-105 is scheduled to be transferred to tank 241-AW-102 in support of Evaporator Campaign 97-1. The evaluation and analysis for the evaporator processing operations are contained in the *242-A Campaign 97-1 Process Control Plan* (Le and Guthrie 1997). A summary of this evaluation related to tank 241-AP-105 is included.

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. To assess the suitability of the waste for volume reduction and to predict the characteristics of the concentrated product, selected constituents of the waste in tank 241-AP-105 were measured. The analytical results are compared in Table 2-2 to decision thresholds listed in the evaporator DQO (Von Bargen 1995) and the TSAP (Schreiber 1996).

2.3.1 Process Control Issues

Process control consists of two broad areas: waste compatibility and separable organic layers. Waste compatibility is influenced by the chemical, physical, and radiochemical characteristics of the waste. The waste must be compatible with other waste forms, with tank and piping systems, and with the evaporator itself. Transuranic (TRU) and complexant wastes must be segregated from non-TRU and noncomplexant wastes. High-phosphate waste can cause crystallization if it is mixed with high-nitrate-salt-content waste. High-heat waste must be discharged to a tank designed for high heat, and the corrosivity of the waste must be controlled to prolong the life of the carbon steel tank components. The presence of a separable organic layer requires that the minimum level in evaporator feed tank 241-AW-102 be increased from 15.24 cm (6 in.) to 25.3 cm (8.3 ft) to prevent pumping of organic material to the evaporator.

Tank waste compatibility for evaporator operations is assured by a documented assessment of the waste by the compatibility program. Results from sampling and analysis events and boildown studies are used to predict the behavior of the waste when it is mixed with waste from other tanks. Results from the mixing compatibility study and boildown tests are documented in *242-A Campaign 97-1 Process Control Plan* (Le and Guthrie 1997).

Table 2-2. Decision Variables and Criteria for the Evaporator Operation Data Quality Objective. (4 sheets)

Evaporator Issues	Primary Decision Variable	Decision Criteria Threshold	Mean Analytical Result
Process Control			
Mixing and compatibility study	Samples from the candidate feed wastes are combined in the laboratory; the resultant mixture is observed for changes in temperature, color, clarity, or other visually determinable characteristic. (Le and Guthrie 1997)		No changes observed.
High-phosphate waste	$[PO_4^{3-}]$	$[PO_4^{3-}] > 0.1M$ (9,500 μg/mL)	0.00132M (1,320 μg/mL)
Complexed waste segregation	TOC content, wt% water	if > 3% TOC (dry basis), then waste must be stored in a tank with > 50 wt% water	0.39% TOC (dry basis), 69.5 wt% water
Ferrocyanide/ organic	Total fuel content	For exothermic reactions < 177 °C (350 °F), absolute value of exotherm/endotherm ratio ≥ 1	No exothermic reactions. Ratio is 0.0.
Flammable gas accumulation	Specific gravity	Specific gravity > 1.41	1.23 specific gravity
TRU segregation	TRU elements	$[^{239/240}Pu]$, $[^{238}Pu]$, $[^{241}Am]$, [U total], $[^{243/244}Cm]$, $[^{237}Np]$ total concentration > 0.1 μCi/g	3.82E-04 μCi/g (based on $[^{241}Am]$ and $[^{239/240}Pu]$)
Heat generation	Design limits of evaporator feed and slurry tanks	Heat production from radioactive decay >70,000 Btu/hr	6,910 Btu/hr (based on $[^{137}Cs]$ and $[^{89/90}Sr]$)
Corrosion	$[OH^-]$ $[NO_3^-]$ $[NO_2^-]$	Under $1.0M < [NO_3^-] < 3.0M$ $0.1 \times [NO_3^-] < [OH^-] < 10M$ $[OH^-]+[NO_2^-] > 0.4 \times [NO_3^-]$	$[OH^-] = 1.99M$ $[NO_3^-] = 1.61M$ $[NO_2^-] = 1.02M$
Operational level of evaporator feed tank	Separable organic layer	Visual detection of separable organic layer	No separable organic layer detected

Table 2-2. Decision Variables and Criteria for the Evaporator Operation Data Quality Objective. (4 sheets)

Evaporator Issues	Primary Decision Variable	Decision Criteria Threshold		Mean Analytical Result
Safety				
Criticality	$^{239/240}Pu$	> 0.005 g/L (> 0.3075 μCi/mL)[1]		1.91 E-04 μCi/mL
Radioactive source term	Activity of selected radionuclides	Radionuclide	Limit (μCi/mL)	Mean radioactivity (μCi/mL)
		^{14}C	0.26	0.00033
		^{60}Co	1.2	< 0.00757
Radioactive source term	Activity of selected radionuclides	Radionuclide	Limit (μCi/mL)	Mean radioactivity (μCi/mL)
		^{79}Se	0.078	2.12E-04
		^{90}Sr	220	0.21
		^{94}Nb	0.098	< 0.0141
		^{99}Tc	2	0.0594
		$^{106}Ru/Rh$	53	< 1.13
		^{129}I	0.0026	1.25E-04
		^{134}Cs	15	< 0.0559
		^{137}Cs	800	112
		^{154}Eu	5	< 0.0282
		^{155}Eu	7	< 0.205
		^{226}Ra	0.033	< 1.45
		^{238}Pu	0.0013	< 2.02E-04
		$^{239/240}Pu$	0.16	< 2.02E-04
		^{241}Pu	15 (based on [$^{39/240}Pu$] x 41)	< 8.28E-03
		^{241}Am	1	< 3.58E-04
		^{244}Cm	0.013	< 3.58E-04
Corrosion and leakage	$[OH^-]$ $[NO^3]$ $[NO^2]$	Under 1.0*M* < $[NO_3^-]$ < 3.0*M* 0.1 x $[NO_3^-]$ < $[OH^-]$ < 10*M* $[OH^-]$+$[NO_2^-]$ > 0.4 x $[NO_3^-]$		$[OH^-]$= 1.99*M* $[NO_3^-]$= 1.61*M* $[NO_2^-]$ = 1.02*M*

Table 2-2. Decision Variables and Criteria for the Evaporator Operation Data Quality Objective. (4 sheets)

Evaporator Issues	Primary Decision Variable	Decision Criteria Threshold		Mean Analytical Result
Compliance				
CERCLA[2] reportable quantity of ammonia	Feed tank ammonia content	No specific limit. Results are used to develop process controls to ensure reportable quantity is not exceeded.		64.8 μg/mL (highest value)
Vessel vent organic discharge	Feed tank organic compound content	Organic compound	Limit[3] μg/mL	Mean analytical result (μg/mL)
		Acetone	174.4 (R-1)/R	0.55
		1-Butanol	452 (R-1)/R	< 25.0
		2-Butoxyethanol	190.4 (R-1)/R	< 2.00
		2-Butanone	116 (R-1)/R	< 0.500
		Tributyl phosphate	20,300 (R-1)/R	2.4
		TOC (TC-TIC)	174.4 (R-1)/R (as acetone)	2.03 E+03
Compliance with WAC 173-303-100	Ammonia content of feed tank	No specific limit. Evaporator feed stock is blended so that the process condensate contains < 5,000 μg/mL ammonia.		

Table 2-2. Decision Variables and Criteria for the Evaporator Operation Data Quality Objective. (4 sheets)

Evaporator Issues	Primary Decision Variable	Decision Criteria Threshold		Mean Analytical Result
Compliance (Cont'd)				
Liquid effluent retention facility liner compatibility	Organic content of feed tank	Organic compound	Limit[3] (μg/mL)	Mean analytical result (μg/mL)
		1-Butanol	500,000	< 250
		Sum of: Acetone 2-Butanone, 2-Hexanone, Methyl isobutyl ketone, 2-Pentanone	200,000 (R-1)/R	< 2.55 (all but acetone were undetected)
		Tetrahydrofuran	2,000	< 0.5
		2-Butoxyethanol	2,000	<2.0
		Tributyl phosphate	2,000	2.4
		Ammonia	100,000	64.8
		TOC (TC-TIC)	< 1,240 (R-1)/R	2.83E+03

Notes:

TC = total carbon
TIC = total inorganic carbon

[1]Although the actual decision criterion listed in Von Bargen (1995) was 0.005 g/L, total alpha was measured in μCi/mL rather than g/L. To convert the notification limit for total alpha into the same units as the laboratory, it was assumed that all alpha activity originated from ^{239}Pu. Using the specific activity of ^{239}Pu (0.0615 Ci/g), the decision criterion converts to 0.3075 μCi/mL as shown:

$$\left(\frac{0.005\ \text{g}}{\text{L}}\right)\left(\frac{1\ \text{L}}{10^3\ \text{mL}}\right)\left(\frac{0.0615\ \text{Ci}}{1\ \text{g}}\right)\left(\frac{10^6\ \mu\text{Ci}}{1\ \text{Ci}}\right) = 0.3075\ \frac{\mu\text{Ci}}{\text{mL}}.$$

[2]*Comprehensive Environmental Response Compensation and Liability Act of 1980*, 40 U.S.C. 9601, et seq.

[3]R is the ratio of the evaporator feed flow rate to the slurry flow rate. R is equal to 2 for tank 241-AP-105.

The boildown studies and mixing tests indicated the behavior of noncomplexed waste; no visible changes in the waste were evident when mixed.

When high-phosphate waste is mixed with high-salt waste or neutralized cladding removal waste, crystal formation could result that could plug pumps and equipment and make future waste handling difficult. The phosphate concentration in the tank was well within compatibility limits.The waste was analyzed for TOC content to determine its ability to sustain an exothermic reaction, and to evaluate whether the waste could be classified as complexant. The TOC limit is three weight percent (dry basis). Waste in tanks exceeding this value must be stored in tanks with a water content greater than 50 percent. The waste in tank 241-AP-105 contains less than four-tenths of a percent TOC (overall mean 0.39 dry weight percent), and is 69.5 weight percent water. The same energetics limit that applies to the waste compatibility DQO also applies to the evaporator DQO, and the tests are the same. All results were well within the decision thresholds.

Flammable gas can accumulate in waste that has a high specific gravity. Consequently, the evaporator is operated so that the specific gravity of the slurry does not exceed 1.41. The specific gravity of the waste in tank 241-AP-105 was 1.23.

TRU wastes are routinely segregated from non-TRU wastes to avoid increasing TRU waste unnecessarily. The total concentration, in μCi/mL, of six transuranic elements listed in Table 2-2 was compared to the limit for designating TRU waste (100 nCi/g, or 0.1 μCi/g). The waste in tank 241-AP-105 is well below the established limit for TRU waste.

The heat generation caused by radioactive decay is calculated and modeled to ensure that high-heat waste is not discharged to a tank not designed for high heat. The slurry tanks used in conjunction with the evaporator (241-AW Tank Farm) are designed for head loads of 20,500 W (70,000 Btu/hr). The heat load in tank 241-AP-105 was determined to be 2,024 W (6,910 Btu/hr), well below the high-heat limit.

The nitrate, nitrite and hydroxide concentrations are limited in order to inhibit uniform corrosion and stress corrosion cracking in the double-shell tanks. For tank 241-AP-105, the waste temperature is < 75 °C (167 °F), and the Table 2-2 limits apply. For more information, refer to Section 6.1.4 in Fowler (1995).

Organic vapors can accumulate in condensate collection tank C-100 during evaporator operation if separable organic in the feed tanks is processed. No separable organic layer was found based on the TOC results of surface samples.

2.3.2 Safety Issues

Safety issues relate to personnel, the public, the prevention of damage to equipment, or the unintentional release of hazardous materials to the environment. Criticality, the release of radioactive materials, large energy releases, and maintenance of plant integrity are dealt with in the evaporator DQO.

Criticality is prevented by controlling the concentration of fissile materials. Pu is by far the most significant contributor to the criticality potential of tank waste. The TSAP for tank 241-AP-105 (Schreiber 1996) requires the analysis of $^{239/240}Pu$ and sets the limit at 0.005 g/L. The conversion of the units g/L to μCi/mL is discussed in footnote 1 of Table 2-2; the conversion yielded a limit of 0.3075 μCi/mL. The fissile content of the waste is less than 3.08E-06 μCi/mL, well below the limit.

Radionuclides in candidate waste are measured to ensure that the concentrations of selected radionuclides will not be increased by waste volume reduction in excess of the boundary limits set by the 242-A Evaporator safety analysis report (Lavender 1993). The concentrations of most radionuclides listed in Table 2-2 are below the detection level or are present at a level well below the DQO limit. The reasons for measuring fuel content, the limits, and the analytical results are the same as for the process control issue. As discussed in the process control section, control of corrosion is directly related to plant integrity and thereby safety. The same analyses were performed, and they have the same limits and analytical results.

2.3.3 Compliance Issues

Compliance issues are primarily pertinent to obtaining permits to discharge listed materials to the environment. The feed tank must be characterized adequately, and the evaporator must be operated correctly before compliance with permit requirements can be accomplished. Following is a discussion of each compliance issue, its limits, and its analytical results. Total fuel content has been discussed adequately in preceding sections and will not be repeated.

The ammonia content of the feed tank is measured to develop process controls so that the CERCLA reportable amount of ammonia of 100 pounds in any 24-hour period is not exceeded. An evaluation based on past data determined that the mean analytical result of 64.8 μg/mL would not exceed this limit when processed through the evaporator.

Vessel vent organic discharge levels are limited to 1.36 kg (3 pounds) per hour or 2.82 metric tons (3.1 tons) per year. In order to meet this standard, the concentrations of organic materials are measured in the feed tank. The limits are adjusted according to the ratio between the feed flow rate and slurry flow rate (R), according to the modifier (R-1)/R. At high boildown levels, the modifier is relatively large, allowing the presence of larger amounts of organic compounds in the feed tank. Conversely, smaller amounts of organic compounds are allowed in the feed tank when the boildown rate is low. A TC-TIC (the difference between the value of total carbon and total inorganic carbon) screen is also performed to monitor for any major organic that may have been missed. For further discussion, refer to Von Bargen (1995).

The R value used for tank 241-AP-105 was 2, giving an effective limit to TC-TIC of 87.2 μg/mL. The measured value of TC-TIC for tank 241-AP-105 was 2,830 μg/mL, thus exceeding the limit. In this case, a technical evaluation (Le and Guthrie 1997, Appendix J) was performed as called for in the evaporator DQO. Based on this evaluation, it was determined that additional organic identified in the TC-TIC calculation would not cause the emission limit to be exceeded.

Ammonia levels have no specific limit but are controlled so that the process condensate contains $<$ 5,000 μg/mL of ammonia. This limit is derived from the "Dangerous Waste Regulations" (WAC-173-303) limit for extremely hazardous waste of one weight percent, or 10,000 μg/mL. Assuming a 50 percent volume reduction and 100 percent carryover of ammonia through the evaporator, the ammonia concentration is controlled to 5,000 μg/mL or less in the feed tank. The mean analytical result for ammonia was 64.8 μg/mL.

In addition to complying with permit requirements for discharging organic compounds to the environment, organic compounds are also controlled to prevent the degradation of the high-density polyethylene liner in the Liquid Effluent Retention Facility. The limits for the organic compound were established by the manufacturer. The limits are higher than the concentrations typically seen and are adjusted by the (R-1)/R modifier to compensate for condensate flow rate. The analytes on the list are chosen because they have been seen in the process condensate. The TC-TIC screen is performed to monitor for any major organic compounds that may have been missed. All required organic compounds exhibited mean analytical concentrations much lower than their respective limits.

2.4 WASTE COMPATIBILITY EVALUATION

This waste compatibility evaluation on tank 241-AP-105 supports Evaporator Campaign 97-1. The 1996 grab sampling results representing the top 3,660 kL (967 kgal) supernatant wastes provided the analytical results for this evaluation. In accordance with Fowler (1995), tank 241-AP-105 was analyzed to assess the safety and operational implications of combining the wastes in the tank and the double-shell tank system. Safety considerations included criticality, flammable gas generation and accumulation, energetics, corrosion and leakage, and unwanted chemical reactions. Operational considerations included plugged pipelines and equipment, TRU segregation, complexant waste segregation, and heat load limits of the receiving tank. Table 2-3 summarizes the primary decision variables, decision thresholds, and the analytical results from the 1996 grab sampling event for each safety or operational issue. All listed analyses and evaluations were well within the decision threshold levels specified in the waste compatibility DQO (Fowler 1995).

Table 2-3. Decision Variables and Criteria for the Waste Compatibility Data Quality Objective.

Compatibility Issue	Primary Decision Variable	Decision Criteria Threshold	Mean Analytical Result
Safety			
Criticality	[$^{239/240}$Pu]	$^{239/240}$Pu > 0.013 g/L (> 0.7995 μCi/mL)[1]	< 3.45E-05 μCi/mL
Flammable gas	Specific gravity	> 1.41	1.23
Organic	Total fuel content	For exothermic reactions < 177 °C (350 °F), the absolute value of exotherm/endotherm ratio ≥ 1 (No notification required)	No exothermic reactions
Corrosion and leakage	[OH^-] [NO_3^-] [NO_2^-]	Under 1.0*M* <[NO_3^-] <3.0*M* 0.1 x [NO_3^-] <[OH^-] < 10*M* [OH^-]+[NO_2^-] > 0.4 x [NO_3^-]	[OH^-]= 1.99*M* [NO_3^-]= 1.61*M* [NO_2^-] = 1.02*M*
Operations			
TRU segregation	TRU elements	[$^{239/240}$Pu], [^{238}Pu], [^{241}Am], [U total], [$^{243/244}$Cm], [^{237}Np] total concentration > 0.1 μCi/g	3.82E-04 μCi/g (based on [^{241}Am] and [$^{239/240}$Pu])
Complexant segregation	TOC at double-shell slurry feed	If TOC > 10 g/L, then the waste is defined as complexed waste; otherwise it is non-complexed waste	1.49 g/L (non-complexed waste)
Heat load	Heat generation rate from radioactive decay	≥ 20,500 W (70,000 Btu/hr)	2,024 W (6,910 Btu/hr)

Note:

[1]Although the actual decision criterion listed in Fowler (1995) was 0.013 g/L, total alpha was measured in μCi/mL rather than g/L. To convert the notification limit for total alpha into the same units used by the laboratory, it was assumed that all alpha activity originated from ^{239}Pu. Using the specific activity of ^{239}Pu (0.0615 Ci/g), the decision criterion converts to 0.3075 μCi/mL as shown:

$$\left(\frac{0.005\ g}{L}\right)\left(\frac{1\ L}{10^3\ mL}\right)\left(\frac{0.0615\ Ci}{1\ g}\right)\left(\frac{10^6\ \mu Ci}{1\ Ci}\right) = 0.3075\ \frac{\mu Ci}{mL}.$$

2.5 OTHER TECHNICAL ISSUES

Heat generation from radioactive decay is a factor used in assessing tank safety. The heat load in tank 241-AP-105 was calculated as 3,297 W (11,258 Btu/hr), as listed in Table 2-4. This estimate is well below the 20,500 W (70,000 Btu/hr) operating specification limit for double-shell tanks (Harris 1994).

Table 2-4. Tank 241-AP-105 Radionuclide Inventory and Projected Heat Load.

Radionuclide	Projected Inventory[1] (Ci)	Decay Heat Generation Rate (W/Ci)	Decay Heat Generation (W)
^{137}Cs	697,000	4.72E-03	3,290
$^{89/90}Sr$	1,010	6.69E-03	7
Total watts			3,297

Note:

[1]See Table D3-2 in Appendix D.

2.6 SUMMARY

The 1996 grab sampling results showed that no primary analyte in the top supernatant wastes exceeded safety decision threshold limits. Exotherms were not analyzed in the bottom solid/liquid waste. An exothermic reaction in the sludge is very unlikely for the liquid portion of the bottom waste because of low TOC and high moisture content (indicated by 1993 grab samples). No analytical results are available for the waste solids portion of this bottom 583 kL (154 kgal) of waste.

The process control, safety and environmental compliance, and compatibility issues for Evaporator Campaign 97-1 were evaluated using the analytical results of 1996 grab samples. All the analytes except TC-TIC from the supernatant waste of tank 241-AP-105 were well within the limits of evaporation and waste compatibility DQOs. For the TC-TIC exceeding limit, a further technical evaluation (Bowman 1997) on gas chromatography (GC) results indicated the potential organic compound emissions are well below the environmental regulations for Evaporator Campaign 97-1.

3.0 BEST-BASIS INVENTORY ESTIMATE

Key waste management activities include overseeing tank farm operations and identifying, monitoring and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes and facilities for retrieving wastes and processing them into a form suitable for long-term storage. Information about chemical, radiological and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessments associated with these activities, as well as regulatory issues. Chemical and radiological inventory information is generally derived using three approaches: (1) component inventories are estimated using the results of sample analyses; (2) component inventories are predicted using the Hanford defined waste (HDW) model, process knowledge, and historical information; or (3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage and other operating data.

An effort is underway to provide waste inventory estimates that will serve as standard characterization for the various waste management activities (Hodgson and LeClair 1996). As a part of this effort, an evaluation of available chemical information for tank 241-AP-105 was performed that included the following.

- Data from the March 1993 and August/September 1996 sampling events as shown in Appendix B.
- The TCR for tank 241-AN-101 (Benar and Amato 1996), which provides data from the last sampling event for this tank before 3,660 kL (967 kgal) of dilute non-complexed waste (DN) was transferred to tank 241-AP-105 in August 1996.
- The inventory estimate (Agnew et al. 1996) generated from the HDW model.
- An estimate of 337 kL (89 kgal) of waste solids was identified in the bottom 583 kL (154 kg) of waste, with the balance being dense supernatant. There are no sample analyses of the solids waste in tank 241-AP-105. A composition for the solids layer was estimated by the Environmental Simulation Program (ESP), a computer program produced by OLI Systems (OLI Systems Inc. 1996). ESP uses thermodynamic theory to predict phase equilibrium concentrations in aqueous systems. ESP predictions of binary phase systems have shown good agreement with laboratory results (Meng et al. 1994).

Results from this evaluation, detailed in Appendix D, support using the sampling data as the basis for the best estimate inventory for tank 241-AP-105 for the following reasons:

1. The March 1993 and August/September 1996 samples are the only samples taken from tank 241-AP-105 that represent the current waste contents of the tank.

2. 1996 samples agree reasonably well with samples taken of the waste prior to its transfer to tank 241-AP-105.

3. The HDW model estimate is outdated because of the large number of waste transfers that have occurred subsequent to the date that the HDW model estimate was made.

4. Because of the lack of sample data for the solids in tank 241-AP-105, ESP calculations provide the best available estimate of the solids composition.

5. The reported solids volume (Hanlon 1997) conflicts with recent sampling events. This evaluation demonstrates that the reported solids volume overstates the amount of solids in the tank.

Best-basis inventory estimates for tank 241-AP-105 are presented in Tables 3-1 and 3-2. While samples were analyzed for numerous analytes, only those detected in the waste are included in these tables.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-105 as of January 31, 1997.

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	66,900	S	
Cl	12,700	S	241-AN-101 concentration used for top layer (3,300 μg/mL)
TIC as CO_3	53,500	S	
Cr	831	S	
F	5,820	S/E	4,610 kg estimated for saltcake
Fe	<19.5	S	
K	17,700	S/E	9,970 kg estimated for saltcake
Na	662,000	S/E	203,000 kg estimated for saltcake
Ni	<18.3	S	
NO_2	16,700	S/E	3,710 kg estimated for saltcake
NO_3	945,000	S/E	538,000 kg estimated for saltcake
OH	122,000	S	
PO_4	4,960	S	
Si	312	S	
SO_4	8,320	S	
TOC	6,200	S	
U_{TOTAL}	458	S	
Zr	NR		

Notes:

NR = not reported

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

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 as of January 31, 1997 (Decayed to January 1, 1994).

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	38.1	S	
^{14}C	1.26	S	
^{60}Co	<28.5	S	
^{79}Se	< 0.776	S	
^{90}Sr	807	S	
^{90}Y	807	S	
^{99}Tc	237	S	
^{106}Ru	<3,270		
^{125}Sb	<139	S	
^{134}Cs	<146	S	
^{137}Cs	465,000	S	
^{137m}Ba	442,000	S	
^{154}Eu	<95.2	S	
^{155}Eu	<652	S	
^{226}Ra	<5,310	S	
^{237}Np	<6.33	S	
^{238}Pu	<0.886	S	
$^{239/240}Pu$	<0.739	S	
^{241}Am	<1.42	S	
$^{243/244}Cm$	<1.45	S	

Note:

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

4.0 CONCLUSIONS AND RECOMMENDATIONS

Tank 241-AP-105 was characterized based on grab samples obtained in August/September 1996 and March 1993. The August/September 1996 samples were obtained to meet evaporator (Von Bargen 1995) and waste compatibility (Fowler 1995) DQOs in support of the Evaporator Campaign 97-1. The safety screening DQO was fully addressed for the top 3,660 kL (967 kgal) of supernatant waste by the analytical results of the August/September 1996 grab samples. However, no exothermic analyses were performed for the bottom 583 kL (154 kgal) of solid/liquid waste layer. The possibility of an endothermic reaction in the liquid portion of the bottom waste layer was evaluated using the TOC value and moisture content from 1993 grab samples. No analytical results are available to address the issue of safety screening for the waste solids in the tank bottom. For the hazardous vapor safety screening DQO, no flammable gas was detected from the vapor data (see Appendix B) measured in August/September 1996 prior to grab sampling, and the toxicity issue has been closed (Hewitt 1996). The vapor data required to address the organic solvent pool issue are not available and the issue is still outstanding. Overall, no adverse analytical results were observed with regard to tank safety and Evaporator Campaign 97-1.

All 1996 sample analyses except TC-TIC exhibited results well within the limits imposed by the safety screening, waste compatibility, and evaporator DQOs for the top 3,660 kL (967 kgal) of supernatant waste layer. The mean total alpha activity was 3.28E-04 μCi/mL, well below the safety screening DQO decision threshold of 41 μCi/mL; the differential scanning calorimetry (DSC) scans exhibited only endothermic reactions; no organic layer was detected; and the weight percent water results were 69.5 percent by thermogravimetric analysis (TGA). The flammability of the tank headspace vapor was measured at 0 percent of the LFL. To have an exothermic reaction in the liquid portion of bottom waste is very unlikely because of the low TOC concentration and high moisture content found in the 1993 grab samples. A push-mode sampling is needed to address the safety screening issue for the bottom solid waste. The analyses performed in accordance with the waste compatibility DQO exhibited no results that would preclude waste transfers. The waste is non-TRU and noncomplexant; therefore, it does not require segregation. The analyses performed to satisfy the evaporator DQO revealed that the waste is suitable for concentration by evaporation. For the TC-TIC results that exceeded the specified limit, a further technical evaluation (Bowman 1997) on GC results indicated the potential organic compound emissions are well below the environmental regulations for Evaporator Campaign 97-1.

Analytical results from both 1993 and 1996 sampling events were used to determine the best-basis inventory of the supernatant. The composition of solid waste in the tank bottom was estimated by ESP.

Table 4-1 summarizes the status of Project Hanford Management Contractor (PHMC) TWRS Program Office review and acceptance of the sampling and analysis results reported in this TCR. All DQO issues required to be addressed by sampling and analysis are listed in column one of Table 4-1. The second column indicates whether the requirements of the

DQO were met by the sampling and analysis activities performed. The third column indicates concurrence and acceptance by the program in TWRS that is responsible for the DQO that the sampling and analysis activities performed adequately meet the needs of the DQO. A "Yes" or "No" in column three indicates acceptance or disapproval of the sampling and analysis information presented in the TCR.

Table 4-1. Acceptance of Tank 241-AP-105 Sampling and Analysis.

Issue	Evaluation Performed	PHMC TWRS Program Acceptance
Safety screening DQO	Partial	Partial
Evaporator DQO	Yes	Yes
Waste compatibility DQO	Yes	Yes

Table 4-2 summarizes the status of PHMC TWRS Program review and acceptance of the evaluations and other characterization information contained in this report. The evaluations specifically outlined in this report are the best-basis inventory evaluation and the evaluation to determine whether the tank is safe, conditionally safe, or unsafe. Column one lists the different evaluations performed in this report. Columns two and three are in the same format as Table 4-1. The manner in which concurrence and acceptance are summarized is also the same as that in Table 4-1. The safety categorization of the tank is listed as "partial" in Tables 4-2 and 4-1 because no analytical results are available for the waste solids in the tank bottom.

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-AP-105.

Issue	Evaluation Performed	PHMC TWRS Program Acceptance
Safety categorization	Partial	Partial
Evaporation	Yes	Yes
Waste compatibility	Yes	Yes

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APPENDIX A

HISTORICAL TANK INFORMATION

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APPENDIX A

HISTORICAL TANK INFORMATION

Appendix A describes tank 241-AP-105 based on historical information. For this report, historical information includes any information about the fill history, waste types, surveillance, or modeling data about the tank. This information may be useful for supporting or challenging conclusions based on sampling and analysis.

This appendix contains the following information:

- **Section A1**: Current status of the tank, including the current waste levels.
- **Section A2**: Information about tank design.
- **Section A3**: Process knowledge of the tank; i.e., the waste transfer history and the estimated contents of the tank based on modeling data.
- **Section A4**: Surveillance data for tank 241-AP-105, including surface level readings and temperatures.
- **Section A5**: References for Appendix A.

A1.0 CURRENT TANK STATUS

As of January 31, 1997, tank 241-AP-105 contained an estimated 4,243 kL (1,121 kgal) of dilute non-complexed waste (Hanlon 1997). The total waste volume was estimated using a Food Instrument Corporation (FIC) automatic level measurement gauge and a manual tape. Two major sources of the waste currently in the tank are 3,660 kL (967 kgal) of DN supernatant transferred in August 1996 and 583 kL (154 kgal) of solid/liquid concentrated double-shell feed slurry left in the tank since August 1995. The volume of supernatant and waste solids in the bottom 583 kL (154 kgal) waste were estimated with the aid of an in-tank video taken on September 27, 1995 and the waste transfer pumping information (White 1996). This estimated solid/liquid volume is discussed in Appendix D, Section D3.0. The amounts of various waste phases in the tank are presented in Table A1-1.

Tank 241-AP-105 is categorized as sound, and is not on the Watch List. The tank is actively ventilated. The tank is presently used as a concentrated or DN waste storage tank in support of evaporation campaigns. All monitoring systems were in compliance with documented standards as of January 31, 1997 (Hanlon 1997).

Table A1-1. Estimated Tank Contents (January 31, 1997).[1]

Waste Form[2]	Estimated Volume	
	kL	kgal
Total waste	4,243	1,121
Supernatant liquid	3,660	1032[3]
Sludge	0	0[3]
Saltcake	337	89[3]
Drainable interstitial liquid	0	0[4]
Drainable liquid remaining	3,660	1,032[4]
Pumpable liquid remaining	3,660	1,032[4]

Notes:

[1]This is an active tank; any new waste transfer will change the data presented in this table.
[2]For definitions and calculation methods, refer to Appendix C of Hanlon (1997).
[3]The estimated volume is different from Hanlon (1997) and is discussed in Appendix D, Section 3.0.
[4]The estimated saltcake volume is dry solid and has no interstitial liquid.

A2.0 TANK DESIGN AND BACKGROUND

The 241-AP Tank Farm was constructed from 1983 to 1986 in the 200 East Area, and contains eight double-shell tanks. These tanks have a capacity of 4,390 kL (1,160 kgal), and a diameter of 22.9 m (75 ft). These tanks have a maximum design temperature of 150 °C (300 °F) (Brevick et al. 1995).

Tank 241-AP-105 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 13 mm (0.5 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 9.5 mm (0.375 in.) thick. The concrete walls are 460 mm (1.5 ft) thick and the dome is 380 mm (1.25 ft) thick (Brevick et al. 1995). 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 the concrete foundation beneath the secondary steel liner. The grid's function is to collect any waste that may leak from the tank and divert it to the leak detection well.

Tank 241-AP-105 has 29 risers ranging in diameter from 100 mm (4 in.) to 1.1 m (42 in.) that provide access to the tank, and 42 risers that provide access to the annulus. Table A2-2 shows numbers, diameters, and descriptions of the risers (annular risers are not included).

Table A2-1. Tank 241-AP-105 Risers. (2 sheets)

Riser Number	Diameter		Description and Comments
	(cm)	(in.)	
1 (NE) 30°	10	4	Sludge measurement port
1 (SE) 150°	10	4	Sludge measurement port
1 (W) 270°	10	4	Sludge measurement port
2	10	4	Automatic liquid indicator tape
3	30	12	Supernatant pump (central pump pit)
4	30	12	Thermocouple probe
5	110	42	Manhole (riser plug)
5	110	42	Manhole (riser plug)
7	30	12	Spare (riser plug)
7	30	12	Primary tank exhaust
10	30	12	Spare (riser plug)
10	30	12	Spare (riser plug)
11	110	42	Slurry distributor (central pump pit)
12	30	12	Observation port - spare
13	30	12	Tank pressure
14	10	4	Central pump nozzle
15	10	4	Spare (riser plug)
16 (NE) 30°	30	12	Sludge measurement port
16 (SE) 150°	30	12	Sludge measurement port
16 (W) 270°	30	12	Sludge measurement port
21	10	4	Spare (riser plug)
22	10	4	Sludge measurement port
24	10	4	Spare (riser plug)
25	10	4	High liquid level sensor
26	10	4	Liquid level indicator
27 (NW) 315°	10	4	Spare (riser plug)

Table A2-1. Tank 241-AP-105 Risers. (2 sheets)

Riser Number	Diameter (cm)	Diameter (in.)	Description and Comments
27 (W) 270°	10	4	Spare (riser plug)
27 (SW) 225°	10	4	Spare (riser plug)
28	10	4	Spare (riser plug)

Note:
Brevick et al. (1995) and Salazar (1994)

A plan view that depicts the riser configuration is shown as Figure A2-1. Seven 100-mm (4-in.)-diameter risers (nos. 15, 21, 24, 28, and three no. 27's), four 300-mm (12-in.)-diameter risers (nos. 7, 12, and two no. 10's), and two 1.1-mm (42-in.)-diameter risers (two no. 5's) are available for use to reach the tank interior (Brevick et al. 1995). A tank cross-section showing the approximate waste level, and a schematic of the tank equipment, is in Figure A2-2.

Figure A2-1. Riser Configuration for Tank 241-AP-105.

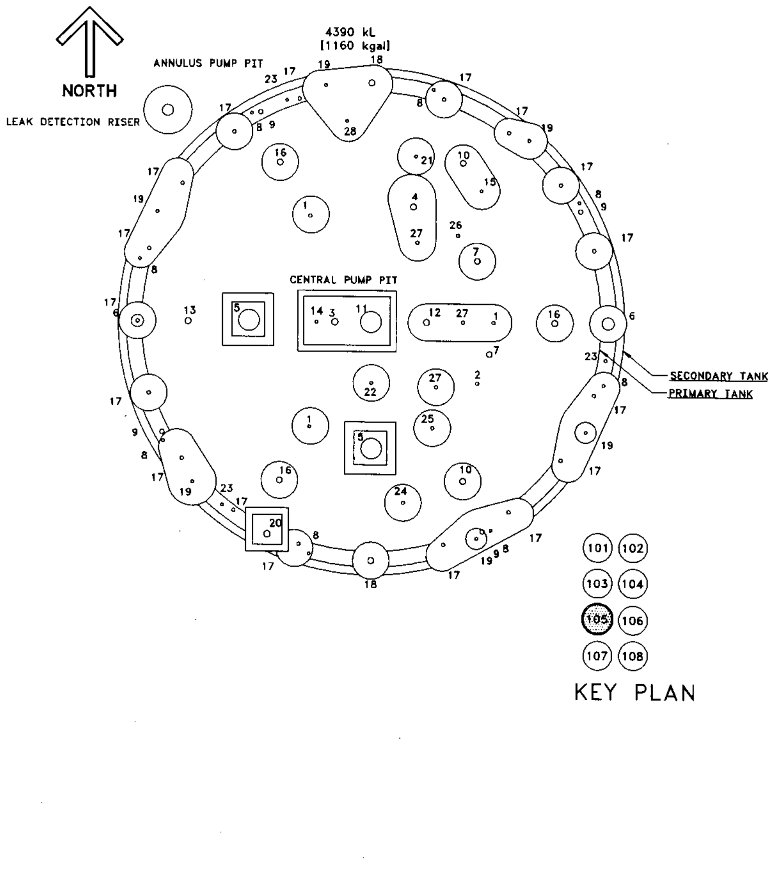
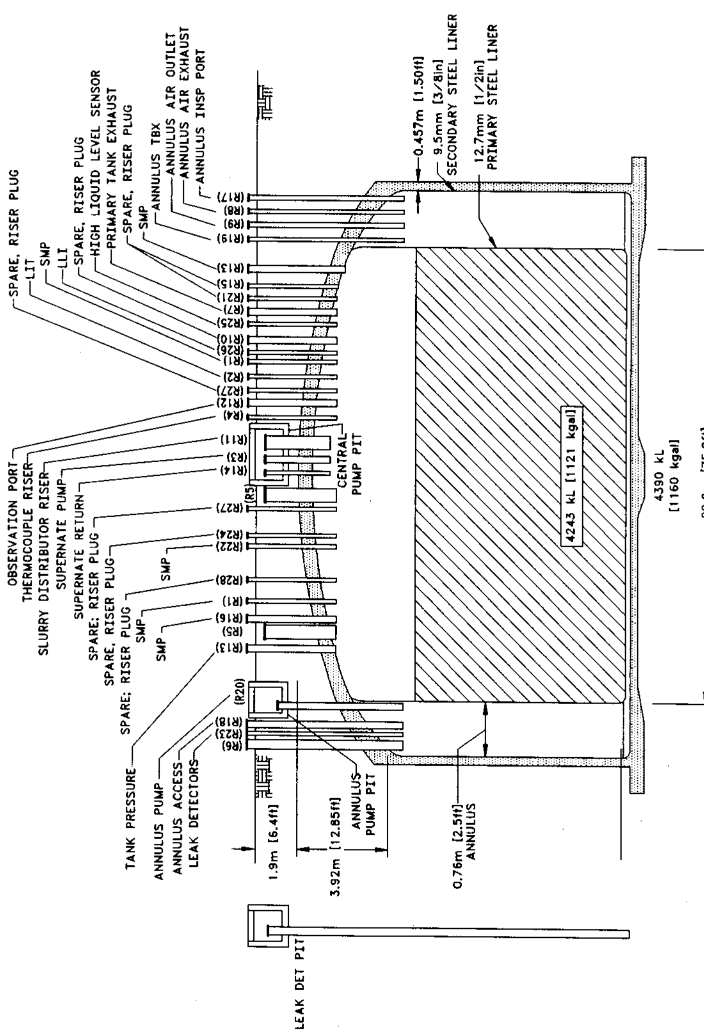


Figure A2-2. Tank 241-AP-105 Cross Section and Schematic.



A3.0 PROCESS KNOWLEDGE

The sections below: 1) provide information about the transfer history of tank 241-AP-105; 2) describe the process wastes that made up the transfers.

A3.1 WASTE TRANSFER HISTORY

Table A3-1 summarizes the waste transfer history for tank 241-AP-105 based on Agnew et al. (1997a) to 1994 and on the Hanford tank transfer database (Strode and Koreski 1996) from 1994 to present. Tank 241-AP-105 went into service in the third quarter of 1986 with the addition of 64 kL (17 kgal) of flush water; two smaller additions of water followed in 1987. In first quarter of 1988, tank 241-AP-105 received 344 kL (91 kgal) of supernatant waste from tank 241-AW-106, a tank used primarily to hold waste from the 242-A Evaporator. This transfer was followed by an additional 64 kL (17 kgal) of flush water.

During 1988 and 1989, a series of transfers occurred between tank 241-AP-105 and tank 241-AW-102, the feed tank for the 242-A Evaporator. Tank 241-AP-105 received a total of 2,211 kL (584 kgal) of supernatant waste from tank 241-AW-102 in the first quarter of 1988. During the third quarter of 1988, 2,616 kL (691 kgal) of supernatant waste was sent from tank 241-AP-105 to tank 241-AW-102 for processing in the 242-A Evaporator. In the first quarter of 1989, tank 241-AP-105 received 2,324 kL (614 kgal) of DN waste from the evaporator via tank 241-AW-102, and 594 kL (157 kgal) of supernatant waste was sent to tank 241-AW-102.

In the third quarter of 1989, tank 241-AP-105 received 1,344 kL (355 kgal) of double-shell slurry feed supernatant waste from tank 241-AP-106. In the third quarter of 1995, tank 241-AP-105 was emptied nearly to the sludge heel (about 590 kL [156 kgal]) with the contents transferred to tank 241-AP-101. For this transfer, the waste in tank 241-AP-105 was designated as double-shell slurry feed. The most recent waste transfer to tank 241-AP-105 was the addition of 3,660 (967 kgal) of DN waste from tank 241-AN-101 in August 1996.

A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS

Agnew et al. (1997b) predicts the content of each of the Hanford Site's 177 single-shell and double-shell radioactive waste storage tanks. However, the Agnew model is based on waste transfers that occurred before 1995. Because tank waste transfers occurred during 1995 and 1996, the predicted tank contents tabulated in Agnew et al. (1997a) are not current for tank 241-AP-105 and are not discussed in this TCR.

Table A3-1. Summary of Tank 241-AP-105 Major Waste Transfers.

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Volume[1,2] kL	Estimated Volume[1,2] kgal
Miscellaneous sources		Flush water	1986 - 1988	144	38
241-AW-106		Supernatant	1988	344	91
241-AW-102		Dilute non-complexed supernatant	1988 - 1989	2,733	722
	241-AW-102	Dilute non-complexed supernatant	1988 - 1989	-3,210	-848
241-AW-102		Double-shell slurry feed	1989	1,802	476
241-AP-106		Double-shell slurry feed	1989	1,344	355
	241-AP-101	Double-shell slurry feed	1995	-2,498	-660[3]
241-AN-101		Dilute non-complexed waste	1996	3,660	967[3]

Notes:

[1]Unless otherwise noted, data are derived from Agnew et al. (1997b).

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

[3]Operational waste volume database and Strode and Koreski (1996)

A4.0 SURVEILLANCE DATA

Tank 241-AP-105 surveillance consists of surface-level measurements (liquid and solid) and temperature monitoring inside the tank (waste and headspace). The tank annulus is equipped with leak-detection instrumentation consisting of continuous air monitors and conductivity probes (Johnson 1995). Surveillance data provide the basis for determining tank integrity. For double-shell tanks, the leak detection instruments are the primary means of detecting a leak from the primary tank; liquid level measurements may be used to confirm a possible leak detected by the annulus instruments (Johnson 1995). No occurrence reports have been written against tank 241-AP-105 that would indicate a leak from the primary tank. Solid-level measurements indicate physical changes and consistency of the solid layers in a tank.

A4.1 SURFACE-LEVEL READINGS

An FIC gauge and manual tape are used to monitor the waste surface level in tank 241-AP-105 through riser 2. On January 31, 1997, the surface level using the automatic FIC was 10.35 m (407.6 in.) and 10.36 m (407.7 in.) using the manual tape. A graphical representation of the tank volume history is presented in Figure A4-1. The figure shows a gradual decrease in liquid surface level in the tank for the time period between 1989 and 1995. This decrease is attributed to evaporation of water from the tank waste caused by the tank's active ventilation system (Brevick et al. 1995).

A4.2 INTERNAL TANK TEMPERATURES

Tank 241-AP-105 has a thermocouple tree located in riser 4 with 18 thermocouples to monitor the waste temperature. Elevations are available for all thermocouples. Plots of the individual thermocouple readings can be found in the AP Tank Farm supporting document for the historical tank content estimate (Brevick et al. 1995).

Temperature data, obtained from the Surveillance Analysis Computer System (SACS) (LMHC 1997), were recorded from July 1989 through January 1997. Data were available for six thermocouples: 1, 3, 5, 7, 11, and 17. The mean temperature of the SACS data is 22.9 °C (73.2 °F) with a minimum of 13 °C (55 °F) and a maximum of 43.9 °C (111 °F). A graph of the weekly high temperatures is provided as Figure A4-2.

A4.3 TANK 241-AP-105 PHOTOGRAPHS

No interior photographs are available for this tank; however, a video is available from September 1995 that shows the tank interior and waste surface. The video shows grayish white crystalline solids exposed along the tank wall above the liquid surface at a level of about 142 cm (56 in.) from the bottom of the tank (White 1996).

Figure A4-1. Tank 241-AP-105 Level History.

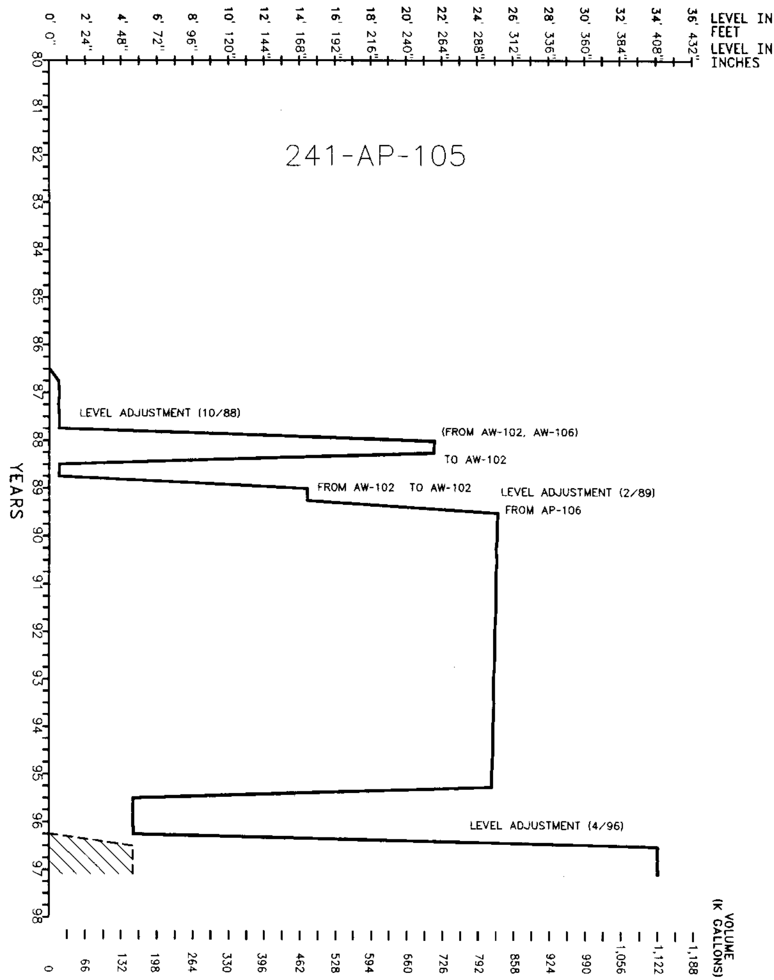
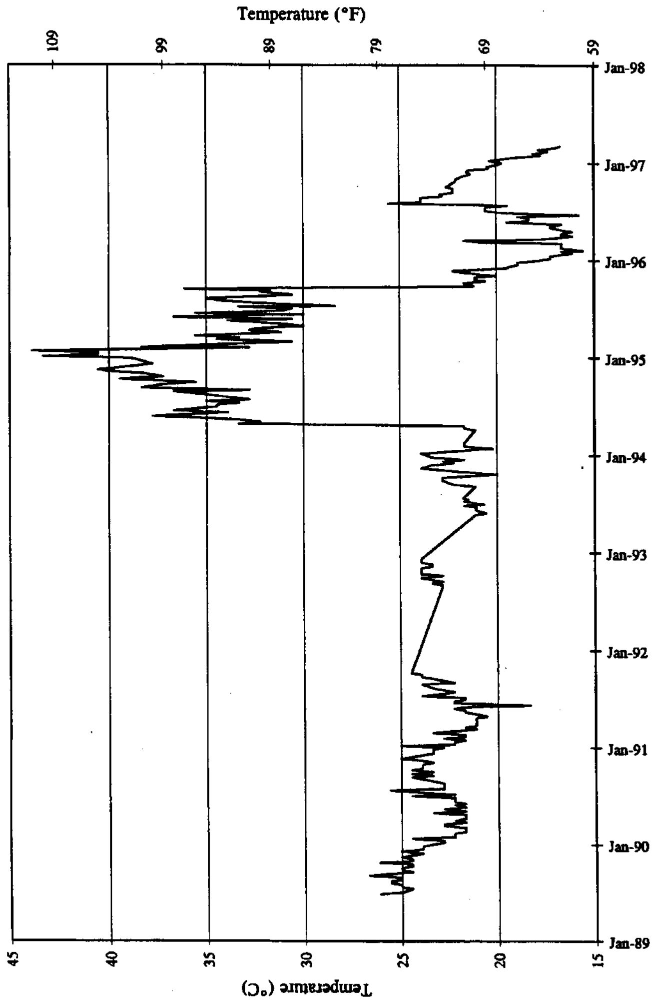


Figure A4-2. Tank 241-AP-105 Weekly High Temperature Plot.



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APPENDIX B

SAMPLING OF TANK 241-AP-105

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APPENDIX B

SAMPLING OF TANK 241-AP-105

Appendix B provides sampling and analysis information for each known sampling event for tank 241-AP-105, and an assessment of the grab sample results.

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

Future sampling of tank 241-AP-105 will be appended to the above list.

B1.0 TANK SAMPLING OVERVIEW

This section describes two sampling events that provide information that can be used to characterize tank 241-AP-105: the August/September 1996 grab sampling event and the March 1993 grab sampling event.

The August/September 1996 grab samples were taken from the top 3,660 kL (967 kgal) of supernatant waste in support of 242-A Evaporator Campaign 97-1. The sampling and analyses were conducted in accordance with the requirements 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), and the *Tank 241-AP-105 Grab Sampling Waste Analysis Plan* (Schreiber 1996). Further discussions of the sampling and analysis procedures can be found in *Tank Characterization Reference Guide* (DeLorenzo et al. 1994). Table B1-1 summarizes the sampling mode, applicable DQOs, and sampling and analytical requirements for the sampling event. The detail of analytical results can be found in the *Final Characterization and Safety Screen Report of Double Shell Tank 241-AP-105 for 242-A Evaporator Campaign 97-1* (Miller 1997).

In March 1993, grab samples were obtained to determine the acceptability of the waste in tank 241-AP-105 for the Hanford Grout Disposal Program. After this sampling event, several waste transfers occurred (see Appendix A) and a total of 583 kL (154 kgal) of solid/liquid waste remain in the tank bottom. This liquid portion of the remaining material can be characterized using the results of this sampling event. The analytical results were reported in *Tank 241-AP-105 Characterization Results* (Welsh 1994).

Table B1-1. Data Quality Objective Requirements for Tank 241-AP-105.[1]

Sampling Event	Applicable DQOs	Sampling Requirements	Analytical Requirements
1996 grab sampling	Safety screening	Vertical profiles from two widely spaced risers	• Energetics • Moisture content • Total alpha activity • Visual check for organic layer • Headspace gas flammability
	Waste compatibility	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	Grab samples from different depths	• Energetics • Moisture content • Total alpha and beta activities • Visual check for organic layer • Metals by ICP • Anions by IC • Radionuclides • TC, TIC, TOC • Hydroxide • Specific gravity • pH • Ammonia • Uranium • Organic (SVOA, VOA)

Notes:

IC = ion chromatography
ICP = inductively coupled plasma spectrometry
pH = hydrogen potential
SVOA = semivolatile organic analysis
VOA = volatile organic analysis

[1]Schreiber (1996)

B1.1 1996 GRAB SAMPLING

B1.1.1 Description of Sampling Event

The supernatant waste in tank 241-AP-105 was grab sampled on August 29 and September 3, 1996. According to the sampling and analysis plan (Schreiber 1996), 13 liquid samples were taken through riser 1 at 90° and riser 1 at 330° using the bottle-on-a-string method. One grab sample was taken from the waste surface (an elevation of approximately 1,041 cm [410 in.]) as measured from the tank bottom to the mouth of the sample bottle), and four samples were taken from each of the three subsurface sampling locations 221, 587 and 688 cm (87, 231 and 271 in.) from the tank bottom. The surface sample was used for TOC and safety screening analyses. The four subsurface samples at each elevation were taken for the following purposes:

- Boildown and mixing study analyses
- Semivolatile organics analysis (SVOA)
- Volatile organic analysis (VOA)
- Safety screening, inorganic and radionuclide analyses.

In addition to the 13 samples, four field blanks and two trip blanks were taken to assess potential contamination during sample collection, transport, preparation or extraction, and analysis. The field blanks were collected during the sampling event--one for VOA, one for SVOA, and two for inorganic/radiological analyses. Trip blanks were collected for organic analyses--one for VOA and one for SVOA.

Before the grab sampling event, the tank headspace vapors were sampled through riser 1 at 90° and riser 1 at 330°, and analyzed for the presence of flammable gases as prescribed by the safety screening DQO.

All analyses were performed at the Rust Federal Services of Hanford Inc. 222-S Laboratory in accordance with the referenced TSAP (Schreiber 1996). Table B1-2 summarizes the sampled date, location (riser number), depth, sample numbering, sample type and sample analysis performed. Sample number is the identification number of the sample collected. Laboratory number is the identification number of the sample when it is analyzed.

Table B1-2. 1996 Grab Sampling Information for Tank 241-AP-105.

Sampled Date/ Location	Sample Depth[1] cm (in.)	Sample Number	Laboratory Number	Waste Type	Analyses Performed
August 29, 1996 Riser 1 at 330°	587 (231)	5-AP-1A	S96V000039	SubS	Organic/VOA
		5-AP-1B	S96V000043	SubS	Organic/VOA
		5-AP-1C	S96V000047 S96V000050[2]	SubS	Inorganic/ radionuclide
		5-AP-1D	S96V000055	SubS	Mixing/boildown
Sept. 3, 1996 Riser 1 at 90°		5-AP-2A	S96V000040	SubS	Organic/VOA
		5-AP-2B	S96V000044	SubS	Organic/SVOA
		5-AP-2C	S96V000048 S96V000051[2]	SubS	Inorganic/ radionuclide
		5-AP-2D	S96V000056	SubS	Mixing/boildown
	688 (271)	5-AP-3A	S96V000041	SubS	Organic/VOA
		5-AP-3B	S96V000045	SubS	Organic/SVOA
		5-AP-3C	S96V000049 S96V000052[2]	SubS	Inorganic/ radionuclide
		5-AP-3D	S96V000057	SubS	Mixing/boildown
	~ 1,041 (410)	5-AP-4	S96V000053 S96V000054[2]	SS	TOC & safety screening
		5-AP-IB1	S96V000058	FB	Inorganic/ radionuclide
		5-AP-IB2	S96V000059 S96V000060[2]	FB	Inorganic/ radionuclide
		5-AP-OB1	S96V000061	FB	Organic/VOA
		5-AP-OB2	S96V000062	FB	Organic/VOA
	n/a	5-AP-TB1	S96V000042	TB	Organic/VOA
	n/a	5-AP-TB2	S96V000046	TB	Organic/VOA

Notes:

n/a = not applicable
SubS = subsurface supernatant
SS = surface supernatant
FB = field blank
TB = trip blank

[1]Sample depth is defined as the distance from the tank bottom to the mouth of the sample bottle.
[2]Sample prepared with acid digestion.

B1.1.2 Sample Handling

Four of the 13 waste samples, 5AP-1A, -1B, -1C and -1D, were taken on August 29, 1996. The remaining 9 samples were taken on September 3, 1996. All 13 samples were received at the 222-S Laboratory the day after they were obtained. All four field blanks and two trip blanks were taken on September 3, 1996. Two field blanks, 5-AP-IB2 and 5-AP-OB1, and one trip blank, 5-AP-TB2 were received at the laboratory on September 5, 1996, and the other three blanks were received on the day after they were collected. Chain-of-custody forms were generated by the sample collector and delivered to 222-S Laboratory with the samples.

The "bottle-on-a-string" method was used to collect liquid grab samples from the tank. Each glass sample bottle was amber, precleaned, and contained approximately 100 mL. Each bottle was closed with a seal cap (or septum for volatile organic analysis samples). Field blank samples were prepared by placing deionized water into sampling bottles, lowering the unclosed bottles into the riser for a period of time, retrieving them from the riser, and then closing the bottles with the same types of caps used for the tank samples. Samples were not preserved (acidification or refrigeration) at the time of sampling. On receipt, samples were placed in shielded containers and transferred to metal storage cabinets. The sample bottles destined for organic analyses were placed in a refrigerator.

B1.1.3 Sample Analysis

The analyses performed on the grab samples were those required by the waste analysis plan (Schreiber 1996). All reported analyses were performed in accordance with approved laboratory procedures. Table B1-3 displays the analytical procedures by title and number and analytes performed. No deviations or modifications were noted by the laboratory.

Table B1-3. Analytical Procedures of 1996 Sampling for Tank 241-AP-105. (3 sheets)

Analytes	Procedure	Analytical Method
Organic layer	LA-519-151	Visual check and over-the-top reading
Energy	LA-514-113	DSC
Moisture content	LA-560-112	Determination of weight loss as percent water by TGA
pH	LA-212-106	pH determination of aqueous wastes
Specific gravity	LA-510-112	Specific gravity of high beta gamma caustic samples
Hydroxide	LA-211-102	Determination of free OH^-/H^+ using titroprocessor
Ammonia	LA-631-001	Determination of ammonia by selective ion electrode using a double increment known additions method
Total inorganic carbon	LA-342-100	Determination of carbon by hot persulfate oxidation and coulometric detection

Table B1-3. Analytical Procedures of 1996 Sampling for Tank 241-AP-105. (3 sheets)

Analytes	Procedure	Analytical Method
Total carbon	LA-344-105	Determination of carbon in solutions by combustion and coulometry
Total organic carbon	LA-344-105	Determination of carbon in solutions by combustion and coulometry
F^-, NO_2^-, NO_3^-, SO_4^{2-}, PO_4^{3-}	LA-533-105	Anion analysis
Al, Na	LA-505-161	ICP emission spectrometric method
	LA-505-158	Acid digestion of aqueous samples and extracts for total metals for analysis by flame atomic absorption and ICP spectroscopy
U-gross	LA-925-009	Determination of uranium by kinetic phosphorescence
^{137}Cs, ^{94}Nb, ^{106}Ru, ^{95}Nb, ^{144}Ce Pr, ^{60}Co, $^{154/55}Eu$, ^{226}Ra, ^{113}Sn	LA-548-121	Preparation of sample mounts for GE(Li) GEA - low level (preparation for LA-508-162)
	LA-508-162	GEA
Total Alpha/Beta	LA-508-101	Low-level alpha and beta in water samples
	LA-508-114	Operation of gamma products alpha beta counting systems using personal computer control (subsequent to LA-508-101)
^{241}Am, $^{243/244}Cm$	LA-953-103	Determination of americium by extraction with TRU · spectroscopy resin (also Cm-243/244)
^{238}Pu, $^{239/240}Pu$	LA-943-128	Determination of plutonium by extraction with TRU · spectroscopy resin
^{3}H	LA-218-114	Tritium by Lachat micro-distillation and liquid scintillation counting
	LA-508-121	Operation of the liquid scintillation counter
^{14}C	LA-348-104	C-14 in small-volume samples by persulfate oxidation and liquid scintillation
	LA-508-121	Operation of the liquid scintillation counter
^{99}Tc	LA-438-101	Determination of Tc-99 by solvent extraction and liquid scintillation counting
$^{89/90}Sr$	LA-220-101	High-level strontium-89,90 in aqueous samples
^{79}Se	LA-365-132	Determination of Se-79
^{237}Np	LA-933-141	Determination of Np-237 by TiOA/TTA extraction and alpha counting
^{129}I	LA-378-103	Determination of iodine-129 in waste tank samples

Table B1-3. Analytical Procedures of 1996 Sampling for Tank 241-AP-105. (3 sheets)

Analytes	Procedure	Analytical Method
Volatile organic analysis (VOA): Acetone, 1-Butanol, 2-Butanone, 2-Hexanone, 2-Pentanone Methyl Isobutyl Ketone, and Tetrahydrofuran	LA-523-405	Volatile organics by gas chromatography/mass spectrometry (GC/MS) using EPA standard method SW-846. (VOA)
Semi-volatile organic analysis (SVOA): 2-Butoxyethanol, n-Tributylphosphate	LA-523-132	Semi-micro continuous liquid-liquid extraction of semivolatiles based on EPA standard method SW-846 methods
	LA-523-406	Semivolatile organics by gas chromatography/mass spectroscopy based on EPA standard method SW-846, method 8270A (SVOA)

Notes:

EPA = U.S. Environmental Protection Agency
GC/MS = gas chromatograph/mass spectrometer
GEA = gamma energy analysis

B1.2 1993 GRAB SAMPLING

Tank 241-AP-105 was sampled on March 10 and 14, 1993. The tank contained 3,140 kL (820 kgal) at the time of the sampling. After samples were obtained, 2,498 kL (660 kgal) of waste was transferred to tank 241-AP-101. A total of 591 kL (156 kgal) of solid/liquid waste remains at the tank bottom. The liquid portion of the remaining material can be characterized using the results of this sampling event.

B1.2.1 Description of Sampling Event

This sampling event accomplished two objectives. The first was to provide inorganic, radioactive, and organic information about the tank contents. The second was to determine if the waste, if blended with dilute waste from tank 241-AP-106, was suitable feed for the Grout Treatment Facility. Blending with the waste in tank 241-AP-106 was thought to be needed to lower the radiolytic heat generation of the concentrated waste in tank 241-AP-105. The waste in tank 241-AP-105 was assumed to consist of two distinct layers. It was also assumed that the waste within each layer was homogeneous (Hendrickson and Welsh 1992). Therefore, it was determined that a total of six samples from each layer of tank waste would adequately represent the inorganic and radionuclide character of the waste. Samples were thus taken from three equally spaced risers situated 120 degrees apart, at a radius of 6 m (20 ft) from the tank's center. The "bottle-on-a-string" method was used to collect approximately 100 mL of liquid for each sample.

Thirteen samples (twelve samples and one duplicate) were submitted to the Westinghouse Hanford Company 222-S Analytical Laboratory (now operated by Rust Federal Services of Hanford, Inc.) for analysis. These samples were used to characterize the inorganic and radiochemical properties of the tank. In addition, eight samples (seven samples and a field blank) were shipped to the Pacific Northwest Laboratory, where they were analyzed for organic constituents.

Table B1-4 summarizes the sample information, including sample riser, sample depth, sample number, and sample laboratory number. A list of the analytes evaluated in each sample by laboratory is presented in Table B1-5. The analytical results of the samples taken from depth of 43 cm (17 in.) and 106 cm (42 in.) will be used in this report to characterize the liquid portion of 583 kL (154 kgal) of solid/liquid waste in the tank bottom.

Table B1-4. 1993 Grab Sampling Information for Tank 241-AP-105.

Sample Riser	Sample[1] Depth cm (in.)	Position	Tank Farm Sample Number	Laboratory Sample Number
WHC Sampling Analyses Information				
1 (East), 90°	704 (277) 457 (180) 338 (133) 43 (17)	1 2 3 4	G243 G241 G240 G238	G409 G407 G402 G401
1 (SW), 210°	655 (258) 561 (221) 373 (147) 165 (65)	5 6 7 8	G249 G248 G245 G244	G418 G417 G413 G412
1 (NW), 330°	724 (285) 724 (285) 516 (203) 292 (115) 107 (42)	9A 9B 10 11 12	G254 G271 G253 G251 G250	G396 G397 G392 G391 G422
Composite[2]	--	Composite Composite	Composite Composite	G378 G379
PNL Sample Information				
1 (East), 90°	457 (180) 43 (17)	2 4	G242 G239	93-05388 93-05387
1 (SW), 210°	561 (221) 373 (147)	6 7	G247 G246	93-05390 93-05389
1 (NW), 330°	724 (285) 724 (285) 292 (115)	9A 9B 11	G255 G270 G252	93-05393 93-05392 93-05391
Field blank			G273	93-05394

Notes:

PNL = Pacific Northwest Laboratory, renamed Pacific Northwest National Laboratory (PNNL) in 1995

WHC = Westinghouse Hanford Company 222-S Laboratory, now operated by Rust Federal Services of Hanford, Inc.

[1]Sample depth measured from tank bottom
[2]Composite sample consisted of all 13 samples

Table B1-5. Requested Analytes of 1993 Grab Samples for Tank 241-AP-105.

Sample Numbers	Laboratory Numbers	Laboratory	Requested Analytes
G251 G250 G254 G271 G238 G240 G241 G243 G244 G254 G248 G249 G250	G391 G392 G396 G397 G401 G402 G407 G409 G412 G413 G417 G418 G422	Westinghouse Hanford Company 222-S Laboratory	Al, Sb, Ba, Be, Cd, Cr, Fe, Ni, K, Na, P, Pb, Se, Ag, F^-, Cl^-, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, ^{137}Cs, ^{134}Cs, ^{60}Co, $^{144}Ce/Pr$, ^{125}Sb, $^{106}Ru/Rh$, ^{94}Nb, SpG, % H_20, TIC, TOC, ^{241}Am, ^{99}Tc, ^{14}C, ^{90}Sr, ^{237}Np, ^{238}Pu, $^{239/240}Pu$, $^{243/244}Cm$, ^{129}I
Composite Samples	G378, G379	Westinghouse Hanford Company 222-S Laboratory	Al, As, Hg, Sb, Ba, Be, Cd, Cr, Fe, Ni, K, Na, P, Pb, Ag, Se, F^-, Cl^-, OH^-, CN^-, NO_2^-, NO_3^-, PO_4^{3}, SO_4^{2-}, NH_3/NH_4^+, ^{137}Cs, ^{134}Cs, ^{60}Co, $^{144}Ce/Pr$, ^{125}Sb, $^{106}Ru/Rh$, ^{94}Nb, SpG, % H_20, TOC, ^{241}Am, ^{99}Tc, ^{90}Sr, ^{237}Np, $^{243/244}Cm$, ^{129}I, U, ^3H
G239 G242 G246 G247 G252 G270 G255 G273	93-05387 93-05388 93-05389 93-05390 93-05391 93-05392 93-05393 93-05394	PNL	Volatiles, semi-volatiles, EDTA, HEDTA, citrate, oxalate, glycolate

Notes:

EDTA = ethylenediaminetetraacetic acid
HEDTA = N-(2-hydroxyethyl)ethylenediaminetriacetic acid
SpG = specific gravity

B1.2.2 Sample Handling

The samples were delivered to the Westinghouse Hanford Company 222-S Processing and Analytical Chemistry Laboratory on June 3, 1993 for inorganic and radiochemical analyses. The samples were received at ambient temperature.

Eight samples from tank 241-AP-105 were received by the PNL Analytical Chemistry Laboratory on June 22, 1993, for VOA, SVOA, glycolate, oxalate, EDTA/HEDTA, and citrate analyses. The samples were refrigerated upon receipt. The documentation for VOA stated that the analysis should be performed within a 14-day holding time from receipt of the sample (Hosaka 1993). The SVOA was performed on July 8, 1993, and EDTA/HEDTA and citrate analyses were performed on September 10, 1993. All holding times were exceeded.

To limit personnel exposure to hazardous ionizing radiation, no attempt was made to completely fill the bottles; as a result, the potential for headspace existed in all sample bottles. Due to the shielding requirements for the shipping containers, refrigeration of the sample was not possible. Also, the waste was not expected to contain any organic materials that might influence the results of the samples; therefore, no preservatives were used in the sample bottles.

Lack of sample preservation should not impact the validity of the sample results. The majority of the waste in tank 241-AP-105 has been processed through the evaporator and stored in the tank for a number of years at temperatures at or above ambient conditions with active ventilation. The sample handling required because of the radioactivity of the waste did not cause the sample to be subjected to a more rigorous environment (for volatile component removal) than was present in the tank. Therefore, the additional time at ambient temperature after sampling should not affect the validity of the sample results. This assertion is supported by recent work in the establishment of holding times for sample analyses (Maskarinec et al. 1990). For the same reasons, the headspace and lack of sample refrigeration also should not impact the sample results.

B1.2.3 Sample Analyses

At the time of collection, the waste was thought to have two separate layers that were assumed to be homogeneous within layers (Hendrickson and Welsh 1992). According to Sample Receipt Forms (Hosaka 1993), Sample G255 had an oily liquid present in the sample, but no contamination was found. Samples G238 and G239 were received with two phases (liquid and solid) present (Welsh 1994).

B1.2.3.1 Physical Tests. Physical tests performed on the samples included weight percent water and specific gravity (SpG). The weight percent water procedure used approximately 1 mL of sample, which was heated in an oven at 120 °C (248 °F) until gravimetric measurements could be made. Procedure LA-564-101, Rev. E-3 was used for this analysis. This is a later revision than specified in the Technical Project Plan (Procedure LA-564-101, Rev. E-1) because the procedure had to be modified to allow for calculating weight percent solids rather than percent water. Therefore, this procedure applies to the determination of total dissolved solids/percent water in solutions, slurries, and solid waste. The weight percent water was performed on all individual and composite samples in duplicate. The SpG analysis was performed on full characterization samples and the composite samples.

B1.2.3.2 Chemical and Radionuclide Constituent Analysis. Thirteen of the twenty samples obtained from tank 241-AP-105 were analyzed for chemical and radionuclide constituents. The thirteen samples consisted of four samples from each riser and one duplicate. From the thirteen selected samples, a composite was made and two sub-samples were prepared, for a total of fifteen samples analyzed. The composite sample was prepared using equal volumes from each of the samples for inorganic analysis (not the field duplicates). This was due to the assumptions that the tank waste consisted of two layers that would be homogeneous within layers, but heterogeneous between layers (Hendrickson and Welsh 1992). A comparison of the means computed from individual sample results and the composite means determined that the data for all analytes except Cd and K was equivalent.

B1.2.3.3 Volatile and Semi-Volatile Organic Constituent Analysis. Seven samples (six samples plus one duplicate) of waste from tank 241-AP-105 were analyzed for volatile and semi-volatile constituents by PNL. Both the volatile and semi-volatile organic compounds were analyzed using gas chromatography/mass spectrometry (GC/MS). The glycolate and oxalate were analyzed using high-performance liquid chromatography as explained in detail below (Hendrickson and Welsh 1992).

- Rapid screening by headspace/gas chromatography to establish laboratory dilution requirements. PNL procedure PNL-ALO-331 is a modified version of U.S. Environmental Protection Agency method 3810 (EPA 1986).

- Gas chromatography/mass spectrometry (GC/MS) analysis of volatile organic component. PNL procedure PNL-ALO-335 follows the U.S. Environmental Protection Agency Contract Laboratory Program Statement of Work (EPA 1991).

- Gas chromatography/mass spectrometry (GC/MS) for semi-volatile component analysis. PNL procedure PNL-ALO-345 follows the Contract Laboratory Program protocol (EPA 1991).

- Organic complexants. Glycolate and oxalate were analyzed using liquid chromatography. Citrate, HEDTA, and EDTA were analyzed using high-performance liquid chromatography (Welsh 1994).

Quality assurance techniques of the EPA methods cited were followed as closely as technically feasible. Section 5.0 of this report further addresses the quality assurance samples results from the analyses performed above.

B1.2.3.5 Grout Product Tests. A portion of tank 241-AP-105 waste was blended with dilute waste from tank 241-AP-106, according to the test plan (Hendrickson and Welsh 1992) under the direction of Grout technology personnel. For this setup, a mixture of 20 percent of tank 241-AP-106 waste was blended with 80 percent of tank 241-AP-105 waste.

The blend was mixed with the formulation developed for tank 241-AP-102 waste (Lokken et al. 1993). The formulation consisted of 21 percent Type II Portland cement, 11 percent attapulgite clay, and 68 percent Class F fly ash. This particular formulation did not produce acceptable grout with this waste mixture (Welsh 1994).

B1.2.3.6 Module-Specific Analyses. The characterization program for tank 241-AP-105 was intended to satisfy criteria set by the Hanford Grout Disposal Program, one of the program elements of the Tank Waste Remediation System (TWRS) designed for the retrieval and final disposal of low-level wastes. The TWRS sample characterization objectives are to provide adequate characterization of physical, chemical and radiological properties of Hanford Site tank wastes to support the resolution of unreviewed safety questions, other safety issues surrounding the Watch List tanks, and the design of retrieval, pretreatment and final disposal systems (Bell 1994).

The waste from tank 241-AP-105 was designated as potential feed for the terminated Grout Treatment Facility. After this designation was made, the waste in tank 241-AP-105 was sampled, analyzed and tested to determine its suitability for disposal as grout, and the grout product's physical and chemical characteristics to satisfy regulatory compliance. The sampling and analysis plan for tank 241-AP-105 included characterization for metals, water-soluble ions, volatile and semi-volatile organic compounds, and radionuclides of the grout feed, as well as analyses of the grout product characteristics.

Table B1-6. Analytical Methods of 1993 Grab Sampling for Tank 241-AP-105. (2 sheets)

Analyte	Method	Procedure
Hg	CVAA	LA-325-104
As, Se	GHAA	LA-355-131/-365-131
$^{238,239,240}Pu$, ^{241}Am, $^{243/244}Cm$	Separation/AEA[1]	LA-503-156/-508-051
Ag, Ba, Cd, Cr, Na, Ni, K, Pb, P, Al, Be, Sb, Fe	Inductively coupled plasma	LA-503-156/-508-051 LA-505-151
U	Laser fluorimetry	LA-925-106
NH_3/NH_4^+	See note[2]	LA-634-102
CN^-	Dist/Spec[3]	LA-695-102
F^-, Cl^-, NO_2^-, NO_3^-, SO_4^{2-}, PO_4^{3-}	Ion chromatography	LA-533-105
TOC	see note[4]	LA-344-105
TIC	see note[5]	LA-622-102

Table B1-6. Analytical Methods of 1993 Grab Sampling for Tank 241-AP-105. (2 sheets)

Analyte	Method	Procedure
$^{89,90}Sr$	Separation/beta[6]	LA-220-101
^{99}Tc	Extraction/LSC[7]	LA-438-101
^{14}C	Distillation/LSC	LA-348-104
^{134}Cs, ^{137}Cs, ^{94}Nb, $^{106}Ru/Rh$, ^{125}Sb, $^{144}Ce/Pr$, ^{60}Co	GEA	LA-548-121/-508-052
^{237}Np	Extraction/alpha[8]	LA-933-141
^{129}I	Extraction/GEA[9]	LA-378-103
^{3}H	Separation/LSC	LA-218-114
% H_2O	Oven drying	LA-564-101
OH^-	Potentiometric autotitration	LA-661-102
SpG	Density measurement	LA-510-112

Notes:

AEA = alpha energy analysis
CVAA = cold vapor atomic absorption
GHAA = gaseous hydride atomic absorption (spectrophotometer)
LSC = liquid scintillation counting

[1]Chemical separation (anion exchange resin) and AEA

[2]Distillation into a weak acid receiver and detection by back titration with a strong acid

[3]Acidification and distillation followed by spectrophotometric analysis

[4]Use TIC leftover carbon; TOC concentration measured by combustion, detection of CO_2 by coulometry

[5]Acidify, purge, and heat sample; detect CO_2 using coulometry

[6]Chemical separation along with total beta proportional counting

[7]Extraction process followed by LSC

[8]Extraction process followed by alpha proportional counting

[9]Extraction process followed by GEA.

B2.0 ANALYTICAL RESULTS

B2.1 OVERVIEW

This section summarizes the sampling and analytical results associated with the 1996 grab sampling, 1993 grab sampling and 1996 headspace flammability screening for tank 241-AP-105. The chemical, radiochemical, physical, and organic results associated with tank 241-AP-105 are presented within this document as indicated in Table B2-1. These results are documented in WHC (1992).

Table B2-1. Analytical Presentation Tables.

Analysis	Table number
1996 Grab Sampling Results	
B2.2.1 Summary data for physical analyses	B2-3 through B2-4
B2.2.2 Summary data for inorganic analyses	B2-5 through B2-25
B2.2.3 Summary data for organic analyses	B2-26 through B2-33
B2.2.4 Summary data for radiochemical analyses	B2-34 through B2-54
B2.3 Summary data for headspace flammability screening	B2-55
1993 Grab Sampling Results	
B2.4.1 Summary data for physical analyses	B2-56 through B2-57
B2.4.2 Summary data for inorganic analyses	B2-58 through B2-84
B2.4.3 Summary data for organic analyses	B2-87 through B2-91
B2.4.4 Summary data for radiochemical analyses	B2-92 through B2-107

The four quality control (QC) parameters assessed in conjunction with the tank 241-AP-105 samples were standard recoveries, spike recoveries, duplicate analyses, and blanks. The QC criteria applied to the 1996 sample data are detailed in the TSAP (Schreiber 1996), the results are discussed in the laboratory final report (Miller 1997), and the 1993 data are discussed in the characterization results report (Welsh 1994). Sample and duplicate pairs in which any of the QC parameters were outside of these limits are footnoted in the "Sample Mean" column of the following data summary tables with an a, b, c, d, e, or f as follows:

- "a" indicates that the standard recovery was below the QC limit.
- "b" indicates that the standard recovery was above the QC limit.
- "c" indicates that the spike recovery was below the QC limit.

- "d" indicates that the spike recovery was above the QC limit.
- "e" indicates that the RPD was above the QC limit.
- "f" indicates that the blank was contaminated.

B2.2 1996 GRAB SAMPLING RESULTS

This section summarizes the analytical results from the August/September 1996 grab sampling. The sections below present the results of physical analyses, inorganic analyses, organic analyses and radiochemical analyses. Detailed analytical results, chain of custody forms, sample breakdowns, sample preparation procedures, and lab work lists can be found in the laboratory data package (Miller 1997).

B2.2.1 Physical Analyses

This subsection summarizes the analytical results of thermal, moisture content, and specific gravity analyses, and the visual check for the presence of an organic layer.

B2.2.1.1 Differential Scanning Calorimetry (DSC). Analyses were performed in duplicate on the direct sample using procedure LA-514-113. No exotherms were observed in any of the samples or their duplicates. Endotherms were observed as expected in the standards, as well as in all samples. The sample endotherms were due mainly or wholly to the presence of water. The average endotherms ranged from 1,203 to 1,803 J/g.

B2.2.1.2 Thermogravimetric Analysis (TGA). All analyses were performed in a nitrogen atmosphere in duplicate on the direct sample, using procedure LA-560-112. Average weight percent of water in the samples ranged from 69.1 to 69.8. The grand mean TGA value of all samples was 69.4 weight percent.

B2.2.1.3 Specific Gravity. Analyses were performed on the direct samples using procedure LA-510-112. Average specific gravity of samples 1C, 2C, 3C and 4 was 1.226, 1.232, 1.231 and 1.242, respectively, with a mean of 1.233.

B2.2.1.4 Appearance/Homogeneity. Observations were performed on the direct sample procedure LA-519-151 at approximately 24 °C (75 °C). Each of the samples was clear with no observable solids. No organic phase was observed.

B2.2.2 Inorganic Analyses

The following sections discuss the types of inorganic analyses performed and results, including pH, hydroxide, ammonia, TOC, TIC, TC, IC analyses and ICP analyses.

B2.2.2.1 Inductively Coupled Plasma/Emission Spectroscopy (for Al and Na). The following analytes were analyzed according to procedure LA-505-161: aluminum, chromium, iron, manganese, nickel, silicon, sodium and uranium. An acid predigestion was performed on ICP samples prior to analysis. All metals other than aluminum and sodium were reported voluntarily, and there was no requirement to hold these data to TSAP's spike duplicate criterion. Aluminum and sodium were the most abundant metals in tank 241-AP-105. The mean values of aluminum and sodium are 1.74E+04 μg/mL and 1.13E+05 μg/mL, respectively.

Interelement data corrections were automatically performed for spectral interferences from calcium on iron, manganese, and silicon; from chromium on iron, silicon and uranium; from iron on chromium, and manganese; from potassium on silicon; from sodium on silicon and nickel; from antimony on nickel; and from uranium on aluminum, chromium, iron, manganese, nickel, and silicon.

The linear concentration range was determined for ICP analytes. The maximum concentration within the linear range (defined as the highest concentration in which the percent recovery of a standard deviates less than five percent from 100 percent with a 5-second signal integration time) was 1,000 μg/mL for both aluminum and sodium.

Aluminum. The aluminum concentration of the preparation blank was less than the detection limit, and was only slightly greater than the detection limit for the field blank, indicating the absence of contamination. Average aluminum concentrations of the samples ranged from 17,200 to 17,500 μg/mL, with a mean of 17,400 μg/mL.

Sodium. The preparation blank concentration was about five orders of magnitude less than the mean of sample values, indicating the absence of contamination. The field blank's sodium concentration was three orders of magnitude less than the lowest mean sample concentration; consequently, it, too was determined to not be contaminated. Average sample sodium concentrations ranged from 112,000 to 113,000 μg/mL, with a grand mean of 113,000 μg/mL.

B2.2.2.2 Kinetic Phosphorescence (for Total Uranium). The analyses for total uranium were performed on direct samples using procedure LA-925-009. The average sample concentrations for total uranium ranged from 14.1 μg/mL to 18.5 μg/mL, with a mean of 16.4 μg/m.

B2.2.2.3 Ion Chromatography (for F, NO_3, NO_2, PO_4, and SO_4). The following anions were determined by using procedure LA-533-105: fluoride, nitrate, nitrite, phosphate, and sulfate. All of the analytes were detected in the waste samples. As was discussed above, tank AP-105 samples were not preserved. Because of the characteristic high pH and radioactivity of the waste, the samples were not likely to be subject to biodegradation, which is generally the greatest source of nitrate deterioration.

Results are presented in Tables B2-16 through B2-21. All the reagent blanks and field blank nitrite concentrations were less than the detection limits, indicating no sample was contaminated. All observed samples met the accuracy and precision control limit.

Fluoride. Concentrations ranged from 254 to 348 μg/mL with a mean of 308 μg/mL.

Nitrate. Concentrations ranged from 95,000 to 102,000 μg/mL, with a mean of 99,300 μg/mL.

Nitrite. Concentrations ranged from 45,700 to 48,100 μg/mL, with a mean of 46,900 μg/mL.

Phosphate. Concentrations ranged from 1,150 to 1,540 μg/mL with a mean of 1,360 μg/mL.

Sulfate. Concentrations ranged from 1,930 to 2,060 μg/mL with a mean of 2,180 μg/mL.

B2.2.2.4 Selective Ion Electrode (for ammonia). The ammonia analysis was performed by procedure LA-631-001 on direct waste sample by selective ion electrode using the double increment known additions method. Ammonia concentration was less than the detection limit for the field blank and for the reagent blank, indicating the absence of blank contamination. Sample concentrations were low, ranging from 20 to 64.8 μg NH_3/mL, with a mean concentration of 49.3 μg NH_3/mL.

B2.2.2.5 Titration (for hydroxide). Hydroxide was determined by using procedure LA-211-102 on direct waste samples. The field blank hydroxide concentration was less than the detection limit, and was determined to not be contaminated. Sample hydroxide concentrations ranged from 31,800 to 36,100 μg/mL. The mean hydroxide concentration of the three samples was 33,500 μg/mL.

B2.2.2.6 pH Meter/Electrode (for hydrogen ion activity). Analyses were performed on the direct samples using procedure LA-212-106. The pH of samples 1C, 2C, and 3C was 13.31, 13.49 and 13.45, respectively.

B2.2.2.7 Combustion and Coulometry (for total carbon). Total carbon (TC) analyses were performed on direct samples using procedure LA-344-105. Total carbon analysis is a subset of the procedure for total organic carbon. Total carbon concentrations of the samples ranged from 4,650 μg C/mL to 4,810 μg C/mL. The mean concentration of the three samples was 4,710 μg/mL.

B2.2.2.8 Coulometry (for total inorganic carbon). Total inorganic carbon (TIC) analyses were performed on direct samples with procedure LA-342-100. Carbonate concentrations of the samples ranged from 2,510 μg C/mL to 2,740 μg C/mL. The mean concentration of the three samples was 2,680 μg C/mL.

B2.2.2.9 Combustion and Coulometry (for total organic carbon). Total organic carbon (TOC) analyses were performed using procedure LA-344-105 on direct waste samples. TOC concentrations of the samples, including the tank surface sample, ranged from 1,440 μg C/mL to 1,530 μg C/mL. The mean concentration of the four samples was 1,490 μg C/mL.

B2.2.3 Organic Analyses

The following sections discuss organic analyses for volatile organic compounds and semi-volatile organic compounds.

B2.2.3.1 GC/MS (for volatile organic compounds). The samples were analyzed using procedure LA-523-405, a purge and trap/gas chromatograph-mass spectrometer instrumental method. No target analytes were observed in any of the samples above the notification limit. Acetone was observed in all three samples with the concentrations ranging from 490 (estimated) to 550 μg/L. All other target analytes were below quantitation limit. Information on tentatively identified compounds (TIDs) is available in the raw data section on the laboratory report (Miller 1997).

B2.2.3.2 GC/MS (for Semivolatile Organic Compounds). The samples were extracted with a semi-micro continuous liquid/liquid extractor using procedure LA-523-132. The sample extracts were analyzed by a gas chromatograph/mass spectrometer instrument using procedure LA-523-406.

Many TIDs were observed in the tank 241-AP-105 samples (Miller 1997). All the target compounds are below or only slightly over their quantitation limits.

B2.2.4 Radiochemical Analyses

The following sections discuss radiochemical analyses including GEA, AEA, alpha proportional counting, beta proportional counting, separation/proportional counting, liquid scintillation analyses, internal proportional counter, and ion exchange/GEA.

B2.2.4.1 Gamma Energy Analysis (for ^{137}Cs, ^{134}Cs, ^{94}Nb, ^{106}Ru/Rh, ^{95}Nb, ^{144}Ce/Pr, ^{60}Co, $^{154/55}$Eu, ^{226}Ra, and ^{113}Sn). The activities of the following radionuclides were determined by gamma energy analysis according to procedure LA-548-121: ^{137}Cs, ^{134}Cs, ^{94}Nb, ^{106}Ru/Rh, ^{95}Nb, ^{144}Ce/Pr, ^{60}Co, $^{154/55}$Eu, ^{226}Ra, and ^{113}Sn. The activity of ^{129}I was determined by low energy gamma analysis according to procedure LA-378-103.

B2.2.4.2 Alpha Energy Analysis (for ^{241}Am, $^{243/244}$Cm, $^{239/240}$Pu and ^{238}Pu). The following radionuclides were evaluated by alpha energy analysis according to procedure LA-953-103 for ^{241}Am and $^{243/244}$Cm, LA-943-128 for $^{239/240}$Pu and ^{238}Pu.

B2.2.4.3 Alpha Proportional Counting (for total alpha). Total alpha was analyzed on acid predigested samples by alpha proportional counting according to procedure LA-508-101.

B2.2.4.4 Beta Proportional Counting (for Total Beta). Total beta was analyzed on acid predigested samples by alpha proportional counting according to procedure LA-508-101.

B2.2.4.5 Separation/ Proportional Counting (for $^{89/90}Sr$). The activity of $^{89/90}Sr$ was evaluated by beta proportional counting according to procedure LA-220-101.

B2.2.4.6 Liquid Scintillation (for Tritium, ^{14}C, ^{79}Se, and ^{99}Tc). Tritium, ^{14}C, ^{79}Se, and ^{99}Tc were analyzed by liquid scintillation (LS) according to procedures LA-218-114 of Lachat LS, LA-348-104 of LS, LA-365-132 of ion exchange/distillation LS, and LA-438-101 of extraction LS, respectively.

B2.2.4.7 Internal Proportional Counter (for ^{237}Np). Neptunium-237 analyses were performed on previously acid digested samples using procedure LA-933-141.

B2.2.4.8 Ion Exchange/GEA (for ^{129}I). Iodine-129 analysis was performed on direct samples using procedure LA-378-103.

Table B2-3. 1996 Grab Sampling Results for Tank 241-AP-105: Percent Water (TGA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				%	%	%
S96V000047	R1(330°)	587	Grab sample	70.03	69.5	69.765
S96V000048	R1(90°)	221	Grab sample	69.34	69.43	69.385
S96V000049		688	Grab sample	69.38	69.32	69.35
S96V000053		1,041	Grab sample	69.2	68.95	69.075

Table B2-4. 1996 Grab Sampling Results from Tank 241-AP-105: Specific Gravity.

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				unitless	unitless	unitless
S96V000047	R1(330°)	587	Grab sample	1.2294	1.2228	1.2261
S96V000048	R1(90°)	221	Grab sample	1.2349	1.228	1.23145
S96V000049		688	Grab sample	1.2347	1.2272	1.23095
S96V000053		1,041	Grab sample	1.2473	1.2356	1.24145

Table B2-5. 1996 Grab Sampling Results for Tank 241-AP-105: Aluminum (ICP).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				μg/mL	μg/mL	μg/mL
S96V000050	R1(330°)	587	Grab sample	17,400	17,500	17,450
S96V000051	R1(90°)	221	Grab sample	17,700	16,700	17,200
S96V000052		688	Grab sample	17,200	17,600	17,400
S96V000054		1,041	Grab sample	17,700	17,300	17,500
S96V000060		n/a	Field blank	7.42	6.98	7.2[QC:f]

Table B2-6. 1996 Grab Sampling Results for Tank 241-AP-105: Chromium (ICP).

Sample Number	Sample Riser	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				μg/mL	μg/mL	μg/mL
S96V000050	R1(330°)	587	Grab sample	213	213	213
S96V000051	R1(90°)	221	Grab sample	216	205	210.5
S96V000052		688	Grab sample	211	215	213
S96V000054		1,041	Grab sample	216	211	213.5
S96V000060		n/a	Field blank	< 0.5	< 0.5	< 0.5

Table B2-7. 1996 Grab Sampling Results for Tank 241-AP.-105: Iron (ICP).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µg/mL	µg/mL	µg/mL
S96V000050	R1(330°)	587	Grab sample	< 12.5	< 12.5	< 12.5
S96V000051	R1(90°)	221	Grab sample	< 12.5	< 12.5	< 12.5
S96V000052		688	Grab sample	< 12.5	< 12.5	< 12.5
S96V000054		1,041	Grab sample	< 12.5	< 12.5	< 12.5
S96V000060		n/a	Field blank	< 2.5	< 2.5	< 2.5

Table B2-8. 1996 Grab Sampling Results for Tank 241-AP.-105: Manganese (ICP).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µg/mL	µg/mL	µg/mL
S96V000050	R1(330°)	587	Grab sample	< 2.5	< 2.5	< 2.5
S96V000051	R1(90°)	221	Grab sample	< 2.5	< 2.5	< 2.5
S96V000052		688	Grab sample	< 2.5	< 2.5	< 2.5
S96V000054		1,041	Grab sample	< 2.5	< 2.5	< 2.5
S96V000060		n/a	Field blank	< 0.5	< 0.5	< 0.5

Table B2-9. 1996 Grab Sampling Results for Tank 241-AP-105: Nickel (ICP).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µg/mL	µg/mL	µg/mL
S96V000050	R1(330°)	587	Grab sample	< 5	< 5	< 5
S96V000051	R1(90°)	221	Grab sample	< 5	< 5	< 5
S96V000052		688	Grab sample	< 5	< 5	< 5
S96V000054		1,041	Grab sample	< 5	< 5	< 5
S96V000060		n/a	Field blank	< 1	< 1	< 1

Table B2-10. 1996 Grab Sampling Results for Tank 241-AP-105: Silicon (ICP).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µg/mL	µg/mL	µg/mL
S96V000050	R1(330°)	587	Grab sample	94.4	73.7	84.05[QC:,f]
S96V000051	R1(90°)	221	Grab sample	84.4	83.6	84[QC:f]
S96V000052		688	Grab sample	83.6	86.9	85.25[QC:f]
S96V000054		1,041	Grab sample	90.9	85.1	88[QC:f]
S96V000060		n/a	Field blank	68.2	74.3	71.25[QC:f]

Table B2-11. 1996 Grab Sampling Results for Tank 241-AP-105: Sodium (ICP).

Sample Number	Sample Location	Sample Depth (cm)	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest				µg/mL	µg/mL	µg/mL
S96V000050	R1(330°)	587	Grab sample	1.130E+05	1.130E+05	1.130E+05[QC:c]
S96V000051	R1(90°)	221	Grab sample	1.160E+05	1.090E+05	1.125E+05
S96V000052		688	Grab sample	1.100E+05	1.130E+05	1.115E+05
S96V000054		1,041	Grab sample	1.140E+05	1.120E+05	1.130E+05
S96V000060		n/a	Field blank	49	55	52[QC:f]

Table B2-12. 1996 Grab Sampling Results for Tank 241-AP-105: Total Uranium (ICP).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µg/mL	µg/mL	µg/mL
S96V000050	R1(330°)	587	Grab sample	< 125	< 125	< 125
S96V000051	R1(90°)	221	Grab sample	< 125	< 125	< 125
S96V000052		688	Grab sample	< 125	< 125	< 125
S96V000054		1,041	Grab sample	< 125	< 125	< 125
S96V000060		n/a	Field blank	< 25	< 25	< 25

Table B2-13. 1996 Grab Sampling Results for Tank 241-AP-105: Total Uranium (Uranium Gross [Kinetic Phosphorescence]).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000047	R1(330°)	587	Grab sample	14.2	13.9	14.05[QC:f]
S96V000048	R1(90°)	221	Grab sample	19.7	17.3	18.5
S96V000049		688	Grab sample	16.7	N/A	16.7
S96V000058		n/a	Field blank	< 0.0037	< 0.0037	< 0.0037[QC:f]

Note:

N/A = not available

Table B2-14. 1996 Grab Sampling Results for Tank 241-AP-105: Fluoride (IC).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000047	R1(330°)	587	Grab sample	323.4	N/A	323.4
S96V000048	R1(90°)	221	Grab sample	253.9	N/A	253.9
S96V000049		688	Grab sample	348.5	N/A	348.5
S96V000058		n/a	Field blank	< 0.072	N/A	< 0.072

Table B2-15. 1996 Grab Sampling Results for Tank 241-AP-105: Nitrate (IC).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000047	R1(330°)	587	Grab sample	95,030	N/A	95,030
S96V000048	R1(90°)	221	Grab sample	1.008E+05	N/A	1.008E+05
S96V000049		688	Grab sample	1.019E+05	N/A	1.019E+05
S96V000058		n/a	Field blank	0.863	N/A	0.863

Table B2-16. 1996 Grab Sampling Results for Tank 241-AP-105: Nitrite (IC).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μg/mL	μg/mL	μg/mL
S96V000047	R1(330°)	587	Grab sample	45,690	N/A	45,690
S96V000048	R1(90°)	221	Grab sample	46,760	N/A	46,760
S96V000049		688	Grab sample	48,100	N/A	48,100
S96V000058		n/a	Field blank	< 0.648	N/A	< 0.648

Table B2-17. 1996 Grab Sampling Results for Tank 241-AP-105: Phosphate (IC).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μg/mL	μg/mL	μg/mL
S96V000047	R1(330°)	587	Grab sample	1,151	N/A	1,151
S96V000048	R1(90°)	221	Grab sample	1,387	N/A	1,387
S96V000049		688	Grab sample	1,538	N/A	1,538
S96V000058		n/a	Field blank	< 0.72	N/A	< 0.72

Table B2-18. 1996 Grab Sampling Results for Tank 241-AP-105: Sulfate (IC).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μg/mL	μg/mL	μg/mL
S96V000047	R1(330°)	587	Grab sample	1,933		1,933
S96V000048	R1(90°)	221	Grab sample	2,538		2,538
S96V000049		688	Grab sample	2,055		2,055
S96V000058		n/a	Field blank	14.69		14.69

Table B2-19. 1996 Grab Sampling Results from Tank 241-AP-105: pH Measurement (pH).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				unitless	unitless	unitless
S96V000047	R1(330°)	587	Grab sample	13.31	13.35	13.33
S96V000048	R1(90°)	221	Grab sample	13.49	13.48	13.485
S96V000049		688	Grab sample	13.45	13.46	13.455

Table B2-20. 1996 Grab Sampling Results for Tank 241-AP-105: Hydroxide (OH Direct).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μg/mL	μg/mL	μg/mL
S96V000047	R1(330°)	587	Grab sample	31,800	31,300	31,550
S96V000048	R1(90°)	221	Grab sample	32,700	33,200	32,950
S96V000049		688	Grab sample	36,100	36,000	36,050
S96V000058		n/a	Field blank	< 63	< 63	< 63

Table B2-21. 1996 Grab Sampling Results for Tank 241-AP-105: Ammonium (Ion Selective Electrode).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μg/mL	μg/mL	μg/mL
S96V000047	R1(330°)	587	Grab sample	20	N/A	20[QC:f]
S96V000048	R1(90°)	221	Grab sample	63.2	N/A	63.2[QC:f]
S96V000049		688	Grab sample	64.8	N/A	64.8[QC:f]
S96V000058		n/a	Field blank	< 5	N/A	< 5[QC:f]

Table B2-22. 1996 Grab Sampling Results for Tank 241-AP-105: Total Carbon (Furnace Oxidation).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μg/mL	μg/mL	μg/mL
S96V000047	R1(330°)	587	Grab sample	4,670	N/A	4,670[QC:f]
S96V000048	R1(90°)	221	Grab sample	4,650	N/A	4,650[QC:f]
S96V000049		688	Grab sample	4,810	N/A	4,810[QC:f]
S96V000058		n/a	Field blank	50.6	N/A	50.6[QC:f]

Table B2-23. 1996 Grab Sampling Results for Tank 241-AP-105: Total Inorganic Carbon.

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μg/mL	μg/mL	μg/mL
S96V000047	R1(330°)	587	Grab sample	2,740	N/A	2,740[QC:f]
S96V000048	R1(90°)	221	Grab sample	2,780	N/A	2,780[QC:f]
S96V000049		688	Grab sample	2,510	N/A	2,510[QC:f]
S96V000058		n/a	Field blank	7	N/A	7[QC:f]

Table B2-24. 1996 Grab Sampling Results for Tank 241-AP-105: Total Organic Carbon (Furnace Oxidation).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μg/mL	μg/mL	μg/mL
S96V000047	R1(330°)	587	Grab sample	1,500	N/A	1,500[QC:f]
S96V000048	R1(90°)	221	Grab sample	1,480	N/A	1,480[QC:f]
S96V000049		688	Grab sample	1,530	N/A	1,530[QC:f]
S96V000053		1,041	Grab sample	1,440	N/A	1,440[QC:f]
S96V000058		n/a	Field blank	7.7	N/A	7.7[QC:f]

Table B2-25. 1996 Grab Sampling Results for Tank 241-AP-105: 1-Butanol (VOA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000042	n/a	n/a	Trip blank	< 25	N/A	< 25
S96V000039	R1(330°)	587	Grab sample	< 25	N/A	< 25
S96V000040	R1(90°)	221	Grab sample	< 25	N/A	< 25
S96V000041		688	Grab sample	< 25	N/A	< 25
S96V000061		n/a	Field blank	< 25	N/A	< 25

Table B2-26. 1996 Grab Sampling Results for Tank 241-AP-105: 2-Butanone (VOA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000042	n/a	n/a	Trip blank	<0.50	N/A	<0.50
S96V000039	R1(330°)	587	Grab sample	<0.50	N/A	<0.50
S96V000040	R1(90°)	221	Grab sample	<0.50	N/A	<0.50
S96V000041		688	Grab sample	<0.50	N/A	<0.50
S96V000061		n/a	Field blank	<0.50	N/A	<0.50

Table B2-27. 1996 Grab Sampling Results for Tank 241-AP-105: 2-Hexanone (VOA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000042	n/a	n/a	Trip blank	<0.50	N/A	<0.50
S96V000039	R1(330°)	587	Grab sample	<0.50	N/A	<0.50
S96V000040	R1(90°)	221	Grab sample	<0.50	N/A	<0.50
S96V000041		688	Grab sample	<0.50	N/A	<0.50
S96V000061		n/a	Field blank	<0.50	N/A	<0.50

Table B2-28. 1996 Grab Sampling Results for Tank 241-AP-105: 2-Pentanone (VOA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000042	n/a	n/a	Trip blank	<0.50	N/A	<0.50
S96V000039	R1(330°)	587	Grab sample	<0.50	N/A	<0.50
S96V000040	R1(90°)	221	Grab sample	<0.50	N/A	<0.50
S96V000041		688	Grab sample	<0.50	N/A	<0.50
S96V000061		n/a	Field blank	<0.50	N/A	<0.50

Table B2-29. 1996 Grab Sampling Results for Tank 241-AP-105: 4-Methyl-2-Pentanone (VOA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000042	n/a	n/a	Trip blank	<0.50	N/A	<0.50
S96V000039	R1(330°)	587	Grab sample	<0.50	N/A	<0.50
S96V000040	R1(90°)	221	Grab sample	<0.50	N/A	<0.50
S96V000041		688	Grab sample	<0.50	N/A	<0.50
S96V000061		n/a	Field blank	<0.50	N/A	<0.50

Table B2-30. 1996 Grab Sampling Results for Tank 241-AP-105: Acetone (VOA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000042	n/a	n/a	Trip blank	< 0.5	N/A	< 0.5
S96V000039	R1(330°)	587	Grab sample	0.55	N/A	0.55
S96V000040	R1(90°)	221	Grab sample	0.49	N/A	0.49
S96V000041		688	Grab sample	0.44	N/A	0.44
S96V000061		n/a	Field blank	< 0.5	N/A	< 0

Table B2-31. 1996 Grab Sampling Results for Tank 241-AP-105:Tetrahydrofuran (VOA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000042	n/a	n/a	Trip blank	< 0.5	N/A	< 0.5
S96V000039	R1(330°)	587	Grab sample	< 0.5	N/A	< 0.5
S96V000040	R1(90°)	221	Grab sample	< 0.5	N/A	< 0.5
S96V000041		688	Grab sample	< 0.5	N/A	< 0.5
S96V000061		n/a	Field blank	< 0.5	N/A	< 0.5

Table B2-32. 1996 Grab Sampling Results for Tank 241-AP-105:
2-Butoxyethanol (SVOA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000046	n/a	n/a	Trip blank	< 0.5	N/A	< 0.5
S96V000043	R1(330°)	587	Grab sample	< 0.5	N/A	< 0.5
S96V000044	R1(90°)	221	Grab sample	< 0.5	N/A	< 0.5
S96V000045		688	Grab sample	< 0.5	N/A	< 0.5
S96V000062		n/a	Field blank	< 0.5	N/A	< 0.5

Table B2-33. 1996 Grab Sampling Results for Tank 241-AP-105: Tri-n-butylphosphate.

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
S96V000046	n/a	n/a	Trip blank	0.026[QC:f]	N/A	< 0.5
S96V000043	R1(330°)	587	Grab sample	2.1[QC:f]	N/A	< 0.5
S96V000044	R1(90°)	221	Grab sample	2.4[QC:f]	N/A	< 0.5
S96V000045		688	Grab sample	1.5[QC:f]	N/A	< 0.5
S96V000062		n/a	Field blank	< 0.2	N/A	< 0.5

Table B2-34. 1996 Grab Sampling Results for Tank 241-AP-105: Americium-241 (AEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 2.690E-04	< 3.000E-04	< 2.845E-04
S96V000051	R1(90°)	221	Grab sample	< 3.080E-04	< 3.560E-04	< 3.320E-04
S96V000052		688	Grab sample	< 2.610E-04	< 3.580E-04	< 3.1E-04
S96V000060		n/a	Field blank	< 3.020E-04	< 3.040E-04	< 3.030E-04

Table B2-35. 1996 Grab Sampling Results for Tank 241-AP-105: Cm-243/244 (AEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 2.690E-04	< 3.000E-04	< 2.845E-04
S96V000051	R1(90°)	221	Grab sample	< 3.080E-04	< 3.560E-04	< 3.320E-04
S96V000052		688	Grab sample	< 2.610E-04	< 3.580E-04	< 3.095E-04
S96V000060		n/a	Field blank	< 3.020E-04	< 3.040E-04	< 3.030E-04

Table B2-36. 1996 Grab Sampling Results for Tank 241-AP-105: Plutonium-238 (Total Pu).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 1.770E-04	N/A	< 1.770E-04
S96V000051	R1(90°)	221	Grab sample	< 2.020E-04	N/A	< 2.020E-04
S96V000052		688	Grab sample	< 1.870E-04	N/A	< 1.870E-04
S96V000060		n/a	Field blank	< 1.770E-04	N/A	< 1.770E-04

Table B2-37. 1996 Grab Sampling Results for Tank 241-AP-105: Plutonium-239/40 (Total Pu).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				μCi/mL	μCi/mL	μCi/mL
S96V000050	R1(330°)	587	Grab sample	< 1.770E-04	N/A	< 1.770E-04
S96V000051	R1(90°)	221	Grab sample	< 2.020E-04	N/A	< 2.020E-04
S96V000052		688	Grab sample	< 1.870E-04	N/A	< 1.870E-04
S96V000060		n/a	Field blank	< 1.770E-04	N/A	< 1.770E-04

Table B2-38. 1996 Grab Sampling Results for Tank 241-AP-105: Total Alpha (Alpha Radiation).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				μCi/mL	μCi/mL	μCi/mL
S96V000050	R1(330°)	587	Grab sample	< 0.0102	< 0.00676	< 0.00848
S96V000051	R1(90°)	221	Grab sample	< 0.0102	< 0.00505	< 0.007625
S96V000052		688	Grab sample	< 0.00505	< 0.00505	< 0.00505
S96V000054		1,041	Grab sample	< 0.00505	< 0.00505	< 0.00505
S96V000060		n/a	Field blank	< 2.500E-05	< 4.190E-05	< 3.345E-05

Table B2-39. 1996 Grab Sampling Results for Tank 241-AP-105: Total Beta (Alpha Radiation).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				μCi/mL	μCi/mL	μCi/mL
S96V000050	R1(330°)	587	Grab sample	108	108	108[QC:f]
S96V000051	R1(90°)	221	Grab sample	112	106	109[QC:f]
S96V000052		688	Grab sample	107	108	107.5[QC:f]
S96V000054		1,041	Grab sample	111	110	110.5[QC:f]
96V000060		n/a	Field blank	3.020E-04	2.190E-04	2.605E-04[QC:,f]

Table B2-40. 1996 Grab Sampling Results for Tank 241-AP-105: Strontium-89/90.

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				μCi/mL	μCi/mL	μCi/mL
S96V000050	R1(330°)	587	Grab sample	0.314	N/A	0.314[QC:f]
S96V000051	R1(90°)	221	Grab sample	0.316	N/A	0.316[QC:f]
S96V000052		688	Grab sample	0.00103	N/A	0.00103[QC:f]
S96V000060		n/a	Field blank	2.330E-04	N/A	2.330E-04[QC:f]

Table B2-41. 1996 Grab Sampling Results for Tank 241-AP-105: Carbon-14.

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μCi/mL	μCi/mL	μCi/mL
S96V000047	R1(330°)	587	Grab sample	3.910E-04	3.670E-04	3.790E-04
S96V000048	R1(90°)	221	Grab sample	3.980E-04	N/A	3.980E-04
S96V000049		688	Grab sample	2.130E-04	N/A	2.130E-04
S96V000058		n/a	Field blank	1.480E-05	< 2.100E-06	< 8.450E-06

Table B2-42. 1996 Grab Sampling Results for Tank 241-AP-105: Iodine-129.

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				μCi/mL	μCi/mL	μCi/mL
S96V000047	R1(330°)	587	Grab sample	1.150E-04	1.110E-04	1.130E-04
S96V000048	R1(90°)	221	Grab sample	1.400E-04	1.440E-04	1.420E-04[QC:a]
S96V000049		688	Grab sample	1.190E-04	N/A	1.190E-04[QC:a]
S96V000058		n/a	Field blank	< 1.630E-05	< 1.530E-05	< 1.580E-05[QC:a]

Table B2-43. 1996 Grab Sampling Results for Tank 241-AP-105: Neptunium-237.

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 0.00102	N/A	< 0.00102[QC:a]
S96V000051	R1(90°)	221	Grab sample	< 0.0017	N/A	< 0.0017[QC:a]
S96V000052		688	Grab sample	< 0.0012	N/A	< 0.0012[QC:a]
S96V000060		n/a	Field blank	< 0.00174	N/A	< 0.00174[QC:a]

Table B2-44. 1996 Grab Sampling Results for Tank 241-AP-105: Tritium (Scintillation).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids				µCi/mL	µCi/mL	µCi/mL
S96V000047	R1(330°)	587	Grab sample	0.00465	N/A	0.00465[QC:f]
S96V000048	R1(90°)	221	Grab sample	0.00104	N/A	0.00104[QC:f]
S96V000049		688	Grab sample	0.0276	N/A	0.0276[QC:f]
S96V000058		n/a	Field blank	8.980E-05	N/A	8.980E-05[QC:f]

Table B2-45. 1996 Grab Sampling Results for Tank 241-AP-105: Technetium-99.

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	0.0558	N/A	0.0558
S96V000051	R1(90°)	221	Grab sample	0.0644	N/A	0.0644
S96V000052		688	Grab sample	0.0596	N/A	0.0596
S96V000060		n/a	Field blank	< 3.580E-04	N/A	< 3.580E-04

Table B2-46. 1996 Grab Sampling Results for Tank 241-AP-105: Ce/Pr-144 (GEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				μCi/mL	μCi/mL	μCi/mL
S96V000050	R1(330°)	587	Grab sample	< 0.7198	< 0.727	< 0.7234
S96V000051	R1(90°)	221	Grab sample	< 0.7305	N/A	< 0.7305
S96V000052		688	Grab sample	< 0.7225	N/A	< 0.7225
S96V000060		n/a	Field blank	< 0.05239	N/A	< 0.05239

Table B2-47. 1996 Grab Sampling Results for Tank 241-AP-105: Cesium-134 (GEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				μCi/mL	μCi/mL	μCi/mL
S96V000050	R1(330°)	587	Grab sample	< 0.05501	< 0.0546	< 0.054805
S96V000051	R1(90°)	221	Grab sample	< 0.05593	N/A	< 0.05593
S96V000052		688	Grab sample	< 0.05546	N/A	< 0.05546
S96V000060		n/a	Field blank	< 0.004177	N/A	< 0.004177

Table B2-48. 1996 Grab Sampling Results for Tank 241-AP-105: Cesium-137 (GEA).

Sample Number	Sample Location	Sample Dept (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				μCi/mL	μCi/mL	μCi/mL
S96V000050	R1(330°)	587	Grab sample	110.5	112	111.25
S96V000051	R1(90°)	221	Grab sample	114.5	N/A	114.5
S96V000052		688	Grab sample	112	N/A	112
S96V000060		n/a	Field blank	< 0.01489	N/A	< 0.01489

Table B2-49. 1996 Grab Sampling Results for Tank 241-AP-105: Cobalt-60 (GEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 0.006071	< 0.00731	< 0.0066905
S96V000051	R1(90°)	221	Grab sample	< 0.007572	N/A	< 0.007572
S96V000052		688	Grab sample	< 0.006711	N/A	< 0.006711
S96V000060		n/a	Field blank	< 0.006711	N/A	< 0.006711

Table B2-50. 1996 Grab Sampling Results for Tank 241-AP-105: Europium-154 (GEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 0.02356	< 0.0282	< 0.02588
S96V000051	R1(90°)	221	Grab sample	< 0.02411	N/A	< 0.02411
S96V000052		688	Grab sample	< 0.02631	N/A	< 0.02631
S96V000060		n/a	Field blank	< 0.01528	N/A	< 0.01528

Table B2-51. 1996 Grab Sampling Results for Tank 241-AP-105: Europium-155 (GEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 0.2024	< 0.204	< 0.2032
S96V000051	R1(90°)	221	Grab sample	< 0.205	N/A	< 0.205
S96V000052		688	Grab sample	< 0.2044	N/A	< 0.2044
S96V000060		n/a	Field blank	< 0.01802	N/A	< 0.01802

Table B2-52. 1996 Grab Sampling Results for Tank 241-AP-105: Niobium-94 (GEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 0.01338	< 0.0134	< 0.01339
S96V000051	R1(90°)	221	Grab sample	< 0.0141	N/A	< 0.0141
S96V000052		688	Grab sample	< 0.01371	N/A	< 0.01371
S96V000060		n/a	Field blank	< 0.005693	N/A	< 0.005693

Table B2-53. 1996 Grab Sampling Results for Tank 241-AP-105: Radium-226 (GEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 1.427	< 1.43	< 1.4285
S96V000051	R1(90°)	221	Grab sample	< 1.449	N/A	< 1.449
S96V000052		688	Grab sample	< 1.432	N/A	< 1.432
S96V000060		n/a	Field blank	< 0.1119	N/A	< 0.1119

Table B2-54. 1996 Grab Sampling Results for Tank 241-AP-105: Ruthenium/Rhodium-106 (GEA).

Sample Number	Sample Location	Sample Depth (cm)	Sample Type	Result	Duplicate	Mean
Liquids: acid digest				µCi/mL	µCi/mL	µCi/mL
S96V000050	R1(330°)	587	Grab sample	< 1.1	< 1.11	< 1.105
S96V000051	R1(90°)	221	Grab sample	< 1.126	N/A	< 1.126
S96V000052		688	Grab sample	< 1.112	N/A	< 1.112
S96V000060		n/a	Field blank	< 0.1058	N/A	< 0.1058

B2.3 1996 HEADSPACE FLAMMABILITY SCREENING RESULTS

As requested in the TSAP (Schreiber 1996), the tank 241-AP-105 headspace was sampled and analyzed for the presence of flammable gases prior to grab sampling. The safety screening DQO notification limit for flammable gas concentration is 25 percent of the LFL

(Dukelow et al. 1995). The combustible gas meter used to sample the tank headspace reports results as a percent of the lower explosive limit (LEL). Because the National Fire Protection Association defines the terms LFL and LEL identically, the two terms may be used interchangeably (NFPA 1995). The reported LEL of 0 percent was well below the safety screening DQO limit of 25 percent of the LFL. In addition, the concentration of oxygen gas, ammonia gas, and total organic carbon vapor were determined. Table B2-55 shows the results of the combustible gas monitoring.

Table B2-55. Headspace Flammability Screening for Tank 241-AP-105.

Vapor Characteristic Measured	Riser 1 at 90°		Riser 1 at 330°	
	3-ft Depth (Sample Riser)	20-ft Depth (Headspace)	3-ft depth (Sample Riser)	20-ft Depth (Headspace)
Flammability vapor concentration as percent of the LFL	0%	0%	0%	0%
Volume percent oxygen gas	21.0%	20.9%	21.0%	21.0%
Concentration of ammonia gas	0 ppm	20 ppm	2 ppm	70 ppm
Concentration of total organic carbon vapor	0 ppm	3 ppm	1 ppm	6 ppm

B2.4 1993 GRAB SAMPLING RESULTS

This section summarizes the analytical results from the March 1993 grab sampling. The sections below present the results of physical analyses, inorganic analyses, organic analyses and radiochemical analyses. Detailed descriptions of analytical results and data quality control can be found in the laboratory data package (Welsh 1994). The bottom two samples taken from depths of 43 cm (17 in.) and 107 cm (42 in.) were used to characterize the liquid portion of the 583 kL (154 kgal) of solid/liquid waste in the tank bottom.

B2.4.1 Physical Properties

This subsection summarizes the analytical results of moisture content and specific gravity for the presence of an organic layer.

B2.4.1.1 Specific Gravity and Weight Percent Water. The specific gravity of the tank was determined to be 1.336, and the weight percent of water was 60.3 percent.

B2.4.1.2 Rheology. Because of the lack of rheological estimates, the viscosity of the waste was estimated. The specific gravity of the waste is 1.336, and the tank is approximately 60 percent water, by weight. Because a 40 percent, by weight, sodium nitrate solution has a specific gravity of 1.32, its corresponding viscosity of 2.23 centipoise was estimated to be the viscosity of the waste. The viscosity, however, should be determined experimentally before conducting retrieval operations.

B2.4.2 Inorganic Analyses

The following sections discuss the types and results of inorganic analyses performed, including ICP, IC, and measurement of hydroxide, ammonia, TOC and TIC.

B2.4.2.1 Inductively Coupled Plasma Spectroscopy. The major waste constituents identified by inductively coupled plasma spectroscopy were Al, Sb, Ba, Be, Cd, Cr, Fe, Pb, Ni, P, K, Ag and Na. Arsenic and selenium were determined by gaseous hydride atomic absorption spectroscopy, while mercury was analyzed by cold vapor atomic absorption spectroscopy. The laser fluorimetry method was utilized to evaluate uranium.

Aluminum, potassium, and sodium were the analytes present in the greatest concentration; each had concentrations over 8,000 ppm. Mercury was the only elemental constituent not detected by the laboratory methods.

B2.4.2.2 Ion Chromatography. The most abundant anion in tank 241-AP-105 waste is nitrate. Carbonate, chloride, hydroxide, nitrite, and sulfate were present in concentrations above 1,000 ppm; also present in lesser amounts were cyanide and phosphate. Ammonia was not detected by the laboratory analyses. The IC data were inconclusive as to whether or not fluoride was present in tank 241-AP-105, because an unidentified compound coeluted with fluoride and interfered with peak integration. A single composite sample was then analyzed by an ion selective electrode technique.

B2.4.2.3 Potentiometric Autotitration (for OH^- and pH). Only the composite samples were used to evaluate ammonia, cyanide, and hydroxide. The hydroxide concentrations of two composite samples were determined to be 54.8 g/L (3.22*M*), and 53.1 g/L (3.12*M*), yielding a mean hydroxide concentration of 54.0 g/L (3.18*M*). The resulting pH value calculated from each of the three concentrations is 14.5. Solution behavior for multicomponent systems with high ionic contents is not well quantified. The pH value determined from the hydroxide concentration is probably more representative of the tank waste conditions, of the two value ranges presented. Conventional pH meters are often neither sufficiently accurate nor calibrated correctly for strongly alkaline, high ionic strength solutions. However, solutions with pH values near or above 14 are uncommon. Simply calculating the pH value from the hydroxide concentration, without accounting for phase equilibrium conditions, may also be incorrect. For this tank, the pH of the waste is in excess of 13, and may be as high as 14.5.

B2.4.3 Organic Constituents

Except for acetone, none of the target analytes associated with the volatile and semi-volatile organic analyses were detected in tank 241-AP-105. This was expected because the tank is well ventilated and historical records indicate that only small concentrations of volatile and semivolatile organic compounds were present in dilute noncomplexed (DN) waste. The TOC analysis results showed a mean concentration of 2,570 mg/L in tank 241-AP-105.

B2.4.4 Radiological Determinations

The primary radioactive constituent in tank 241-AP-105 was ^{137}Cs. Also present in detectable concentrations were ^{241}Am, ^{14}C, ^{134}Cs, ^{129}I, ^{237}Np, $^{239/240}Pu$, ^{145}Pm, ^{90}Sr, ^{99}Tc, and ^{3}H. Those analytes not detected by the laboratory included ^{125}Sb, $^{144}Ce/Pr$, ^{60}Co, $^{243/244}Cm$, ^{94}Nb, ^{238}Pu, and $^{106}Ru/Rh$.

Table B2-56. Tank 241-AP-105 Analytical Results of 1993 Sampling: Percent Water.

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	%	%	%
G401	R 1E (90°)	Grab sample	43	55.1	55.1	55.1
G402		Grab sample	338	60.0	60.2	60.1
G407		Grab sample	457	60.3	60.3	60.3
G409		Grab sample	704	64.6	64.5	64.55
G422	R 1NW (330°)	Grab sample	107	59.4	59.2	59.3
G391		Grab sample	292	59.4	59.6	59.5
G392		Grab sample	516	60	60.2	60.1
G396		Grab sample	724	64.8	64.4	64.6
G397		Grab sample	724	63.6	63.6	63.6
G412	R 1SW (210°)	Grab sample	165	55.3	55.4	55.35
G413		Grab sample	373	60.1	60.2	60.15
G417		Grab sample	561	61.4	61.1	61.25
G418		Grab sample	655	64.3	64.4	64.35
G378	n/a	Composite	n/a	60.2	60.3	60.2
G379				60.4	60	60.2

Table B2-57. Tank 241-AP-105 Analytical Results of 1993 Sampling: Specific Gravity.

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	unitless	unitless	unitless
G401	R 1E (90°)	Grab sample	43	1.388	1.39	1.389
G402		Grab sample	338	1.336	1.339	1.3375
G407		Grab sample	457	1.336	1.339	1.3375
G409		Grab sample	704	1.303	1.293	1.298
G422	R 1NW (330°)	Grab sample	107	1.347	1.349	1.348
G391		Grab sample	292	1.34	1.35	1.345
G392		Grab sample	516	1.34	1.34	1.34
G396		Grab sample	724	1.298	1.297	1.2975
G397		Grab sample	724	1.301	1.299	1.3
G412	R 1SW (210°)	Grab sample	165	1.375	1.379	1.377
G413		Grab sample	373	1.332	1.338	1.3335
G417		Grab sample	561	1.326	1.328	1.327
G418		Grab sample	655	1.299	1.301	1.3
G378	n/a	Composite	n/a	1.32	1.348	1.334[QC:e]
G379				1.33	1.328	1.329

Table B2-58. Tank 241-AP-105 Analytical Results of 1993 Sampling: Aluminum (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	μg/mL	μg/mL	μg/mL
G401	R 1E (90°)	Grab sample	43	13,400	14,500	13,950
G402		Grab sample	338	12,200	12,700	12,450
G407		Grab sample	457	11,800	12,100	11,950
G409		Grab sample	704	10,700	10,400	10,550
G422	R 1NW (330°)	Grab sample	107	12,000	11,700	11,900
G391		Grab sample	292	10,800	11,400	11,100
G392		Grab sample	516	11,100	11,400	11,250
G396		Grab sample	724	9,960	9,560	9,760
G397		Grab sample	724	10,300	9,600	9,950
G412	R 1SW (210°)	Grab sample	165	13,400	14,000	13,700
G413		Grab sample	373	12,100	12,500	12,300
G417		Grab sample	561	11,300	11,800	11,550
G418		Grab sample	655	9,950	9,480	9,715
G378	n/a	Composite	n/a	11,500	11,700	11,600
G379				11,300	11,700	11,500

Table B2-59. Tank 241-AP-105 Analytical Results of 1993 Sampling: Antimony (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	μg/mL	μg/mL	μg/mL
G401	R 1E (90°)	Grab sample	43	5.97	< 5.25	< 5.61
G402		Grab sample	338	< 5.25	< 5.25	< 5.25
G407		Grab sample	457	< 12.9	< 12.9	< 12.9
G409		Grab sample	704	< 12.9	< 12.9	< 12.9
G422	R 1NW (330°)	Grab sample	107	< 210	< 210	< 210
G391		Grab sample	292	< 5.25	< 5.25	< 5.25
G392		Grab sample	516	< 5.25	< 5.25	< 5.25
G396		Grab sample	724	< 5.25	< 5.25	< 5.25
G397		Grab sample	724	< 5.25	< 5.25	< 5.25
G412	R 1SW (210°)	Grab sample	165	7.16	6.36	6.76
G413		Grab sample	373	< 5.25	< 5.25	< 5.25
G417		Grab sample	561	< 263	< 263	< 263
G418		Grab sample	655	< 5.25	< 5.25	< 5.25
G378	n/a	Composite	n/a	< 5.25	< 5.25	< 5.25
G379				< 5.25	< 5.25	< 5.25

Table B2-60. Tank 241-AP-105 Analytical Results of 1993 Sampling: Arsenic (AA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	μg/mL	μg/mL	μg/mL
G378	n/a	Composite	n/a	1.04	1.02	1.03
G379				0.844	0.730	0.787

Note:

AA = atomic absorption

Table B2-61. Tank 241-AP-105 Analytical Results of 1993 Sampling: Barium (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	0.428	0.502	0.465
G402		Grab sample	338	0.468	0.549	0.508
G407		Grab sample	457	0.736	0.758	0.747
G409		Grab sample	704	1.48	1.41	1.445
G422	R 1NW (330°)	Grab sample	107	<3.0	<3.0	<3.0
G391		Grab sample	292	0.559	0.487	0.523
G392		Grab sample	516	0.497	0.583	0.54
G396		Grab sample	724	0.487	0.478	0.482[QC:f]
G397		Grab sample	724	0.654	0.541	0.5975[QC:f]
G412	R 1SW (210°)	Grab sample	165	0.521	0.567	0.544
G413		Grab sample	373	0.525	0.545	0.535
G417		Grab sample	561	< 3.75	< 3.75	< 3.75
G418		Grab sample	655	0.531	0.532	0.5315
G378	n/a	Composite	n/a	0.505	0.528	0.5165[QC:f]
G379				0.541	0.554	0.547[QC:f]

Table B2-62. Tank 241-AP-105 Analytical Results of 1993 Sampling: Beryllium (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	1.59	1.76	1.675
G402		Grab sample	338	1.49	1.52	1.505
G407		Grab sample	457	1.64	1.59	1.615
G409		Grab sample	704	1.47	1.34	1.405
G422	R 1NW (330°)	Grab sample	107	<3.0	<3.0	<3.0
G391		Grab sample	292	1.43	1.49	1.46
G392		Grab sample	516	1.45	1.49	1.47
G396		Grab sample	724	1.16	1.18	1.17
G397		Grab sample	724	1.22	1.22	1.22
G412	R 1SW (210°)	Grab sample	165	1.6	1.65	1.625
G413		Grab sample	373	1.45	1.43	1.44
G417		Grab sample	561	< 3.75	< 3.75	< 3.75
G418		Grab sample	655	1.21	1.26	1.235
G378	n/a	Composite	n/a	1.47	1.47	1.47
G379				1.5	1.56	1.53

Table B2-63. Tank 241-AP-105 Analytical Results of 1993 Sampling: Cadmium (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	1.63	1.82	1.725
G402		Grab sample	338	1.69	1.82	1.755
G407		Grab sample	457	1.85	1.78	1.815
G409		Grab sample	704	2.1	1.81	1.955
G422	R 1NW (330°)	Grab sample	107	<6.0	6.05	<6.0
G391		Grab sample	292	1.58	1.69	1.635
G392		Grab sample	516	1.6	1.64	1.62
G396		Grab sample	724	1.75	1.81	1.78
G397		Grab sample	724	1.87	2.07	1.97
G412	R 1SW (210°)	Grab sample	165	1.64	1.75	1.695
G413		Grab sample	373	1.8	1.71	1.755
G417		Grab sample	561	< 7.5	< 7.5	< 7.5
G418		Grab sample	655	1.84	1.9	1.87
G378	n/a	Composite	n/a	2.02	1.97	1.995
G379				2.13	1.96	2.045

Table B2-64. Tank 241-AP-105 Analytical Results of 1993 Sampling: Chromium (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	μg/mL	μg/mL	μg/mL
G401	R 1E (90°)	Grab sample	43	210	228	219
G402		Grab sample	338	191	197	194
G407		Grab sample	457	194	201	197.5
G409		Grab sample	704	179	174	176.5
G422	R 1NW (330°)	Grab sample	107	199	195	197
G391		Grab sample	292	175	184	179.5
G392		Grab sample	516	178	182	180
G396		Grab sample	724	144	147	145.5
G397		Grab sample	724	154	154	154
G412	R 1SW (210°)	Grab sample	165	204	209	206.5
G413		Grab sample	373	186	189	187.5
G417		Grab sample	561	197	201	199
G418		Grab sample	655	156	164	160
G378	n/a	Composite	n/a	193	195	194[QC:c]
G379				192	199	195.5[QC:c]

Table B2-65. Tank 241-AP-105 Analytical Results of 1993 Sampling: Iron (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	μg/mL	μg/mL	μg/mL
G401	R 1E (90°)	Grab sample	43	5.29	7.66	6.475[QC:,f]
G402		Grab sample	338	4.77	5.18	4.975[QC:f]
G407		Grab sample	457	6.05	5.53	5.79
G409		Grab sample	704	7.75	6.71	7.23
G422	R1NW (330°)	Grab sample	107	<15.0	<15.0	<15.0
G391		Grab sample	292	4.72	8.43	6.575[QC:,f]
G392		Grab sample	516	7.96	4.24	6.1[QC:,f]
G396		Grab sample	724	6.83	6.37	6.6[QC:f]
G397		Grab sample	724	11.3	8.07	9.685[QC:,f]
G412	R 1SW (210°)	Grab sample	165	7.73	10.2	8.965[QC:,f]
G413		Grab sample	373	5.9	5.08	5.49[QC:f]
G417		Grab sample	561	18.8	19.7	19.25[QC:f]
G418		Grab sample	655	6.37	6.08	6.225[QC:f]
G378	n/a	Composite	n/a	6.47	5.6	6.035[QC:f]
G379				7.25	5.21	6.23[QC:f]

Table B2-66. Tank 241-AP-105 Analytical Results of 1993 Sampling: Lead (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	μg/mL	μg/mL	μg/mL
G401	R 1E (90°)	Grab sample	43	4.89	5.78	5.335
G402		Grab sample	338	4.38	6.63	5.505
G407		Grab sample	457	6.61	< 3.8	< 5.205
G409		Grab sample	704	7.81	7.43	7.62
G422	R1NW (330°)	Grab sample	107	<62	<62	<62
G391		Grab sample	292	6.23	4.36	5.295
G392		Grab sample	516	3.98	5.54	4.76
G396		Grab sample	724	4.68	5.83	5.255
G397		Grab sample	724	3.48	7.83	5.655[QC:e]
G412	R 1SW (210°)	Grab sample	165	5.66	5.51	5.585
G413		Grab sample	373	5.29	4.27	4.78
G417		Grab sample	561	< 77.5	< 77.5	< 77.5
G418		Grab sample	655	3.78	4.59	4.185
G378	n/a	Composite	n/a	4.14	4.89	4.515
G379				5.02	5.02	5.02

Table B2-67. Tank 241-AP-105 Analytical Results of 1993 Sampling: Mercury (AA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	μg/mL	μg/mL	μg/mL
G378	n/a	Composite	n/a	<0.0250	<0.0250	<0.0250
G379				<0.0100	<0.0100	<0.0100

Table B2-68. Tank 241-AP-105 Analytical Results of 1993 Sampling: Nickel (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	μg/mL	μg/mL	μg/mL
G401	R 1E (90°)	Grab sample	43	11.8	12.8	12.3
G402		Grab sample	338	10.9	11.5	11.2
G407		Grab sample	457	9.96	14	11.98[QC:e]
G409		Grab sample	704	11.1	9.78	10.44
G422	R 1NW (330°)	Grab sample	107	15.4	<13.0	<14.2
G391		Grab sample	292	10.6	11.4	11
G392		Grab sample	516	10.7	10.9	10.8
G396		Grab sample	724	8.88	9.1	8.99
G397		Grab sample	724	9.72	9.68	9.7
G412	R 1SW (210°)	Grab sample	165	11.9	11.9	11.9
G413		Grab sample	373	11	10.9	10.95
G417		Grab sample	561	< 16.3	< 16.3	< 16.3
G418		Grab sample	655	9.29	9.93	9.61
G378	n/a	Composite	n/a	10.8	11.2	11
G379				11.2	11.5	11.35

Table B2-69. Tank 241-AP-105 Analytical Results of 1993 Sampling: Phosphorous (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	286	312	299
G402		Grab sample	338	296	295	295.5
G407		Grab sample	457	313	317	315
G409		Grab sample	704	462	455	458.5
G422	R 1NW (330°)	Grab sample	107	207	216	211
G391		Grab sample	292	259	306	282.5[QC:e:f]
G392		Grab sample	516	304	307	305.5[QC:f]
G396		Grab sample	724	377	394	385.5
G397		Grab sample	724	416	436	426
G412	R 1SW (210°)	Grab sample	165	316	313	314.5
G413		Grab sample	373	290	306	298
G417		Grab sample	561	194	250	222[QC:e]
G418		Grab sample	655	376	403	389.5
G378	n/a	Composite	n/a	329	344	336.5
G379				344	349	346.5

Table B2-70. Tank 241-AP-105 Analytical Results of 1993 Sampling: Potassium (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	29,100	31,300	30,200
G402		Grab sample	338	31,200	32,100	31,650
G407		Grab sample	457	30,400	30,500	30,450
G409		Grab sample	704	30,200	29,800	30,000
G422	R 1NW (330°)	Grab sample	107	33,300	32,600	33,000
G391		Grab sample	292	28,500	29,700	29,100
G392		Grab sample	516	28,800	30,100	29,450
G396		Grab sample	724	28,800	27,800	28,300
G397		Grab sample	724	29,800	28,200	29,000
G412	R 1SW (210°)	Grab sample	165	36,400	37,700	37,050
G413		Grab sample	373	30,800	32,000	31,400
G417		Grab sample	561	30,000	31,500	30,750
G418		Grab sample	655	30,900	28,900	29,900
G378	n/a	Composite	n/a	32,700	33,500	33,100
G379				32,000	33,800	32,900

Table B2-71. Tank 241-AP-105 Analytical Results of 1993 Sampling: Selenium (AA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	0.164	0.153	0.1585
G402		Grab sample	338	0.127	0.124	0.1255
G407		Grab sample	457	0.102	0.135	0.1185[QC:e]
				.103	0.146	0.1245[QC:e]
G409		Grab sample	704	0.135	0.151	0.143
G402	R 1NW (330°)	Grab sample	107	0.108	0.083	0.095
				.142	0.143	0.143
G391		Grab sample	292	0.133	0.122	0.1275
G392		Grab sample	516	0.118	0.116	0.117
G396		Grab sample	724	0.168	0.153	0.1605
G397		Grab sample	724	0.166	0.154	0.16
G412	R 1SW (210°)	Grab sample	165	0.179	0.21	0.1945
G413		Grab sample	373	0.153	0.169	0.161
G417		Grab sample	561	0.145	0.118	0.1315[QC:e]
G418		Grab sample	655	0.136	0.137	0.1365
G378	n/a	Composite	n/a	< 0.252	< 0.25	< 0.251
G379				<0.25	<0.25	<0.25

Table B2-72. Tank 241-AP-105 Analytical Results of 1993 Sampling: Silver (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	0.131	< 0.125	< 0.128
G402		Grab sample	338	< 0.125	0.154	< 0.1395[QC:e]
G407		Grab sample	457	< 0.6	< 0.6	< 0.6
G409		Grab sample	704	< 0.6	< 0.6	< 0.6
G422	R 1NW (330°)	Grab sample	107	<5.0	<5.0	<5.0
G391		Grab sample	292	< 0.125	< 0.125	< 0.125
G392		Grab sample	516	< 0.125	< 0.125	< 0.125
G396		Grab sample	724	< 0.125	< 0.125	< 0.125
G397		Grab sample	724	< 0.125	0.131	< 0.128
G412	R 1SW (210°)	Grab sample	165	< 0.125	< 0.125	< 0.125
G413		Grab sample	373	< 0.125	< 0.125	< 0.125
G417		Grab sample	561	< 6.25	< 6.25	< 6.25
G418		Grab sample	655	< 0.125	< 0.125	< 0.125
G378	n/a	Composite	n/a	< 0.125	< 0.125	< 0.125
G379				< 0.125	< 0.125	< 0.125

Table B2-73. Tank 241-AP-105 Analytical Results of 1993 Sampling: Sodium (ICP).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	1.860E+05	2.000E+05	1.930E+05
G402		Grab sample	338	1.680E+05	1.740E+05	1.710E+05
G407		Grab sample	457	1.530E+05	1.480E+05	1.505E+05
G409		Grab sample	704	1.530E+05	1.480E+05	1.505E+05
G422	R 1NW (330°)	Grab sample	107	1.760E+05	1.720E+05	1.740E+05
G391		Grab sample	292	1.580E+05	1.660E+05	1.620E+05
G392		Grab sample	516	1.620E+05	1.670E+05	1.645E+05
G396		Grab sample	724	1.490E+05	1.430E+05	1.460E+05
G397		Grab sample	724	1.530E+05	1.440E+05	1.485E+05
G412	R 1SW (210°)	Grab sample	165	1.870E+05	1.930E+05	1.900E+05
G413		Grab sample	373	1.670E+05	1.710E+05	1.690E+05
G417		Grab sample	561	1.590E+05	1.660E+05	1.625E+05
G418		Grab sample	655	1.490E+05	N/A	1.490E+05
G378	n/a	Composite	n/a	1.710E+05	1.740E+05	1.725E+05
G379				1.680E+05	1.750E+05	1.715E+05

Table B2-74. Tank 241-AP-105 Analytical Results: Total Uranium.

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µg/mL	µg/mL	µg/mL
G378	n/a	Composite	n/a	35.8	35.8	35.8
G379				48.9	48.9	48.9

Table B2-75. Tank 241-AP-105 Analytical Results of 1993 Sampling: Chloride (IC).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	2,640	2,720	2,680
				,360	3,360	3,360
G402		Grab sample	338	2,150	2,410	2,280
				,040	4,100	4,070
G407		Grab sample	457	2,190	2,180	2,185
				,380	2,860	2,620
				,910	7,010	6,960
G409		Grab sample	704	1,890	1,850	1,870
				3,200	3,260	3,230
G422	R 1NW (330°)	Grab sample	107	2,420	2,410	2,420
				2,160	2,150	2,160
G391		Grab sample	292	2,200	2,160	2,180
G392		Grab sample	516	2,610	2,660	2,635
G396		Grab sample	724	1,480	1,440	1,460
G397		Grab sample	724	1,860	2,110	1,985
				,730	1,720	1,725
G412	R 1SW (210°)	Grab sample	165	2,330	2,460	2,395
G413		Grab sample	373	2,220	2,300	2,260
G417		Grab sample	561	1,930	2,000	1,965
G418		Grab sample	655	1,530	1,820	1,675
				3,350	1,810	2,580
G378	n/a	Composite	n/a	2,560	2,730	2,645
G379				2,720	2,660	2,690

Table B2-76. Tank 241-AP-105 Analytical Results of 1993 Sampling: Fluoride (IC).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	< 10.1	< 10.1	< 10.1
G402		Grab sample	338	< 10	< 10	< 10
G407		Grab sample	457	< 209	< 209	< 209
G422	R 1NW (330°)	Grab sample	107	667	650	659
G391		Grab sample	292	< 40.1	< 40.1	< 40.1
G392		Grab sample	516	< 40.1	< 40.1	< 40.1
G396		Grab sample	724	8,700	8,860	8,780
				20.1	< 20.1	< 20.1
G397		Grab sample	724	< 20.1	< 20.1	< 20.1
				40.1	< 40.1	< 40.1
G412	R 1SW (210°)	Grab sample	165	646	668	657
G417		Grab sample	561	1,380	1,420	1,400
G418		Grab sample	655	< 20.1	< 20.1	< 20.1
				< 168	< 168	< 168
G378	n/a	Composite	n/a	< 10.1	< 10.1	< 10.1[QC:c]
G379				< 10.1	< 10.1	< 10.1

Table B2-77. Tank 241-AP-105 Analytical Results of 1993 Sampling: Nitrate (IC).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	2.170E+05	2.210E+05	2.190E+05
				.240E+05	2.220E+05	2.230E+05
G402		Grab sample	338	1.360E+05	1.530E+05	1.445E+05
				.980E+05	1.980E+05	1.980E+05
G407		Grab sample	457	1.670E+05	1.690E+05	1.680E+05
G409		Grab sample	704	1.280E+05	1.280E+05	1.280E+05
				2.0,4E+05	2.290E+05	2.165E+05
G422	R 1NW (330°)	Grab sample	107	1.590E+05	1.620E+05	1.610E+05
				1.600E+05	1.590E+05	1.600E+05
G391		Grab sample	292	1.590E+05	1.570E+05	1.580E+05
G392		Grab sample	516	1.520E+05	1.520E+05	1.520E+05
G396		Grab sample	724	1.320E+05	1.320E+05	1.320E+05
				.400E+05	3.380E+05	3.390E+05
G397		Grab sample	724	1.470E+05	1.420E+05	1.445E+05
				.350E+05	1.280E+05	1.315E+05
G412	R 1SW (210°)	Grab sample	165	1.910E+05	1.960E+05	1.935E+05
G413		Grab sample	373	1.660E+05	1.680E+05	1.670E+05
G417		Grab sample	561	1.610E+05	1.600E+05	1.605E+05
G418		Grab sample	655	81,900	81,700	81,800
				1.230E+05	1.260E+05	1.245E+05
G378	n/a	Composite	n/a	1.700E+05	1.690E+05	1.695E+05
G379				1.720E+05	1.680E+05	1.700E+05

Table B2-78. Tank 241-AP-105 Analytical Results of 1993 Sampling: Nitrite (IC).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	62,300	62,200	62,250
				4,400	55,100	54,750
G402		Grab sample	338	39,400	44,700	42,050
				7,900	57,400	57,650
G407		Grab sample	457	54,000	52,900	53,450
G409		Grab sample	704	36,100	35,900	36,000
				6,600	36,700	36,650
				58,600	65,600	62,100
G422	R 1NW (330°)	Grab sample	107	45,300	45,900	45,600
				45,800	45,700	45,800
G391		Grab sample	292	49,700	50,200	49,950
G392		Grab sample	516	48,600	48,200	48,400
G396		Grab sample	724	98,600	98,500	98,550
				2,100	42,100	42,100
G397				2,100	41,400	41,750
				7,900	45,200	46,550
G412	R 1SW (210°)	Grab sample	165	49,600	51,300	50,450
G413		Grab sample	373	49,000	48,500	48,750
G417		Grab sample	561	46,200	46,100	46,150
G418		Grab sample	655	23,200	23,400	23,300
				39,400	40,700	40,050
G378	n/a	Composite	n/a	48,500	49,000	48,750
G379				49,400	48,500	48,950

Table B2-79. Tank 241-AP-105 Analytical Results of 1993 Sampling: Phosphate (IC).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	231	262	246.5
				67	595	581
G402		Grab sample	338	472	484	478
				12	220	216
G407		Grab sample	457	371	365	368
				97	262	279.5
G409		Grab sample	704	557	545	551
				409	394	401.5
G422	R 1NW (330°)	Grab sample	107	<861	<861	<861
				408	571	490
				417	434	426
G391		Grab sample	292	< 401	< 401	< 401
				< 100	< 100	< 100
G392		Grab sample	516	< 401	< 401	< 401
				51	< 51	< 51
G396		Grab sample	724	543	552	547.5
				401	< 40.1	< 220.55
G397		Grab sample	724	681	671	676
				71	564	567.5
G412	R 1SW (210°)	Grab sample	165	280	370	325
				387	363	375
G413		Grab sample	373	419	426	422.5
G417		Grab sample	561	< 861	< 861	< 861
				10	< 10	< 10
G418		Grab sample	655	2,360	2,350	2,355
				597	598	597.5
G378	n/a	Composite	n/a	305	297	301
G379				291	308	299.5

Table B2-80. Tank 241-AP-105 Analytical Results of 1993 Sampling: Sulfate (IC).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	1,120	1,140	1,130
G402		Grab sample	338	1,500	1,540	1,520
				22	462	442
G407		Grab sample	457	3,960	4,120	4,040
G409		Grab sample	704	3,000	2,990	2,995
				860	4,900	4,880
				260	4,290	4,275
G422	R 1NW (330°)	Grab sample	107	2,050	2,080	2,070
				1,340	1,400	1,370
				1,280	1,400	1,340
G391		Grab sample	292	1,680	1,680	1,680
G392		Grab sample	516	1,750	1,780	1,765
G396		Grab sample	724	2,300	2,310	2,305
				200	3,190	3,195
G397		Grab sample	724	3,320	3,340	3,330
				930	2,940	2,935
G412	R 1SW (210°)	Grab sample	165	1,280	1,250	1,265
G413		Grab sample	373	1,970	1,970	1,970
G417		Grab sample	561	2,210	2,190	2,200
G418		Grab sample	655	12,000	12,000	12,000
				3,420	3,360	3,390
G378	n/a	Composite	n/a	3,230	3,240	3,235[QC:c]
G379				1,890	2,050	1,970

Table B2-81. Tank 241-AP-105 Analytical Results: Hydroxide (OH Automatic).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
G378	n/a	Composite	n/a	54,700	54,900	54,800
G379				52,000	54,100	53,050

Table B2-82. Tank 241-AP-105 Analytical Results: Cyanide (Speciation).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids				µg/mL	µg/mL	µg/mL
G378	n/a	Composite	n/a	19.3	19.4	19.35
G379				17.7	17.7	17.7

Table B2-83. Tank 241-AP-105 Analytical Results: Ammonium (Distillation [NH3]).

Sample Number	Sample Location	Sample Type	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
G378	n/a	Composite	< 40	< 40	< 40
G379			< 40	< 40	< 40

Table B2-84. Analytical Results of 1993 Sampling for Tank 241-AP-105: Total Inorganic Carbon.

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	3,540	3,410	3,475[QC:f]
G402			338	3,840	3,860	3,850[QC:f]
G407			457	3,740	3,650	3,695[QC:f]
G409			704	5,920	6,060	5,990[QC:f]
				6,690	5,480	6,085[QC:f]
G391	R 1NW (330°)		292	4,.690	4,720	4,705
G392			516	4,830	4,890	4,860[QC:f]
G396			724	5,720	5,720	5,720[QC:f]
				5,830	5,540	5,685[QC:f]
G397				6,120	6,200	6,160[QC:f]
G412	R 1SW (210°)		165	3,610	3,590	3,600[QC:f]
G413			373	3,830	3,930	3,880[QC:f]
G417			561	3,810	3,820	3,815[QC:f]
G418			655	6,180	6,180	6,180[QC:f]

Table B2-85. Tank 241-AP-105 Analytical Results of 1993 Sampling: Total Organic Carbon (Furnace Oxidation).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids: acid digest			cm	µg/mL	µg/mL	µg/mL
G401	R 1E (90°)	Grab sample	43	3,240	3,230	3,235[QC:f]
G402		Grab sample	338	3,010	3,000	3,005[QC:f]
G407		Grab sample	457	2,890	2,800	2,845[QC:f]
G409		Grab sample	704	2,780	2,760	2,770[QC:f]
G422	R 1NW (330°)	Grab sample	107	2,790	2,810	2,800
G391		Grab sample	292	2,830	2,820	2,825[QC:f]
G392		Grab sample	516	2,260	2,250	2,255[QC:f]
G396		Grab sample	724	2,780	2,660	2,720[QC:f]
G397		Grab sample	724	2,730	2,770	2,750[QC:f]
				270	2,720	2,995[QC:f]
G412	R 1SW (210°)	Grab sample	165	2,790	2,800	2,795[QC:f]
				820	1,880	1,850[QC:f]
G413		Grab sample	373	2,500	2,550	2,525[QC:f]
G417		Grab sample	561	2,600	2,640	2,620[QC:f]
G418		Grab sample	655	2,990	2,990	2,990[QC:f]
G378	n/a	Composite	n/a	2,720	2,810	2,765[QC:f]
G379				3,040	3,010	3,025[QC:f]

Table B2-86. Tank 241-AP-105 Analytical Results of 1993 Sampling: EDTA.

Sample number	Sample Location	Sample Type	Sample Depth	Results	Duplicate	Mean
			cm	mg/L	mg/L	mg/L
G242	R 1E (90°)	Grab sample	457	1.24E+02	1.38E+02	1.31E+02
G239			43	1.56E+02	1.39E+02	1.48E+02
G247	R 1SW (210°)		561	1.41E+02	1.36E+02	1.39E+02
G246			373	1.29E+02	1.18E+02	1.24E+02
G255	R NW (330°)		724	9.10E+01	NA	9.10E+01
G270				9.70E+01	NA	9.70E+01
G252			292	1.36E+02	NA	1.36E+02
G273	n/a	Field blank	n/a	< 2.00E+01	NA	< 2.00E+01

Note:

NA = not analyzed

Table B2-87. Tank 241-AP-105 Analytical Results of 1993 Sampling: HEDTA.

Sample number	Sample Location	Sample Type	Sample Depth	Results	Duplicate	Mean
			cm	mg/L	mg/L	mg/L
G242	R 1E (90°)	Grab sample	457	2.5E+01	1.7E+01[1]	2.1E+01
G239			43	2.2E+01	2.4E+01	2.3E+01
G247	R 1SW (210°)		561	1.6E+01[1]	1.6E+01[1]	1.6E+01
G246			373	1.7E+01[1]	1.7E+01[1]	1.7E+01
G255	R NW (330°)		724	5.0E+00[1]	NA	5.0E+00
G270				0E+00[1]	NA	6.0E+00
G252			292	2.3E+01	NA	2.3E+01
G273	n/a	Field blank	n/a	< 2.0E+01	NA	< 2.0E+01

Notes:

[1]These values were reported with the qualifier "J," where "J" indicates that the compound was identified but the response was below the contract required quantitation limit.

Table B2-88. Tank 241-AP-105 Analytical Results of 1993 Sampling: Citrate.

Sample number	Sample Location	Sample Type	Sample Depth	Results	Duplicate	Mean
			cm	mg/L	mg/L	mg/L
G242	R 1E (90°)	Grab sample	457	3.72E+02	4.26E+02	3.99E+02
G239			43	6.97E+02	6.60E+02	6.79E+02
G247	R 1SW (210°)		561	6.56E+02	5.59E+02	6.08E+02
G246			373	3.83E+02	5.61E+02	4.72E+02
G255	R NW (330°)		724	2.33E+02	N/A	2.33E+02
G270				02E+02	N/A	2.02E+02
G252			292	5.55E+02	N/A	5.55E+02
G273	n/a	Field blank	N/A	< 1.00E+02	N/A	< 1.00E+02

Table B2-89. Tank 241-AP-105 Analytical Results of 1993 Sampling: Oxalate.

Sample number	Sample Location	Sample Type	Sample Depth	Results	Duplicate	Mean
			cm	mg/L	mg/L	mg/L
G242	R 1E (90°)	Grab sample	457	4.00E+02	3.00E+02	3.50E+02
G239			43	4.00E+02	N/A	4.00E+02
G247	R 1SW (210°)		561	2.00E+02	N/A	2.00E+02
G246			373	3.00E+02	N/A	3.00E+02
G255	R NW (330°)		724	1.20E+03	N/A	1.20E+02
G270				00E+02	N/A	9.00E+02
G252			292	3.00E+02	N/A	3.00E+02
G273	n/a	Field blank	N/A	< 2.50E+01	N/A	< 2.50E+01

Table B2-90. Tank 241-AP-105 Analytical Results of 1993 Sampling: Glycolate.

Sample number	Sample Location	Sample Type	Sample Depth	Results	Duplicate	Mean
			cm	mg/L	mg/L	mg/L
G242	R 1E (90°)	Grab sample	457	7.00E+02	6.00E+02	6.50E+02
G239			43	8.00E+02	N/A	8.00E+02
G247	R 1SW (210°)		561	6.00E+02	N/A	6.00E+02
G246			373	6.00E+02	N/A	6.00E+02
G255[1]	R NW (330°)		724	5.00E+02	N/A	5.20E+02
G270				00E+02	N/A	5.00E+02
G252			292	6.00E+02	N/A	6.00E+02
G273	n/a	Field blank	N/A	< 2.50E+02	N/A	< 2.50E+02

Note:

[1]The spike percent recovery was outside the limits.

Table B2-91. Analytical Results of 1993 Sampling for Tank 241-AP-105: Americium-241 (Spectroscopy).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	5.230E-04	5.000E-04	5.115E-04
G402			338	3.760E-04	3.940E-04	3.850E-04
G407			457	4.210E-04	3.660E-04	3.935E-04[QC:f]
G409			704	3.840E-04	4.630E-04	4.235E-04[QC:f]
G422	R 1NW (330°)		107	2.650E-04	3.390E-04	3.020E-04[QC:f]
G391			2	3.640E-04	4.040E-04	3.840E-04[QC:f]
G392			516	3.910E-04	4.670E-04	4.290E-04[QC:f]
G396			724	3.720E-04	3.570E-04	3.645E-04[QC:f]
G397				4.510E-04	3.000E-04	3.755E-04[QC:,f]
G412	R 1SW (210°)		165	3.760E-04	4.340E-04	4.050E-04[QC:f]
G413			373	2.950E-04	0.00405	0.0021725[QC:,f]
G417			561	4.470E-04	3.790E-04	4.130E-04[QC:f]
G418			655	4.260E-04	4.660E-04	4.460E-04[QC:f]
G378	n/a	Composite	n/a	3.440E-04	5.200E-04	4.320E-04[QC:,f]
				2.660E-04	2.630E-04	2.645E-04[QC:f]
G379				4.050E-04	4.250E-04	4.150E-04[QC:f]

Table B2-92. Analytical Results of 1993 Sampling for Tank 241-AP-105: Curium-243/44 (AEA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	<2.35E-04	<5.94E-04	<4.15E-04
G402			338	<6.37E-04	<4.20E-04	<5.29E-04
G407			457	<2.76E-04	<4.46E-04	<3.61E-04[QC:f]
G409			704	<2.04E-04	<6.37E-04	<4.21E-04[QC:f]
G422	R 1NW (330°)		107	<6.37E-04	<1.57E-04	<3.97E-04
G391			2	<5.19E-04	<2.54E-04	<3.87E-04
G392			516	<6.37E-04	<6.37E-04	<6.37E-04[QC:f]
G396			724	<2.52E-04	<3.44E-04	<2.98E-04[QC:f]
G397				<6.37E-04	<1.89E-04	<4.13E-04
G412	R 1SW (210°)		165	<6.37E-04	<2.77E-04	<4.57E-04
G413			373	<1.84E-04	<3.50E-04	<2.67E-04[QC:f]
G417			561	<6.37E-04	<6.37E-04	<6.37E-04[QC:f]
G418			655	<4.27E-04	<8.58E-05	<2.56E-04
G378	n/a	Composite	n/a	<2.67E-04	<6.37E-04	<4.52E-04
				<1.91E-05	<3.36E-05	<2.64E-05[QC:f]
G379				<6.37E-04	<1.90E-04	<4.14E-04[QC:f]

Table B2-93. Tank 241-AP-105 Analytical Results: Plutonium-238 (Alpha Spectroscopy).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	< 2.120E-04	< 6.090E-04	< 4.105E-04
G402			338	< 7.280E-04	< 2.360E-04	< 4.820E-04
G407			457	< 9.620E-05	< 9.810E-05	< 9.715E-05
G409			704	< 9.230E-05	< 1.030E-04	< 9.765E-05
G422	R 1NW (330°)		107	< 2.52E-04	< 2.39E-04	<2.46E-04
G391			292	< 1.110E-04	< 9.810E-05	< 1.046E-04
G392			516	< 9.130E-05	< 1.010E-04	< 9.615E-05
G396			724	< 2.500E-04	< 2.360E-04	< 2.430E-04
G397				< 1.610E-04	< 5.010E-04	< 3.310E-04
G412	R 1SW (210°)		165	< 1.030E-04	< 9.290E-05	< 9.795E-05
G412				< 5.970E-04	< 8.400E-04	< 7.185E-04
G413			373	< 9.400E-05	< 9.360E-05	< 9.380E-05
G413				< 8.980E-04	< 2.230E-04	< 5.605E-04
G417			561	< 1.940E-04	< 2.050E-04	< 1.995E-04
G418			655	< 5.780E-05	< 8.890E-05	< 7.335E-05

Table B2-94. Analytical Results of 1993 Sampling for Tank 241-AP-105: Plutonium-239/240 (Alpha Spectroscopy).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	< 1.020E-04	< 1.140E-04	< 1.080E-04
G402			338	< 1.340E-04	1.610E-04	< 1.475E-04
G407			457	9.660E-05	1.440E-04	1.203E-04[QC:e]
G409			704	1.800E-04	1.790E-04	1.795E-04
G422	R 1NW (330°)		107	1.570E-04	1.620E-04	1.600E-04
G391			292	1.450E-04	1.500E-04	1.475E-04
G392			516	1.620E-04	1.560E-04	1.590E-04
G396			4	1.570E-04	1.600E-04	1.585E-04
G397				630E-04	1.750E-04	1.690E-04
G412	R 1SW (210°)		165	1.300E-04	1.300E-04	1.300E-04
				1.370E-04	< 1.290E-04	< 1.330E-04
G413			373	1.540E-04	1.490E-04	1.515E-04
				1.860E-04	1.540E-04	1.700E-04
G417			1	1.830E-04	1.790E-04	1.810E-04
G418			655	1.820E-04	1.600E-04	1.710E-04
				< 2.120E-04	< 1.640E-04	< 1.880E-04

Table B2-95. Tank 241-AP-105 Analytical Results: Carbon-14.

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	2.390E-04	2.420E-04	2.405E-04
G402			338	2.160E-04	2.170E-04	2.165E-04
				2.940E-04	4.840E-04	3.890E-04
G407			457	1.840E-04	2.840E-04	2.340E-04
G409			704	1.980E-04	2.250E-04	2.115E-04
				1.820E-04	2.200E-04	2.010E-04
G391	R 1NW (330°)		292	1.980E-04	1.540E-04	1.760E-04[QC:f]
				2.010E-04	2.160E-04	2.085E-04
G392			516	2.100E-04	1.200E-04	1.650E-04[QC:f]
				1.900E-04	2.230E-04	2.065E-04[QC:f]
				2.160E-04	2.160E-04	2.160E-04
G396			724	1.670E-04	2.200E-04	1.935E-04
				1.400E-04	2.190E-04	1.795E-04
G397				2.030E-04	2.250E-04	2.140E-04
				1.900E-04	2.330E-04	2.115E-04
G412	R 1SW (210°)		165	2.040E-04	2.230E-04	2.135E-04[QC:,f]
				2.050E-04	2.170E-04	2.110E-04
G413			373	2.110E-04	2.160E-04	2.135E-04
G417			561	2.050E-04	2.140E-04	2.095E-04[QC:f]
G418			655	2.070E-04	2.310E-04	2.190E-04[QC:f]

Table B2-96. Analytical Results of 1993 Sampling for Tank 241-AP-105: Iodine-129.

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	1.280E-04	1.840E-04	1.560E-04
G402			338	< 4.730E-05	1.390E-04	< 9.315E-05[QC:e]
				9.930E-05	1.630E-04	1.312E-04
G407			457	1.900E-04	2.020E-04	1.960E-04
G409			704	< 5.810E-05	< 4.780E-05	< 5.295E-05
				< 3.290E-05	1.130E-04	< 7.295E-05[QC:e]
G391	R 1NW (330°)		292	3.050E-04	< 4.690E-05	< 1.760E-04[QC:e]
G392			516	< 3.450E-05	< 4.030E-05	< 3.740E-05
G396			724	< 4.410E-05	< 4.640E-05	< 4.525E-05
G397				8.980E-05	< 6.170E-05	< 7.575E-05
				< 7.020E-05	< 2.050E-04	< 1.376E-04[QC:e]
G412	R 1SW (210°)		165	1.540E-04	< 7.050E-05	< 1.123E-04[QC:e]
G413			373	< 5.310E-05	5.070E-05	< 5.190E-05[QC:f]
G417			561	1.310E-04	1.320E-04	1.315E-04
G418			655	< 4.080E-05	< 7.430E-05	< 5.755E-05[QC:e]
				7.950E-05	1.640E-04	1.218E-04
G378	n/a	Composite	n/a	< 3.760E-05	1.630E-04	< 1.003E-04[QC:e]
				9.550E-05	1.350E-04	1.153E-04
G379				< 6.070E-05	1.180E-04	< 8.935E-05
				< 4.860E-05	1.890E-04	< 1.188E-04[QC:e]

Table B2-97. Analytical Results of 1993 Sampling for Tank 241-AP-105: Neptunium-237.

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	< 3.890E-04	< 3.890E-04	< 3.890E-04
G402			338	< 3.890E-04	< 3.890E-04	< 3.890E-04
G407			457	< 4.640E-04	< 3.140E-04	< 3.890E-04[QC:e]
G409			704	< 4.320E-04	< 2.810E-04	< 3.565E-04[QC:e]
G391	R 1NW (330°)		292	< 4.320E-04	< 4.320E-04	< 4.320E-04
G392			516	< 4.320E-04	< 4.320E-04	< 4.320E-04
G396			724	< 3.350E-04	< 3.350E-04	< 3.350E-04
G397				< 4.640E-04	< 3.350E-04	< 3.995E-04
G412	R 1SW (210°)		165	< 4.320E-04	< 4.320E-04	< 4.320E-04
G413			373	< 2.810E-04	< 4.320E-04	< 3.565E-04[QC:e]
G417			561	< 3.890E-04	< 2.810E-04	< 3.350E-04[QC:e]
G418			655	< 2.180E-04	< 3.890E-04	< 3.035E-04[QC:e]
G378	n/a	Composite	n/a	< 2.050E-04	< 4.320E-04	< 3.185E-04[QC:e]
G379				< 3.890E-04	< 3.890E-04	< 3.890E-04

Table B2-98. Analytical Results of 1993 Samples for Tank 241-AP-105: Tritium (Scintillation).

Sample Number	Sample Location	Sample Type	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
G378	n/a	Composite	0.0081	0.00734	0.00772[QC:c,f]
G379			2.580E-04	1.310E-04	1.945E-04[QC:c]

Table B2-99. Analytical Results of 1993 Sampling for Tank 241-AP-105: Strontium-90.

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	μCi/mL	μCi/mL	μCi/mL
G401	R 1E (90°)	Grab sample	43	0.253	0.23	0.2415[QC:f]
G402			338	0.168	0.191	0.1795[QC:f]
G407			457	0.183	0.18	0.1815
G409			704	0.224	0.244	0.234
G391	R 1NW (330°)		292	0.176	0.188	0.182[QC:f]
G392			516	0.172	0.179	0.1755[QC:f]
G396			724	0.208	0.23	0.219
G397				0.232	0.247	0.2395
G412	R 1SW (210°)		165	0.259	0.246	0.2525[QC:f]
G413			373	0.179	0.198	0.1885[QC:f]
G417			561	0.207	0.207	0.207
G418			655	0.236	0.224	0.23[QC:f]
				0.229	0.281	0.255
G378	n/a	Composite	n/a	0.217	0.199	0.208[QC:f]
G379				0.207	0.194	0.2005[QC:f]

Table B2-100. Analytical Results of 1993 Sampling for Tank 241-AP-105: Technetium-99.

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	0.088	0.084	0.086
G402			338	0.0765	0.0727	0.0746
G407			457	0.077	0.0708	0.0739[QC:f]
G409			704	0.0605	0.0589	0.0597[QC:f]
G391	R 1NW (330°)		292	0.0781	0.071	0.07455
G392			516	0.0704	0.0702	0.0703
G396			724	0.056	0.0561	0.05605
				0.0565	0.0569	0.0567[QC:f]
G397				0.0633	0.0588	0.06105
G412	R 1SW (210°)		165	0.0869	0.0719	0.0794
G413			373	0.0564	0.0686	0.0625
G417			561	0.0626	0.0668	0.0647
G418			655	0.0598	0.0576	0.0587[QC:f]
G378	n/a	Composite	n/a	0.081	0.0734	0.0772
G379				0.0639	0.0665	0.0652

Table B2-101. Analytical Results of 1993 Sampling for Tank 241-AP-105: Antimony-125 (GEA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	μCi/mL	μCi/mL	μCi/mL
G401	R 1E (90°)	Grab sample	43	< 0.312	< 0.308	< 0.31
G402			338	< 0.295	< 0.296	< 0.2955
G407			457	< 0.425	< 0.425	< 0.425
G409			704	< 0.388	< 0.383	< 0.3855
G391	R 1NW (330°)		292	< 0.297	< 0.297	< 0.297
G392			516	< 0.298	< 0.296	< 0.297
G396			724	< 0.694	< 0.699	< 0.6965
G397				< 0.692	< 0.695	< 0.6935
G412	R 1SW (210°)		165	< 0.449	< 0.455	< 0.452
G413			373	< 0.424	< 0.427	< 0.4255
G417			561	< 0.289	< 0.29	< 0.2895
G418			655	< 0.384	< 0.385	< 0.3845
G378	n/a	Composite	n/a	< 0.411	< 0.416	< 0.4135
G379				< 0.413	< 0.417	< 0.415

Table B2-102. Analytical Results of 1993 Sampling for Tank 241-AP-105: Ce/Pr-144 (GEA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	< 0.568	< 0.562	< 0.565
G402			338	< 0.536	< 0.543	< 0.5395
G407			457	< 1.02	< 1.02	< 1.02
G409			704	< 0.917	< 0.926	< 0.9215
G391	R 1NW (330°)		292	< 0.535	< 0.545	< 0.54
G392			516	< 0.545	< 0.541	< 0.543
G396			724	< 1.29	< 1.28	< 1.285
G397				< 1.3	< 1.3	< 1.3
G412	R 1SW (210°)		165	< 1.08	< 1.08	< 1.08
G413			373	< 1.02	< 1.02	< 1.02
G417			561	< 0.527	< 0.53	< 0.5285
G418			655	< 0.919	< 0.942	< 0.9305
G378	n/a	Composite	n/a	< 0.99	< 1.01	< 1
G379				< 0.991	< 0.998	< 0.9945

Table B2-103. Analytical Results of 1993 Sampling for Tank 241-AP-105: Cesium-134 (GEA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	0.605	0.586	0.5955
G402			338	0.526	0.541	0.5335
G407			457	0.587	0.517	0.552
G409			704	0.439	0.409	0.424
G391	R 1NW (330°)		292	0.543	0.556	0.5495
G392			516	0.546	0.558	0.552
G396			724	0.398	0.446	0.422
G397				0.423	0.437	0.43[QC:f]
G412	R 1SW (210°)		165	0.635	0.589	0.612
G413			373	0.528	0.543	0.5355
G417			561	0.504	0.488	0.496
G418			655	0.417	0.442	0.4295
G378	n/a	Composite	n/a	0.501	0.542	0.5215
G379				0.46	0.52	0.49

Table B2-104. Analytical Results of 1993 Sampling for Tank 241-AP-105: Cesium-137 (GEA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	255	254	254.5
G402			338	231	232	231.5
G407			457	232	232	232
G409			704	194	194	194
G391	R 1NW (330°)		292	231	233	232[QC:f]
G392			516	233	232	232.5[QC:f]
G396			724	196	194	195
G397				194	196	195
G412	R 1SW (210°)		165	266	266	266
G413			373	233	236	234.5
G417			561	221	223	222
G418			655	192	195	193.5[QC:f]
G378	n/a	Composite	n/a	224	226	225[QC:f]
G379				222	229	225.5[QC:f]

Table B2-105. Analytical Results of 1993 Sampling for Tank 241-AP-105: Cobalt-60 (GEA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	< 0.011	< 0.0121	< 0.01155
G402			338	< 0.0112	< 0.0099	< 0.01055
G407			457	< 0.015	< 0.0197	< 0.01735[QC:e]
G409			704	< 0.0192	< 0.0175	< 0.01835
G391	R 1NW (330°)		292	< 0.0114	< 0.0121	< 0.01175
G392			516	0.0136	< 0.0131	< 0.01335
G396			724	< 0.039	< 0.0405	< 0.03975
G397				< 0.0433	< 0.0358	< 0.03955
G412	R 1SW (210°)		165	< 0.0169	< 0.0207	< 0.0188
G413			373	< 0.0186	< 0.0109	< 0.01475[QC:e]
G417			561	< 0.0117	< 0.0133	< 0.0125
G418			655	< 0.0175	< 0.0175	< 0.0175
G378	n/a	Composite	n/a	< 0.0143	< 0.0169	< 0.0156
G379				< 0.015	< 0.0135	< 0.01425

Table B2-106. Analytical Results of 1993 Sampling for Tank 241-AP-105: Niobium-94 (GEA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	µCi/mL	µCi/mL	µCi/mL
G401	R 1E (90°)	Grab sample	43	< 0.0174	< 0.0178	< 0.0176
G402			338	< 0.0149	< 0.0162	< 0.01555
G407			457	< 0.025	< 0.0238	< 0.0244
G409			704	< 0.0211	< 0.0219	< 0.0215
G391	R 1NW (330°)		292	< 0.0154	< 0.0165	< 0.01595
G392			516	< 0.016	< 0.0159	< 0.01595
G396			724	< 0.0435	< 0.0457	< 0.0446
G397				< 0.0427	< 0.0416	< 0.04215
G412	R 1SW (210°)		165	< 0.0249	< 0.025	< 0.02495
G413			373	< 0.0247	< 0.0239	< 0.0243
G417			561	< 0.0155	< 0.0149	< 0.0152
G418			655	< 0.0197	< 0.0201	< 0.0199
G378	n/a	Composite	n/a	< 0.0235	< 0.0226	< 0.02305
G379				< 0.0223	< 0.0236	< 0.02295

Table B2-107. Analytical Results of 1993 Sampling for Tank 241-AP-105: Ruthenium/Rhodium-106 (GEA).

Sample Number	Sample Location	Sample Type	Sample Depth	Result	Duplicate	Mean
Liquids			cm	μCi/mL	μCi/mL	μCi/mL
G401	R 1E (90°)	Grab sample	43	< 1.09	< 1.09	< 1.09
G402			338	< 1.05	< 1.04	< 1.045
G407			457	< 1.33	< 1.35	< 1.34
G409			704	< 1.22	< 1.24	< 1.23
G391	R 1NW (330°)		292	< 1.04	< 1.04	< 1.04
G392			516	< 1.06	< 1.04	< 1.05
G396			724	< 2.38	< 2.35	< 2.365
G397				< 2.4	< 2.31	< 2.355
G412	R 1SW (210°)		165	< 1.41	< 1.45	< 1.43
G413			373	< 1.37	< 1.37	< 1.37
G417			561	< 1.02	< 1.04	< 1.03
G418			655	< 1.25	< 1.23	< 1.24
G378	n/a	Composite	n/a	< 1.35	< 1.31	< 1.33
G379				< 1.34	< 1.36	< 1.35

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS

This section discusses the overall quality and consistency of the 1996 sampling results and 1993 sampling results, and evaluates sampling and analysis factors that may impact interpretation of the data. These factors are used to assess the overall quality and consistency of the data and to identify any limitations in the use of the data.

B3.1 FIELD OBSERVATIONS

The safety screening DQO (Dukelow et al. 1995) requirement that at least two widely spaced risers be sampled was fulfilled. The evaporator DQO (Von Bargen 1995) and waste compatibility DQO (Fowler 1995) requirements to take grab samples from different depths were met. The horizontal and vertical comparison of the analytical results. No problems were noted during the sampling operations. All thirteen samples plus the field and trip blanks achieved 100 percent recovery.

B3.2 QUALITY CONTROL ASSESSMENT

The usual quality control assessment includes an evaluation of the appropriate standard recoveries, spike recoveries, duplicate analyses, and blanks that are performed in conjunction with the chemical analyses. All the pertinent quality control tests were conducted on the 1996 and 1993 grab samples, allowing a full assessment regarding the accuracy and precision of the data. Samples that had one or more QC results outside the specified criteria were identified by footnotes in the data summary tables.

The standard and matrix 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. Arsenic, iron, and nitrite had recoveries that were outside the given limits. The poor spike result for nitrite may have been caused by the use of an inappropriate spiking concentration relative to the sample concentration. The 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, multiplied by one hundred.

Many of the data are flagged with "QC:f" indicating contamination of either the field blank or the preparation blank. However, the concentration in the blank is much less than the concentration in the sample, and is almost never a concern. The only exception is the 1996 Si data, where the field blank had concentrations of 68.2 μg/mL and 74.3 μg/mL, and samples had concentration from 73.7 μg/mL to 94.9 μg/mL.

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

B3.3 DATA CONSISTENCY CHECKS

This section assesses the data consistency and quality of these two grab sampling events. Comparisons of different analytical methods can help to assess the consistency and quality of the data. Also the quantity of data from these two grab sampling events made possible the calculation of mass and charge balances.

B3.3.1 Comparison of Results from Different Analytical Methods

The following data consistency check compares the results from two different analytical methods. A close agreement between the two methods strengthens the credibility of both results, whereas a poor agreement brings the reliability of the data into question.

B3.3.1.1 1996 Sampling Event. The following data consistency check compares the results from two different analytical methods for total beta activities. Other standard checks, such as comparing sulfate and phosphate analyses by IC analyses and ICP estimates or comparing total alpha with $^{239/240}$Pu and ^{241}Am isotope analyses, were not possible because of data limitations.

A comparison was made between the beta activities of ^{137}Cs and $^{89/90}$Sr with the total beta measurement. The sum of the beta emitters was as follows:

Sum of beta emitters = (^{137}Cs +2 * $^{89/90}$Sr).

Because $^{89/90}$Sr is in equilibrium with its daughter product ^{90}Y, the $^{89/90}$Sr activities must be multiplied by 2 to account for all beta emitters. As listed in Table B3-1, the activities from the two methods agree closely.

Table B3-1. Comparison of Total Beta Activities from 1996 Grab Sampling Results.

Analyte	Overall Mean (μCi/mL)	Beta Activities (μCi/mL)
^{137}Cs	112	112
$^{89/90}$Sr	0.21	0.42
Sum of beta emitters		112.42
Total beta activities measurement		109
Relative percent difference		3%

B3.3.1.2 1993 Sampling Event. The analytical phosphorous mean was 237 $\mu g/g$ by ICP acid digest, which represents total phosphorus. This amount of phosphorus converts to 726 $\mu g/g$ of phosphate. The IC phosphate result for the solids was 330 $\mu g/g$. The observed IC phosphate result was two times smaller than the predicted phosphate value, suggesting that much of the phosphorous may exist as insoluble compounds.

B3.3.2 Mass and Charge Balance

The principal objective in performing mass and charge balances is to determine if the measurements were consistent. In calculating the mass and charge balances, only analytes detected at a concentration of 100 $\mu g/g$ or greater were considered.

B3.3.2.1 1996 Sampling Event. Table B3-2 lists the overall mean of analytes from Section B3.4 and the assumed species for all analytes. The concentrations of the assumed species were calculated stoichiometrically. Based on the large endothermic reaction that the samples exhibited near 300 °C (572 °F), aluminum was assumed to exist as $Al(OH)_3$. Because precipitates are neutral species, all positive charge was attributed to the sodium cation. The acetate and carbonate data were derived from the TOC and TIC analyses, respectively. The anions listed in Table B3-2 were assumed to be present as sodium salts and were expected to balance the positive charge exhibited by the cations. In the bottom part of Table B3-2, the concentrations of cations, anions and water were used to calculate the mass balance.

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

$$\begin{aligned}\text{Mass balance} &= \text{percent water} + 0.0001 \times \{\text{total analyte concentration}\}\\ &= \text{percent water} + 0.0001 \times \{[Al(OH)_3] + [Na^+] + [C_2H_3O_2^-] + [CO_3^{2-}]\\ &\quad + [F^-] + [NO_3^-] + [NO_2^-] + [OH^-] + [PO_4^{3-}] + [SO_4^{2-}]\}.\end{aligned}$$

The total analyte concentration calculated from the above equation is 295,000 $\mu g/g$. The mean weight percent water obtained from the thermogravimetric analysis reported in Table B3-2 is 69.5 percent, or 695,000 $\mu g/g$. The mass balance resulting from adding the percent water to the total analyte concentration is 99 percent, as shown in Table B3-2.

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

$$\text{Total cations} = [Na^+]/23.0 = 3{,}994\ \mu eq/g$$

$$\begin{aligned}\text{Total anions} = &[C_2H_3O_2^-]/59.0 + [CO_3^{2-}]/30.0 + [F^-]/19.0 + [NO_3^-]/62.0 + [NO_2]/46.\\ &[OH^-]/17.0 + [PO_4^{3-}]/31.7 + [SO_4^{2-}]/48.1 = 4{,}257\ \mu eq/g.\end{aligned}$$

The charge balance obtained by dividing the sum of the positive charge by the sum of the negative charge was 1.07. The net charge is -263 μeq/g.

In summary, the above calculations yield excellent mass and charge balance values (close to 100 percent for the mass balance and close to 1.0 for the charge balance) given the associated uncertainties with the data, indicating that the analytical results are generally consistent.

Table B3-2. Tank 241-AP-105 Mass and Charge Balance of 1996 Grab Sampling.

Analyte	Concentration of Analyte (μg/mL)	Assumed Species	Concentration of Species[1] (μg/g)	Charge (μeq/g)
Cations				
Aluminum	17,400	$Al(OH)_3$	40,867	0
Sodium	113,000	Na^+	91,870	+3,994
Cations total			132,737	+3,994
Anions				
Fluoride	308	F^-	250	-13
Hydroxide	33,400	OH^-	27,150	-1,597
Nitrate	98,300	NO_3^-	79,919	-1,289
Nitrite	46,700	NO_2^-	37,967	-825
Phosphate	1,320	PO_4^{3-}	1,073	-34
Sulfate	2,180	SO_4^{2-}	1,772	-37
TIC	2,680	CO_3^{2-}	10,894	-363
TOC	1,490	$C_2H_3O_2^-$	2,976	-101
Anions Total			162,001	-4,257
Summary				
Cation Total			132,737	+3,394
Anion Total			162,001	-4,257
Water			695,000	0
Grand Total			990,000	-263

Note:

[1]The concentration was converted from μg/mL to μg/g by dividing the SpG by 1.23.

B3.3.2.2 1993 Sampling Event. A mass and charge balance was also calculated for 1993 sample results and listed in Table B3-3. The analytical results were taken from the lab final characterization report (Welsh 1994).

Table B3-3. Tank 241-AP-105 Mass and Charge Balance of 1993 Grab Sampling.

Analyte	Concentration of Analyte (μg/mL)	Assumed Species	Concentration (μg/g)	Charge (μeq/g)
Cations				
Chromium	187	Cr^{+6}	140	16.2
Potassium	31,000	K^{+1}	23,300	596
Sodium	167,000	Na^{+1}	125,000	5,430
Cations total			148,440	6,050
Anions				
Aluminum	11,700	$Al(OH)_4^-$	31,000	325
Tetraborate	21.4	$B_4O_7^{-2}$	231	2.98
Chloride	2,360	Cl^-	1,770	49.9
Fluoride	1,520	F^-	1,140	60.0
Hydroxide	54,000	OH^-	40,500	2,380
Nitrate	165,000	NO_3^-	124,000	2,000
Nitrite	47,800	NO_2^-	36,200	787
Phosphate	440	PO_4^{-3}	330	10.4
Silicon	145	SiO_3^{-2}	295	7.76
Sulfate	2,420	SO_4^{-2}	1,820	37.9
TIC	4,490	CO_2^{-2}	16,800	560
Anions total			254,000	6,220
Summary				
Cations			149,000	+6,050
Anions			254,000	-6,220
Water			603,000	0
Grand totals			1,006,000	-170

Note:

[1]The concentration was converted from μg/mL to μg/g by dividing the SpG by 1.33.

The total analyte concentration was 403,000 μg/g. The mean weight percent water obtained from thermogravimetric analysis was 60.3 percent or 603,000 μg/g. The mass balance resulting from adding the percent water to the total analyte concentration is 100.6 percent as shown in Table B3-3. The charge balance obtained by dividing the sum of the positive charge by the sum of the negative charge was 1.03. The net charge is -170 μeq/g.

In summary, the above calculations yield excellent mass and charge balance values (close to 100 percent for the mass balance and close to 1.0 for the charge balance), which indicates that the analytical results are generally consistent.

B3.3.3 Comparison Between 1996 Sampling of Tank 241-AP-105 and 1995 Sampling of Tank 241-AN-101

As discussed in Section A, the top layer (3,660 kL [967 kgal]) of supernatant in tank 241-AP-105 was transferred from tank 241-AN-101 before the August 1996 sampling event for tank 241-AP-105. As shown in Table B3-4 (a brief waste transfer record for tank 241-AN-101), after the December 1995 grab sampling from tank 241-AN-101, no waste volume changed in tank 241-AN-101 prior to the 3,660-kL transfer to tank 241-AP-105. Therefore, the 1995 grab sampling results for tank 241-AN-101 should be very similar to the 1996 grab sampling results for tank 241-AP-105. As discussed in detail in Appendix D, these two sets of analytical data agree with each other reasonably well.

Table B3-4. Waste Transfer Record of Tank 241-AN-101.

Transfer Begin date	Transfer End Date	Transfer Volume (kgal)	Tank Volume (kgal)	Source	Destination
8/12/95	8/29/95	10	1,013	Water	241-AN-101
Grab samples Collected on August 31 and September 6, 1995 (for Waste Compatibility DQO)					
9/8/95	10/14/95	67	1,080	Dilute Noncomplexed Waste	241-AN-101
Grab Samples Collected on December 13, 1995 (for Safety Screening DQO)					
5/3/96	7/31/96	4	1084	UNKNOWN	241-AN-101
8/16/96	8/26/96	-967	116	241-AN-101	241-AP-105

Note:

Dates are in mm/dd/yy format.

B3.4 MEAN CONCENTRATIONS AND CONFIDENCE INTERVALS

The following statistical evaluation was performed using the analytical data generated from two sets of tank 241-AP-105 grab samples. The first set of grab samples was obtained March 1993 from riser 1 at 90° (43-cm [17-in.] depth) and riser 1 at 330° (106-cm [42-in.] depth). The data from these grab samples were used to represent the liquid portion of the 583 kL (154 kgal) of solid liquid waste in the bottom layer of the tank. The second set of grab samples was obtained August/September 1996 from two risers (riser 1 at 330° and riser 1 at 90°) at different depths. One grab sample was taken from riser 1 at 330° and three grab samples were taken from riser 1 at 90°. The data from these grab samples were used to represent the 3,660 kL (967 kgal) of supernatant in the top layer of the tank.

For each data set, a mean concentration and the associated variability were calculated for each analyte. A two-sided 95 percent confidence interval for the mean concentration was also calculated for each analyte. The confidence interval takes into account the sampling and analytical uncertainties. The upper and lower limits (UL and LL) of a two-sided 95 percent confidence interval for the mean are

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

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

B3.4.1 Mean Concentrations

The statistics in this section were based on analytical data from the 1993 and 1996 tank 241-AP-105 grab sampling events. The 1996 data were statistically evaluated using two different models. The first model used a nested analysis of variance (ANOVA); the data are identified by grab sample within riser. The second model used one-way ANOVA; the data are identified by one variable (the grab sample). Analysis of variance techniques were used to estimate the mean and its associated variability for all analytes that had at least 50 percent of the reported data as quantitative values. No ANOVA estimates were computed for analytes that had less than 50 percent of the reported data as quantitative values. The 1993 data were analyzed using one-way ANOVA with riser and sample confounded.

The mean concentration estimates for the top layer, along with the two-sided 95 percent confidence interval for the mean concentration, are given in Table B3-5 (nested ANOVA) and Table B3-6 (one-way ANOVA) for those analytes with at least 50 percent of the reported data as quantitative values. For some of the analytes, the lower limit of the 95 percent confidence interval was a negative value due to the magnitude of the variability. Since the actual concentration of a tank sample cannot be less than zero, the lower limit is reported as zero. The analytes in Table B3-5 where $\hat{\sigma}_{riser}$ is significantly different from zero are marked with a "*". The riser variable is an indicator of horizontal homogeneity.

For those analytes where $\hat{\sigma}_{riser}$ is not significantly different from zero, the mean concentrations and the variances of the mean concentrations calculated using the two statistical models (one-way ANOVA and nested ANOVA) are not significantly different. In these cases, the one-way ANOVA model is more appropriate. The analytes (top layer) that had less than 50 percent of the reported data as quantitative values are listed in Table B3.4.3. Table B3.4.3 cites the largest value observed from the analytical results.

Table B3-5. Mean Concentrations - Top Supernatant Layer (Nested ANOVA). (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
Al.icp	μg/mL	1.74E+04	1.17E+02	1	1.59E+04	1.89E+04
^{14}C	μCi/mL	3.30E-04	5.86E-05	1	0.00E+00	1.07E-03
Cr.icp	μg/mL	2.13E+02	1.28E+00	1	1.96E+02	2.29E+02
^{137}Cs.gea *	μCi/mL	1.12E+02	1.00E+00	1	9.93E+01	1.25E+02
^{129}I	μCi/mL	1.25E-04	8.88E-06	1	1.19E-05	2.37E-04
Na.icp	μg/mL	1.13E+05	7.79E+02	1	1.03E+05	1.22E+05
OH^-	μg/mL	3.34E+04	1.42E+03	1	1.54E+04	5.14E+04
^{79}Se	μCi/mL	2.12E-04	9.00E-05	1	0.00E+00	1.36E-03
Si.icp	μg/mL	8.53E+01	2.15E+00	1	5.81E+01	1.13E+02
SpG	---	1.23E+00	4.12E-03	1	1.18E+00	1.28E+00
Total Beta	μCi/mL	1.09E+02	7.26E-01	1	9.95E+01	1.18E+02
U.phos *	μg/mL	1.60E+01	1.86E+00	1	0.00E+00	3.96E+01
% Water.tga *	wt%	6.95E+01	2.41E-01	1	6.64E+01	7.26E+01
pH *	pH units	1.34E+01	7.00E-02	1	1.25E+01	1.43E+01
F^-.ic	μg/mL	3.08E+02	2.81E+01	1	0.00E+00	6.65E+02
^{3}H	μCi/mL	1.11E-02	8.32E-03	1	0.00E+00	1.17E-01
NH_3 *	μg/mL	4.20E+01	2.20E+01	1	0.00E+00	3.22E+02
NO_2^-	μg/mL	4.67E+04	8.67E+02	1	3.57E+04	5.77E+04
NO_3^- *	μg/mL	9.83E+04	3.25E+03	1	5.70E+04	1.40E+05
PO_4^{3-} *	μg/mL	1.32E+03	1.57E+02	1	0.00E+00	3.31E+03
SO_4^{2-}	μg/mL	2.18E+03	1.86E+02	1	0.00E+00	4.53E+03
$^{89/90}Sr$	μCi/mL	2.10E-01	1.05E-01	1	0.00E+00	1.54E+00
TIC	μg/mL	2.68E+03	8.41E+01	1	1.61E+03	3.75E+03

Table B3-5. Mean Concentrations - Top Supernatant Layer (Nested ANOVA). (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
TOC	µg/mL	1.49E+03	1.89E+01	1	1.25E+03	1.73E+03
^{99}Tc	µCi/mL	5.94E-02	3.06E-03	1	2.04E-02	9.83E-02
Total carbon	µg/mL	4.71E+03	5.03E+01	1	4.07E+03	5.35E+03

Note:

* = $\hat{\sigma}_{riser}$ is significantly different from zero (evidence of horizontal heterogeneity).

Table B3-6. Mean Concentrations - Top Supernatant Layer (One-Way ANOVA).

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
Al.icp	µg/mL	1.74E+04	1.17E+02	3	1.70E+04	1.78E+04
^{14}C	µCi/mL	3.30E-04	5.86E-05	2	7.82E-05	5.82E-04
Cr.icp	µg/mL	2.13E+02	1.28E+00	3	2.08E+02	2.17E+02
^{129}I	µCi/mL	1.25E-04	8.88E-06	2	8.65E-05	1.63E-04
Na.icp	µg/mL	1.13E+05	7.79E+02	3	1.10E+05	1.15E+05
OH^-	µg/mL	3.35E+04	1.33E+03	2	2.78E+04	3.92E+04
^{79}Se	µCi/mL	2.12E-04	9.00E-05	2	0.00E+00	5.99E-04
Si.icp	µg/mL	8.53E+01	2.15E+00	3	7.85E+01	9.22E+01
SpG	---	1.23E+00	3.25E-03	3	1.22E+00	1.24E+00
Total beta	µCi/mL	1.09E+02	7.26E-01	3	1.06E+02	1.11E+02
F^-.ic	µg/mL	3.08E+02	2.81E+01	2	1.87E+02	4.29E+02
^{3}H	µCi/mL	1.11E-02	8.32E-03	2	0.00E+00	4.69E-02
NO_2^-	µg/mL	4.69E+04	6.94E+02	2	4.39E+04	4.99E+04
SO_4^{2-}	µg/mL	2.18E+03	1.86E+02	2	1.38E+03	2.97E+03
$^{89/90}$Sr	µCi/mL	2.10E-01	1.05E-01	2	0.00E+00	6.61E-01
TIC	µg/mL	2.68E+03	8.41E+01	2	2.31E+03	3.04E+03
TOC	µg/mL	1.49E+03	1.89E+01	3	1.43E+03	1.55E+03
^{99}Tc	µCi/mL	5.99E-02	2.49E-03	2	4.92E-02	7.06E-02
Total carbon	µg/mL	4.71E+03	5.03E+01	2	4.49E+03	4.93E+03

Table B3-7. Analytes (Top Supernatant Layer) With More Than 50 Percent of "Less Than" Values.

Analyte	Unit	Result
^{241}Am.aea	μCi/mL	< 0.000358
^{144}Ce/Pr.gea	μCi/mL	< 0.731
$^{243/244}$Cm	μCi/mL	< 0.000358
^{60}Co.gea	μCi/mL	< 0.00757
^{134}Cs.gea	μCi/mL	< 0.0559
^{154}Eu.gea	μCi/mL	< 0.0282
^{155}Eu.gea	μCi/mL	< 0.205
Fe.icp	μg/mL	< 12.5
Mn.icp	μg/mL	< 2.5
^{94}Nb.gea	μCi/mL	< 0.0141
Ni.icp	μg/mL	< 5
^{237}Np	μCi/mL	< 0.0017
^{238}Pu	μCi/mL	< 0.000202
$^{239/240}$Pu	μCi/mL	< 0.000202
^{226}Ra.gea	μCi/mL	< 1.45
^{106}Ru/Rh.gea	μCi/mL	< 1.13
Total alpha	μCi/mL	< 0.0102
U.icp	μg/mL	< 125
Organics data - VOA and SVOA		U 25,000
1-Butanol	μg/L	U 500
2-Hexanone	μg/L	U 500
2-Pentanone	μg/L	U 500
4-Methyl-2-pentanone	μg/L	550
Acetone	μg/L	U 500
2-Butanone	μg/L	U 500
Tetrahydrofuran	μg/L	U 2,000
2-Butoxyethanol	μg/L	B 2,400
Tri-n-butylphosphate	μg/L	

Note:

U = Compound was analyzed for, but not detected.
B = Compound was found in the blank.

The mean concentration estimates for the bottom sludge layer, along with the two-sided 95 percent confidence interval for the mean concentration, are given in Table B3-8 for those analytes with at least 50 percent of the reported data as quantitative values. For those analytes that had a mixture of both quantitative values and "less than" values, the ANOVA was computed using two different methodologies.

> The upper value of the "less than" (e.g., 3.5 for < 3.5) was used to represent all "less than" analytical values in the first computation. This produces a bias of unknown magnitude in both the mean analyte concentration and the variance associated with the mean; the mean analyte concentration is biased high. The extension ".w" was added to the analyte name in the tables to distinguish which analyte was statistically analyzed using "less than" values.
>
> The "less than" values were deleted in the second computation. Deleting data produces unbalanced data sets, which complicates the statistical analysis. Deleting data decreases the number of degrees of freedom. Deleting data also produces a bias of unknown magnitude in both the mean analyte concentration and the variance associated with the mean. The extension ".wo" was added to the analyte name in the tables to distinguish which analyte was statistically analyzed with the "less than" values deleted.

For some of the analytes, the lower limit of the 95 percent confidence interval was a negative value because of the magnitude of the variability. Because the actual concentration of a tank sample cannot be less than zero, the lower limit is reported as zero. The analytes (bottom layer) that had less than 50 percent of the reported data as quantitative values are listed in Table B3-9. Table B3-9 cites the largest value observed from the analytical results.

Table B3-8. Summary Statistics - Mean Concentration of Bottom Supernatant Layer. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
% Water.grav	wt%	5.72E+01	2.10E+00	1	3.05E+01	8.39E+01
Al.icp	μg/L	1.29E+07	1.05E+06	1	0.00E+00	2.62E+07
^{241}Am.aea	μCi/mL	4.56E-04	1.50E-04	1	0.00E+00	2.36E-03
Ba.icp.w	μg/L	1.73E+03	1.27E+03	1	0.00E+00	1.78E+04
Be.icp.w	μg/L	2.34E+03	6.63E+02	1	0.00E+00	1.08E+04
^{14}C	μCi/mL	2.29E-04	1.15E-05	1	8.29E-05	3.75E-04
Cd.icp.w	μg/L	3.88E+03	2.15E+03	1	0.00E+00	3.12E+04
Cd.icp.wo	μg/L	3.89E+03	2.16E+03	1	0.00E+00	3.14E+04
Cl^-	μg/mL	2.65E+03	3.68E+02	1	0.00E+00	7.32E+03

Table B3-8. Summary Statistics - Mean Concentration of Bottom Supernatant Layer. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
Cr.icp	μg/L	2.08E+05	1.10E+04	1	6.82E+04	3.48E+05
^{134}Cs.gea	μCi/mL	5.80E-01	1.57E-02	1	3.80E-01	7.80E-01
^{137}Cs.gea	μCi/mL	2.45E+02	9.50E+00	1	1.24E+02	3.66E+02
F^-.ic.w	μg/mL	3.34E+02	3.24E+02	1	0.00E+00	4.45E+03
Fe.icp.w	μg/L	1.07E+04	4.26E+03	1	0.00E+00	6.49E+04
^{129}I.w	μCi/mL	1.45E-04	1.61E-05	1	0.00E+00	3.50E-04
^{129}I.wo	μCi/mL	1.57E-04	1.26E-05	1	0.00E+00	3.17E-04
K.icp	μg/L	3.16E+07	1.38E+06	1	1.41E+07	4.90E+07
NO_2^-.ic	μg/mL	5.21E+04	6.41E+03	1	0.00E+00	1.34E+05
NO_3^-.ic	μg/mL	1.91E+05	3.05E+04	1	0.00E+00	5.78E+05
Na.icp	μg/L	1.84E+08	9.50E+06	1	6.28E+07	3.04E+08
Ni.icp.w	μg/L	1.33E+04	9.50E+02	1	1.18E+03	2.53E+04
Ni.icp.wo	μg/L	1.38E+04	1.55E+03	1	0.00E+00	3.35E+04
P.icp	μg/L	2.55E+05	4.38E+04	1	0.00E+00	8.11E+05
PO_4^{3-}.ic.w	μg/mL	5.13E+02	8.85E+01	1	0.00E+00	1.64E+03
PO_4^{3-}.ic.wo	μg/mL	4.36E+02	4.89E+01	1	0.00E+00	1.06E+03
Pb.icp.w	μg/L	3.37E+04	2.83E+04	1	0.00E+00	3.94E+05
^{239}Pu.w	μCi/mL	1.34E-04	2.58E-05	1	0.00E+00	4.61E-04
SO_4^{2-}.ic.w	μg/mL	1.11E+03	4.88E+02	1	0.00E+00	7.31E+03
SO_4^{2-}.ic.wo	μg/mL	1.40E+03	2.27E+02	1	0.00E+00	4.29E+03
Se	μg/mL	1.39E-01	1.99E-02	1	0.00E+00	3.92E-01
SpG	---	1.37E+00	2.05E-02	1	1.11E+00	1.63E+00
^{90}Sr	μCi/mL	2.15E-01	2.70E-02	1	0.00E+00	5.58E-01
TIC	μg/mL	3.67E+03	1.98E+02	1	1.16E+03	6.18E+03
TOC	μg/mL	3.02E+03	2.18E+02	1	2.54E+02	5.78E+03
^{99}Tc	μCi/mL	8.01E-02	5.92E-03	1	4.79E-03	1.55E-01

Table B3-9. Analytes (Bottom Supernatant Layer) With More Than 50 Percent of "Less Than" Values.

Analyte	Unit	Result
^{106}Ru/Rh.gea	µCi/mL	< 1.09
^{125}Sb.gea	µCi/mL	< 0.312
^{144}Ce/Pr.gea	µCi/mL	< 0.568
$^{243/244}$Cm	µCi/mL	< 0.000637
^{60}Co.gea	µCi/mL	< 0.0125
^{94}Nb.gea	µCi/mL	< 0.0178
^{237}Np	µCi/mL	< 0.000431
^{238}Pu	µCi/mL	< 0.000609
Ag.icp	µg/L	< 5,000
Sb.icp	µg/L	< 210,000

B3.4.2 Analysis of Variance Model

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

The data were statistically evaluated using two different models. The first model used a nested ANOVA. The nested ANOVA statistical model used to describe the structure of the data when duplicate analyses were performed is

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

$$i=1,2,\ldots,a;\ j=1,2,\ldots,b_i;\ k=1,2,\ldots,n_{ij};$$

where

Y_{ijk} = concentration from the kth analytical result from the jth grab sample from the ith riser

μ = the grand mean

R_i = the effect of the ith riser

S_{ij} = the effect of the jth grab sample from the ith riser

A_{ijk}	=	the effect of the kth analytical result from the jth grab sample from the ith riser
a	=	the number of risers
b_i	=	the number of grab samples from the ith riser
n_{ij}	=	the number of analytical results from the jth grab sample from the ith riser.

The variables R_i and S_{ij} are assumed to be a random effects. These variables, as well as A_{ijk}, are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(R)$, $\sigma^2(S)$, and $\sigma^2(A)$, respectively. Estimates of $\sigma^2(R)$, $\sigma^2(S)$, and $\sigma^2(A)$ were obtained using REML techniques. This method applied to variance component estimation is described in Harville (1977). The results using the REML techniques were obtained using the statistical analysis package S-PLUS[1] (Statistical Sciences 1993). The *df* associated with the standard deviation of the mean (a function of $\sigma^2(R)$, $\sigma^2(S)$, and $\sigma^2(A)$) is the number of risers minus one.

The nested analysis of variance statistical model used to describe the structure of the data when duplicate analyses were not performed (the sampling and analytical variabilities are confounded) is

$$Y_{ij} = \mu + R_i + S_{ij},$$

$$i=1,2,\ldots,a;\ j=1,2,\ldots,b_i;$$

where

Y_{ij}	=	concentration from the analytical result from the jth grab sample from the ith riser
μ	=	the grand mean
R_i	=	the effect of the ith riser
S_{ij}	=	the effect of the analytical result from the jth grab sample from the ith riser
a	=	the number of risers
b_i	=	the number of grab samples from the ith riser.

[1]Trademark of Statistical Sciences, Inc., Seattle, Washington.

The variable R_i is assumed to be a random effect. This variable, as well as S_{ij}, is assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(R)$ and $\sigma^2(S)$, respectively. Estimates of $\sigma^2(R)$ and $\sigma^2(S)$ were obtained using REML techniques. The results using the REML techniques were obtained using the statistical analysis package S-PLUS™ (Statistical Sciences 1993). The *df* associated with the standard deviation of the mean (a function of $\sigma^2(R)$ and $\sigma^2(S)$) is the number of risers minus one.

The second model used one-way ANOVA. The one-way ANOVA statistical model used to describe the structure of the data when duplicate analyses were performed is

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

$$i=1,2,\ldots,a,\ j=1,2,\ldots,n_i,$$

where

Y_{ij}	=	concentration from the j^{th} analytical result from the i^{th} grab sample
μ	=	the grand mean
S_i	=	the effect of the i^{th} grab sample
A_{ij}	=	the effect of the j^{th} analytical result from the i^{th} grab sample
a	=	the number of grab samples
n_i	=	the number of analytical results from the i^{th} grab sample.

The variable S_i is assumed to be a random effect. This variable, as well as A_{ij}, is assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(S)$ and $\sigma^2(A)$, respectively. Estimates of $\sigma^2(S)$ and $\sigma^2(A)$ were obtained using REML techniques. The results using the REML techniques were obtained using the statistical analysis package S-PLUS™ (Statistical Sciences 1993). The *df* associated with the standard deviation of the mean [a function of $\sigma^2(S)$ and $\sigma^2(A)$] is the number of grab samples minus one.

The one-way ANOVA statistical model used to describe the structure of the data when duplicate analyses were not performed (sampling and analytical variabilities are confounded) is

$$Y_i = \mu + S_i, \quad i=1,2,\ldots,a,$$

where

Y_i	=	concentration from the analytical result from the i^{th} grab sample

μ = the grand mean

S_i = the effect of the i^{th} grab sample

a = the number of grab samples.

The variable S_i (sampling and analytical variabilities are confounded) is assumed to be a random effect. This variable is assumed to be uncorrelated and normally distributed with mean zero and variance $\sigma^2(S)$. The *df* associated with the standard deviation of the mean is the number of grab samples minus one.

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

In Appendix C, the analyses required for the safety screening DQO (Dukelow et al. 1995) for tank 241-AP-103 are reported. Specifically, statistical and other numerical manipulations required in the DQO reports are documented in this appendix.

- **Section C1:** Statistical analysis and numerical manipulations supporting the safety screening DQO.
- **Section C2:** References for Appendix C.

C1.0 STATISTICS FOR SAFETY SCREENING DATA QUALITY OBJECTIVE

The safety screening DQO (Dukelow et al. 1995) defines acceptable decision confidence limits in terms of one-sided 95 percent confidence intervals. In this appendix, one-sided confidence limits supporting the safety screening DQO are calculated for tank 241-AP-105. The data in this section are from both the 1993 and the 1996 sampling events for tank 241-AP-105.

Confidence intervals were computed for each sample number from tank 241-AP-105 analytical data (Miller 1997). The upper limit (UL) of a one-sided 95 percent confidence interval for the mean is

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

In this equation, $\hat{\mu}$ is the arithmetic mean of the data, $\hat{\sigma}_{\hat{\mu}}$ is the estimate of the standard deviation of the mean, and $t_{(df,0.05)}$ is the quantile from Student's t distribution with *df* degrees of freedom for a one-sided 95 percent confidence interval. For the tank 241-AP-105 data (per sample number), *df* equals the number of observations minus one.

The upper limit to a 95 percent confidence interval on the mean for exothermic activity, on dry weight basis is listed in Table C1-1. The analytical requirements for the 1993 grab samples did not include DSC measurements.

Because all the 1996 analytical results for total alpha were below the detection limit, confidence intervals were not computed. The maximum value observed was 1.02E-02 μCi/mL, which is well below the total alpha limit of 61.5 μCi/L. Because no total alpha data are available for 1993 grab samples, the $^{239/240}$Pu data were used to evaluate the plutonium limit of 1 g/L. The $^{239/240}$Pu data were transformed to g/L by assuming that all the plutonium is ^{239}Pu and using the specific activity of 0.062 Ci/g. All the 1996 analytical results for $^{239/240}$Pu were below the detection limit. The maximum value observed was 3.26E-06 g/L, which is orders of magnitude below the limit of 1 g/L. For both 1993 grab samples, the upper limit is significantly less than 1 g/L Pu. The total alpha and $^{239/240}$Pu analytical data are listed in Table C1-2.

Table C1-1. Summary Statistics of Differential Scanning Calorimetry for Tank 241-AP-105.

Sample Number	Sample Description	Sample Depth	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	UL
1996 Grab Samples		cm	Joules/g dry		
S96V000047	Riser 1 at 330°	587	0.00E+00	0.00E+00	0.00E+00
S96V000048	Riser 1 at 90°	221	0.00E+00	0.00E+00	0.00E+00
S96V000049		688	0.00E+00	0.00E+00	0.00E+00
S96V000053		1,041	0.00E+00	0.00E+00	0.00E+00
1993 Grab Samples					
G401	Riser 1 at 90°	43	N/A	N/A	N/A
G422	Riser 1 at 330°	107	N/A	N/A	N/A

Notes:

Depth = Distance from the tank bottom to the mouth of the sample bottle

Table C1-2. Total Alpha and $^{239/240}Pu$ Data for Tank 241-AP-105.

Sample Number	Sample Description	Sample Depth	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	UL
1996 Grab Samples		cm	Total Alpha (µCi/mL)		
S96V000050	Riser 1 at 330°	587	< 1.02E-02 < 6.76E-03	N/A	N/A
S96V000051	Riser 1 at 90°	221	< 1.02E-02 < 5.05E-03	N/A	N/A
S96V000052	Riser 1 at 90°	688	< 5.05E-03 < 5.05E-03	N/A	N/A
S96V000054	Riser 1 at 90°	1,041	< 5.05E-03 < 5.05E-03	N/A	N/A
1993 Grab Samples					
G401	Riser 1 at 90°	43	N/A	N/A	N/A
G402	Riser 1 at 330°	107	N/A	N/A	N/A
1996 Grab Samples		cm	$^{239/240}Pu$ (g/L)		
S96V000050	Riser 1 at 330°	587	< 2.85E-06	N/A	N/A
S96V000051	Riser 1 at 90°	221	< 3.26E-06	N/A	N/A
S96V000052	Riser 1 at 90°	688	< 3.012E-06	N/A	N/A
1993 Grab Samples					
G401	Riser 1 at 90°	43	1.74E-06	9.68E-08	2.35E-06
G422	Riser 1 at 330°	107	2.57E-06	4.05E-08	2.83E-06

C2.0 APPENDIX C REFERENCES

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY

FOR DOUBLE-SHELL TANK 241-AP-105

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AP-105

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for tank 241-AP-105 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Data sources for the liquid layer in tank 241-AP-105 include the following:

- Data from the March 1993 and August/September 1996 sampling events as shown in Appendix B.
- The TCR for tank 241-AN-101, which provides data from the last sampling event for this tank before 3,660 kL (967 kgal) of DN were transferred to tank 241-AP-105 in August 1996.
- The inventory estimate (Agnew et al. 1997) generated from the HDW model.
- There are no sample analyses of the solids layer in tank 241-AP-105. A composition for the solids layer was estimated by the Environmental Simulation Program (ESP), a computer program produced by OLI Systems (OLI Systems Inc. 1996). ESP uses thermodynamic theory to predict phase equilibrium concentrations in aqueous systems. ESP predictions of binary phase systems have shown good agreement with laboratory results (Meng et al. 1994).

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The estimate made by the HDW model attempts to describe the contents of tank 241-AP-105 as of January 1, 1994. Transfers into and out of tank 241-AP-105 since January 1994 have invalidated the HDW model estimate. The HDW model does not predict a solids layer for this tank. Therefore, no comparisons between the latest sample data and the HDW model are made in this evaluation.

D3.0 COMPONENT INVENTORY EVALUATION

D3.1 EVALUATION OF SOLIDS LAYER IN TANK 241-AP-105

In August 1995, material balance problems were detected during the transfer of double-shell slurry feed (DSSF) from tank 241-AP-105 to tank 241-AP-101. In September 1995, a video of the interior of tank 241-AP-105 indicated the presence of grayish-white, crystalline solids at a level of about 142 cm (56 in.) from the bottom of the tank (White 1996). This level measurement corresponds to a tank volume of 583 kL (154 kgal). Based on this information, the volume of the solids layer was set at 583 kL (154 kgal) (Hanlon 1997).

This solids volume conflicts with the March 1993 grab sampling event, where samples were obtained from depths as low as 43 cm (17 in.) from the bottom of the tank (see Appendix B). The samples taken from the lowest depths were characterized as liquid samples although solids were present in the lowest sample. The density of these samples was 1.38 g/mL.

A close inspection of the video indicates that exposed solids appear along the tank walls. These solids slope downward toward the center of the tank, and appear to form a bowl-like formation partially filled with liquid. Thus, the actual volume of solids would appear to be lower than 583 kL (154 kgal).

The rest of this section attempts to establish the best basis for the amount and composition of solids in the tank until more rigorous measurements and analyses are made. Section D3.1.1 summarizes the waste types that contributed to the formation of solids in tank 241-AP-105. Section D3.1.2 summarizes the ESP prediction for composition and volume of these solids at equilibrium.

D3.1.1 Contributing Waste Types

DSSF added to tank 241-AP-105 in 1989 from Evaporator Campaign 89-1 was the primary source of the solids in that tank. This campaign ran from September 27, 1988 to February 18, 1989 (Jonas 1989). At the beginning of January 1989, transfer lines were routed directly from the 242-A Evaporator to tank 241-AP-105. Tank 241-AP-105 received DSSF from the 242-A Evaporator through February 1989, reaching a peak volume of 1,800 kL (476 kgal) (see Figure D3-1).

Equipment problems forced an early shutdown of the evaporator in February, 1989. As a consequence, 1,860 kL (492 kgal) of partially concentrated non-complexed waste (PCN) was transferred to tank 241-AP-106. During July of that same year 1,340 kL (355 kgal) of PCN was transferred to tank 241-AP-105 from tank 241-AP-106. This waste is not expected to contain a significant amount of solids.

During evaporator operations, slurry samples are frequently taken to assess process performance. These samples can be matched to the time periods in which tank 241-AP-105 received evaporator bottoms. Data from these samples can be input to the ESP model to obtain a prediction of the composition of the liquid and solid phases at equilibrium. Table D3-1 summarizes sampling activities during the slurry feed transfers.

Table D3-1. Slurry Samples Taken During Double-Shell Slurry Feed Transfers to Tank 241-AP-105.

Week of	Tank 241-AP-105 Volume kL (kgal)[1]	Slurry Sample Number[2]	Date Sample Taken[3]
1/9/89	69.7 (19.0)		
1/16/89	71.8 (19.0)	T-3635	1/16/89
1/23/89	198 (52.2)	T-3750	1/29/89
1/30/89	334 (88.3)	T-3789	1/31/89
2/6/89	913 (241)		
2/13/89	1,790 (472)	T-3954	2/13/89
2/20/89	1,800 (477)		

Notes:

[1]Volumes taken from SACS database
[2]Jonas (1989)
[3]Dates are in mm/dd/yy format

Between January 9 and January 30, 1989, tank 241-AP-105 received 264 kL (69.7 kgal) of DSSF that can be characterized as the average of slurry samples T-3635 and T-3750. After January 30, 1989, tank 241-AP-105 received another 1,470 kL (387 kgal) of DSSF, characterized by slurry sample T-3789. Sample T-3954 was discarded because the analyses included no ICP results; i.e., no metal cations were reported. Sample T-3954 had a density of 1.20 and 74.1 wt% water. Concentrations of the slurry samples used in ESP are shown in Table D3-2.

Table D3-2. Selected Slurry Sample Data for 242-A Evaporator Campaign 89-1.[1]
(2 Sheets)

Analyte	T3635	T3750	Avg. T3635, T3750[2]	T3789	Avg. T3635, T3750, T3789[3]
Metals (M)					
Al	0.781	NR[4]	0.781	0.0675	0.543
B	0.00163	0.00153	0.00148	0.00251	0.00182
Ca	0.000524	0.000254	0.000391	0.00312	0.00130
Cr	0.00532	0.00520	0.00526	NR	0.00526
Fe	0.000410	0.000177	0.000410	NR	0.000293
Mg	0.000262	NR	0.000262	0.000382	0.000302
Np	6.14E-06	1.12E-05	3.07E-06	< 0.000153	5.30E-05
P	NR[3]	0.0148	0.0148	0.0129	0.0141
K	0.964	NR	0.964	NR	0.0962
Si	0.00835	0.00792	0.00813	0.00253	0.00627
Na	10.2	8.91	9.55	9.23	9.45
Zn	0.00835	0.000286	0.00133	0.00155	0.00141
Ions (M)					
NH_4	0.00681	< 0.00400	0.00540	0.0132	0.0476
CO_3	0.268	0.261	0.264	0.228	0.252
Cl	0.0766	0.120	0.0983	0.0781	0.0916
F	0.0102	0.0961	0.0531	0.102	0.0694
OH	5.59	6.45	6.02	5.12	5.72
NO_3	3.47	2.88	3.275	3.82	3.46
NO_2	0.504	1.89	1.20	1.24	1.21
PO_4	0.013	0.00926	0.0103	0.01202	0.0102
SO_4	< 0.00301	< 0.0290	0.0160	0.00699	< 0.013

Table D3-2. Selected Slurry Sample Data for 242-A Evaporator Campaign 89-1.[1]
(2 Sheets)

Analyte	T3635	T3750	Avg. T3635, T3750[2]	T3789	Avg. T3635, T3750, T3789[3]
Radionuclides (µCi/L)					
^{241}Am	< 3.57	1.65	< 2.61	1.21	< 2.14
^{14}C	5.95	0.312	3.13	4.20	349
^{134}Cs	600	648	624	570	606
^{137}Cs	301,000	370,000	335,500	308,300	326,400
$^{239/240}$Pu	0.0955	0.0605	0.0780	0.137	0.0977
$^{89/90}$Sr	206	86.1	146	148	147
^{99}Tc	124	NR[c]	124	32.5	93.5
Physical Properties					
Water (wt%)	50.9	53.7	52.3	51.8	52.1
SpG	1.44	1.42	1.43	1.43	1.43
TOC (g/L)	3.75	6.95	5.35	3.61	4.77

Notes:

[1]Jonas (1989)
[2]Inputs to ESP
[3]Assumed to be the same as the T3750 concentration
[4]Assumed to be the same as the T3635 concentration

D3.1.2 Environmental Simulation Program Results

An average of slurry samples T-3635 and T-3750 was used in ESP to represent the first period in which tank 241-AP-105 received DSSF; slurry sample T-3789 was used to represent the second period. A charge balance was imposed on the T-3645/T-3750 samples by adjusting the sodium concentration from 9.55*M* to 7.97*M*. The T-3789 composition was balanced by adjusting the hydroxide concentration from 5.12M to 3.83M. Densities, wt% water, and pH values calculated by ESP for the ionically balanced compositions are compared to the reported laboratory values in Table D3-3.

Table D3-3. Results of Environmental Simulation Program Reconciliation of Charge Imbalances for Evaporator Campaign 89-1 Slurry Samples.

	T-3635 / T-3750		T-3789	
	ESP	Laboratory	ESP	Laboratory
Density (g/mL)	1.48	1.43	1.43	1.43
Wt% water	45.6	52.3[1]	52.8	51.8
pH	16.1	13.2[2]	16.0	13.4[2]
Reconciling analyte	Na	n/a	OH	n/a

Notes:

[1]Using the reported laboratory concentrations, no reconciled compositions produced the reported density and weight percent water. The weight percent water value reported by the laboratory is assumed to be in error.

[2]Hydroxide concentrations are in excess of 5*M*. It is impossible for solutions with these hydroxide concentrations to have such low pH values.

With the reconciled composition, ESP predicts that the solids with the greatest tendency to form at ambient temperatures and 1 atmosphere of pressure are KNO_3, KNO_2, $NaNO_3$, $NaNO_2$, with trace amounts of $Ca(OH)_2$, and $Mg(OH)_2$. Sample T-3635/T-3750 was predicted by ESP to contain 23.1 weight percent solids at equilibrium on a dry basis; sample T-3789 was predicted to contain 27.4 weight percent solids. The results are summarized in Table D3-4.

Table D3-4. Composition Predicted by Environmental Simulation Program for the Solids in Tank 241-AP-105 at Equilibrium.[1] (2 sheets)

Analyte	Solids from Slurry Sample T3635/T3750 (wt%)	Solids from Slurry Sample T3789 (wt%)	Solids from Slurry Sample T3635/T3750 (kg)	Solids from Slurry Sample T3789 (kg)	Total Mass of Solids (kg)
KNO_3	25.7	0	25,100	0	25,100
NaF	0.870	1.45	581	9,340	9,920
$NaNO_3$	73.1	97.5	71,500	628,000	699,000
$NaNO_2$	0.28	1.02	274	6,570	6,844
$Ca(OH)_2$	trace	trace	trace	trace	trace
$Mg(OH)_2$	trace	trace	trace	trace	trace

Table D3-4. Composition Predicted by Environmental Simulation Program for the Solids in Tank 241-AP-105 at Equilibrium.[1] (2 sheets)

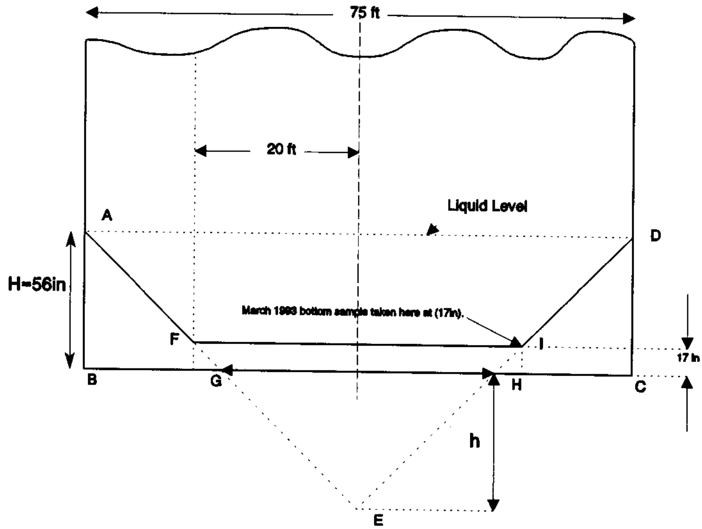
Analyte	Solids from Slurry Sample T3635/T3750 (wt%)	Solids from Slurry Sample T3789 (wt%)	Solids from Slurry Sample T3635/T3750 (kg)	Solids from Slurry Sample T3789 (kg)	Total Mass of Solids (kg)
Wt% solids	23.1	27.6	N/A	N/A	N/A
Vol% solids	16.7	19.4	N/A	Total dry solids mass (kg)	741,000
Solids density, kg/L	2.22	2.26	N/A	Total dry solids volume	328 (86.6)
Slurry volume represented by sample, kL (kgal)	264 (69.7)	1,470 (388)	N/A	Total dry solids density (kg/L)	2.26

Note:
[1]On a dry weight basis

The dry solids volume predicted by ESP at equilibrium is 328 kL (86.7 kgal). The reported volume for the solids layer is 583 kL (154 kgal) (Hanlon 1997). As mentioned earlier, the March 1993 samples taken 6.1 m (20 ft) from the center of the tank at depths of 42 cm (17 in.) (sample G238) and 107 cm (42 in.) (sample G248) from the bottom of the tank were found to be mostly liquid with a density of 1.38 g/mL. From visual observations of the samples in the sample bottles, only sample G238 had a significant amount of solids (approximately 12 vol%).

Rather than extending across the tank at a uniform height, the exposed solids shown in the internal video of tank 241-AP-105 slope downward in a manner similar to Figure D3-1. The solids form a bowl-like shape. If the solids layer is assumed to resemble Figure D3-1, and sample G238 was taken at the point where the downgrade levels out, a solids volume can be approximated by subtracting the cone A-E-D in Figure D3-1 from cylinder A-B-C-D and then adding back the smaller cone G-E-H and smaller cylinder F-G-H-I. The resulting volume is 337 kL (89 kgal). This value compares reasonably well to the ESP equilibrium value of 328 kL (86.7 kgal), although the ESP value is on a dry basis.

Figure D3-1. Solids Level in Tank 241-AP-105.



A solids volume of 337 kL (89 kgal) is a better estimate for the saltcake in tank 241-AP-105 before the addition of DN waste from tank 241-AN-101 in August/September 1996. That volume was used to generate the best-basis solids inventory shown in Table D3-5. The solids volume reported in Hanlon (1997) cannot be correct because liquid samples were drawn at levels 99 cm (39 in.) below the solid level reported by Hanlon. ESP predicts the salts that have settled at the bottom of the tank and line its walls to consist of approximately 95 weight percent $NaNO_3$ with the rest being KNO_3, NaF, and $NaNO_2$. Weight percent values used to calculate the inventories in Table D3-5 were taken from Table D3-4. The DN waste from tank 241-AN-101 has probably dissolved a portion of this saltcake layer, but the extent to which this has happened is unknown.

Table D3-5. Best-Basis Inventory Estimates for Components in Tank 241-AP-105 Saltcake as of January 31, 1997.

Analyte	Composite Sludge Concentration (μg/g)	Total Sludge Inventory (kg)[1]
K	13,100	9,970
Na	268,000	203,000
F	6,060	4,610
NO_2	4,880	3,710
NO_3	709,000	538,000

Note:

[1]Based on a volume of 337 kL (89 kgal) and a density of 2.260 kg/L.

D3.2 EVALUATION OF LIQUID LAYER IN TANK 241-AP-105

Between August 27 and August 29, 1995, 2,500 kL (660 kgal) of DSSF were transferred from tank 241-AP-105, leaving 594 kL (157 kgal) of liquid and solid waste in the tank. On August 16, 1996, the tank received 3,660 kL (967 kgal) of DN waste from tank 241-AN-101. There have been no transfers into or out of the tank since that time.

The only samples taken since the last transfer to tank 241-AP-105 were obtained August/September 1996. The lowest depth from which these samples were taken is 221 cm (87 in.). Appendix B of this report includes the results of the statistical analysis of these samples in addition to samples taken from depths of 107 cm (42 in.) and 43 cm (17 in.) from the bottom of the tank in March 1993 when it contained DSSF and PCN.

A comparison between mean concentrations from samples taken from the upper layer in tank 241-AP-105 and mean concentrations taken from tank 241-AN-101 in August/September 1995, approximately one year before waste was transferred from that tank to tank 241-AP-105, is shown in Table D3-6. Although saltwell liquid and water additions increased the volume in tank 241-AN-101 from 3,834 kL (1,013 kgal) to 4,103 kL (1,084 kgal) before the transfer to tank 241-AP-105, the compared values are reasonably close. The tank 241-AP-105 concentrations are generally lower than the tank 241-AN-101 concentrations but this is consistent with the lower weight percent water value and lower density in the 241-AP-105 samples. The higher nitrate concentration in tank 241-AP-105 could be caused by high nitrate concentrations in the saltwell liquid added to tank 241-AN-101 before the transfer, or re-dissolving of nitrate salts in tank 241-AP-105 after the transfer. The variations for F, PO_4, SO_4, ^{90}Sr, and TOC are the greatest; thus, they have a larger uncertainty. The lower F concentrations in the liquid phase are probably caused by precipitation of NaF (see Section D3.1.2).

Samples taken in March 1993 representing the bottom layer in tank 241-AP-105 are compared in Table D3-7 to the mean of the slurry samples from 242-A Evaporator Campaign 89-1. The compared values are reasonably close. The evaporator slurry sample concentrations all fall within the 95 percent confidence intervals for the March 1993 bottom layer samples (See Appendix B). The March 1993 concentrations are generally lower than the evaporator slurry samples; this is consistent with the higher percentage of water and lower density reported for the March 1993 samples.

Because they are averages of samples taken from the evaporator before being sent to tank 241-AP-105, the slurry sample data have more uncertainty associated with them. However, the reasonable agreement between the slurry sample data and the March 1993 concentrations are a useful check on the analytical results of the latter. Cr, Fe P, F, PO_4, and TOC have the largest variation. Again, the lower F concentrations are likely caused by NaF precipitation. The fact that F, PO_4, and TOC concentrations from the tank 241-AP-105 samples are lower in both comparisons than the source term concentrations suggest that PO_4 and TOC have also precipitated to some extent. This may also account for the lower concentrations of SO_4 and ^{90}Sr in the August/September 1996 samples. In that case, ESP is not fully predicting the behavior of these species.

The August/September 1996 and March 1993 sample results provide the best basis for the liquid inventory in tank 241-AP-105. The August/September 1996 samples are assumed to represent 3,660 kL (967 kgal) of the waste volume in tank 241-AP-105. This is the amount of waste transferred from tank 241-AN-101 in August 1995. The March 1993, samples are assumed to represent 246 kL (65 kgal) of liquid. This is equal to the remaining 583 kL (154 kgal) minus the saltcake volume of 337 kL (89 kgal) calculated in Section D3.1. The results are shown in Tables D3-8 and D3-9.

Table D3-6. Comparison of Analytical Results for the Top Layer in Tank 241-AP-105 to Tank 241-AN-101 as of August, 1995.

Analyte	241-AP-105 Mean Concentrations[1]	241-AN-101 Mean Concentrations[2]	Ratios 241-AP-105/ 241-AN-101
Metals	μg/mL	μg/mL	
Al	17,400	20,900	0.832
Fe	NR	< 20.1	n/a
Na	113,000	128,000	0.883
Anions	μg/mL	μg/mL	
Cl	NR	3,300	n/a
CO_3 [3]	13,400	12,250	1.08
F	308	475	0.648
OH	33,500	31,400	1.07
NO_3	98,300	97,100	1.01
NO_2	46,700	48,200	0.969
PO_4	1,320	2,120	0.623
SO_4	2,180	3,040	0.717
Radionuclides[4]	μCi/L	μCi/L	
^{241}Am	NR	5.16E-05	n/a
^{134}Cs	NR	0.0161	n/a
^{137}Cs	116	128	0.906
^{60}Co	NR	< 0.00413	n/a
$^{239/240}$Pu	NR	5.60E-05	n/a
$^{89/90}$Sr	0.218	0.392	0.556
Physical properties			
Weight percent water	69.5	66.0	1.053
Specific gravity	1.23	1.24	0.992
Total organic carbon	1,490	2,630	0.556

Notes:

NR = not reported

[1]See Appendix B, Tables B3-5 and B3-6
[2]Benar and Amato (1996)
[3]Derived from TIC value
[4]Radionuclides decayed to January 1, 1994

Table D3-7. Comparison of the Analytical Results for the Bottom Layer in Tank 241-AP-105 to Slurry Samples Taken During 242-A Evaporator Campaign 89-1.

Analyte	241-AP-105 Mean Concentrations[1]	Slurry Sample Mean Concentrations[2]	Ratios 241-AP-105/ Slurry Sample
Metals	μg/mL	μg/mL	
Al	12,900	14,700	0.878
B	NR	19.7	n/a
Ca	NR	52.1	n/a
Cr	208	273	0.762
Fe	10.7	16.4	0.652
Mg	NR	16.6	n/a
Np	NR	0.0530	n/a
P	255	429	0.594
K	31,600	37,600	0.840
Si	NR	109	n/a
Na	184,000	217,000	0.848
Zn	NR	91.9	n/a
Anions	μg/mL	μg/mL	
Cl	2,650	3,250	0.815
CO_3	18,300	15,100	1.21
F	334	1,320	0.253
OH	NR	97,240	n/a
NO_3	191,000	214,000	0.892
NO_2	52,000	55,700	0.934
PO_4	513	974	0.527
SO_4	1,110	1,250	0.888
Physical properties			
Weight percent water	57.2	52.1	1.10
Specific gravity	1.37	1.43	0.958
NH_4	NR	809	n/a
Total organic carbon	3,020	4,770	0.633

Notes:

[1]See Appendix B, Table B3-8

[2]Based on the average of samples T-3635, T-3750, T-3789 (Jonas 1989)

Table D3-8. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-105 Supernatant as of January 31, 1997.[1]

Analyte	Supernatant Concentration (μg/mL)	Total Supernatant Inventory (kg)
Al	17,100	66,900
Bi	NR	NR
Ca	NR	NR
Cl	3,260	12,700
TIC as CO_3	13,700	53,500
Cr	213	831
F	310	1,210
Fe	< 19.5	< 12.1
Hg	NR	NR
K	1,990	7,770
La	NR	NR
Mn	NR	NR
Na	117,000	459,000
Ni	< 4.69	18.3
NO_2	3,300	13,300
NO_3	104,000	407,000
OH	31,300	122,000
Pb	NR	NR
PO_4	1,270	4,960
Si	79.9	312
SO_4	2,130	8,320
Sr	NR	NR
TOC	1,590	6,200
U_{TOTAL}	15.0	458
Zr	NR	NR

Note:

[1]Inventories based on a volume of 3,906 kL (1,032 kgal), where 3,660 kL (967 kgal) is based on 1996 sampling results and 246 kL (65 kgal) is based on 1993 sampling results.

Table D3-9. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 Supernatant as of January 31, 1997 (Decayed to January 1, 1994).[1] (2 Sheets)

Analyte	Supernatant Concentration (μCi/mL)	Total Supernatant Inventory (Ci)
^{3}H	0.00975	38.1
^{14}C	0.000324	1.26
^{59}Ni	NR	NR
^{60}Co	<0.00731	<28.5
^{63}Ni	NR	NR
^{79}Se	<0.000199	<0.776
^{90}Sr	0.207	807
^{90}Y	0.207	807
^{93}Zr	NR	NR
^{93m}Nb	NR	NR
^{99}Tc	0.0602	237
^{106}Ru	<0.838	<3,270
^{113m}Cd	NR	NR
^{125}Sb	<0.0355	<139
^{126}Sn	NR	NR
^{129}I	NR	NR
^{134}Cs	<0.0374	<146
^{137}Cs	119	465,000
^{137m}Ba	113	442,000
^{151}Sm	NR	NR
^{152}Eu	NR	NR
^{154}Eu	<0.0244	<95.2
^{155}Eu	<0.167	<652
^{226}Ra	<1.36	<5,310
^{227}Ac	NR	NR
^{228}Ra	NR	NR
^{229}Th	NR	NR
^{231}Pa	NR	NR

Table D3-9. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 Supernatant as of January 31, 1997 (Decayed to January 1, 1994).[1] (2 Sheets)

Analyte	Supernatant Concentration (μCi/mL)	Total Supernatant Inventory (Ci)
^{232}Th	NR	NR
^{232}U	NR	NR
^{233}U	NR	NR
^{234}U	NR	NR
^{235}U	NR	NR
^{236}U	NR	NR
^{237}Np	<0.00162	6.33
^{238}Pu	<0.000227	<0.886
^{238}U	NR	NR
$^{239/240}Pu$	<0.000189	<0.739
^{241}Am	<0.000364	<1.42
^{241}Pu	NR	NR
^{242}Cm	NR	NR
^{242}Pu	NR	NR
^{243}Am	NR	NR
$^{243/244}Cm$	<0.000370	<1.45
^{244}Cm	NR	NR

Note:

[1]Inventories based on a volume of 3,906 kL (1,032 kgal), where 3,660 kL (967 kgal) is based on 1996 sampling results and 246 kL (65 kgal) is based on 1993 sampling results.

D4.0 DEFINE THE BEST BASIS AND ESTABLISH COMPONENT INVENTORIES

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

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

An effort is underway to provide waste inventory estimates that will serve as the standard characterization for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, and evaluation of chemical information for tank AP-105 was performed. The engineering assessment done in this evaluation should serve as the basis for the best estimate inventory for tank 241-AP-105 for the following reasons:

1. The March 1993 and August/September 1996 samples are the only samples taken from tank 241-AP-105 that represent the current waste contents of the tank.

2. These samples agree reasonably well with samples taken before the waste was transferred to tank 241-AP-105.

3. The HDW model estimate is outdated because of the large number of waste transfers that have occurred subsequent to the date that the HDW model estimate is valid.

4. Because of the lack of sample data for the solids in tank 241-AP-105, ESP calculations provide the best available estimate of the solids composition.

5. The reported solids volume (Hanlon 1997) conflicts with recent sampling events. This evaluation demonstrates that the reported solids volume overstates the amount of solids in the tank.

Best-basis inventory estimates for tank 241-AP-105 are presented in Tables D4-1 and D4-2. The values are the sum of the values estimated in Tables D3-5 and D3-8.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-105 as of January 31, 1997.

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	66,900	S	
Bi	NR		
Ca	NR		
Cl	12,700	S	241-AN-101 concentration used for top layer (3,300 μg/mL)
TIC as CO_3	53,500	S	
Cr	831	S	
F	5,820	S/E	4,610 kg estimated for saltcake
Fe	<19.5	S	
Hg	NR		
K	17,700	S/E	9,970 kg estimated for saltcake
La	NR		
Mn	NR		
Na	662,000	S/E	203,000 kg estimated for saltcake
Ni	<18.3	S	
NO_2	16,700	S/E	3,710 kg estimated for saltcake
NO_3	945,000	S/E	538,000 kg estimated for saltcake
OH	122,000	S	
Pb	NR		
PO_4	4,960	S	
Si	312	S	
SO_4	8,320	S	
Sr	NR		
TOC	6,200	S	
U_{TOTAL}	458	S	
Zr	NR		

Note:

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

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 as of January 31, 1997 (Decayed to January 1, 1994). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	38.1	S	
^{14}C	1.26	S	
^{59}Ni	NR		
^{60}Co	<28.5	S	
^{63}Ni	NR		
^{79}Se	< 0.776	S	
^{90}Sr	807	S	
^{90}Y	807	S	
^{93}Zr	NR		
^{93m}Nb	NR		
^{99}Tc	237	S	
^{106}Ru	<3,270		
^{113m}Cd	NR		
^{125}Sb	<139	S	
^{126}Sn	NR		
^{129}I	NR		
^{134}Cs	<146	S	
^{137}Cs	465,000	S	
^{137m}Ba	442,000	S	
^{151}Sm	NR		
^{152}Eu	NR		
^{154}Eu	<95.2	S	
^{155}Eu	<652	S	
^{226}Ra	<5,310	S	
^{227}Ac	NR		
^{228}Ra	NR		
^{229}Th	NR		
^{231}Pa	NR		
^{232}Th	NR		
^{232}U	NR		

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 as of January 31, 1997 (Decayed to January 1, 1994). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{233}U	NR		
^{234}U	NR		
^{235}U	NR		
^{236}U	NR		
^{237}Np	<6.33	S	
^{238}Pu	<0.886	S	
^{238}U	NR		
$^{239/240}Pu$	<0.739	S	
^{241}Am	<1.42	S	
^{241}Pu	NR		
^{242}Cm	NR		
^{242}Pu	NR		
^{243}Am	NR		
$^{243/244}Cm$	<1.45	S	
^{244}Cm	NR		

Note:

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

D5.0 APPENDIX D REFERENCES

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Hodgson, K. M., and M. D. LeClair, 1996, *Work Plan for Defining a Standard Inventory Estimate for Wastes Stored in Hanford Site Underground Tanks*, WHC-SD-WM-WP-311, Rev. 1, Lockheed Martin Hanford Corporation, Richland, Washington.

Jonas, A. L., 1989, *242-A Evaporator FY1989 Campaign Run 89-1 Post Run Document*, WHC-SD-WM-PE-037, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Meng, C. D., G. MacLean, and B. Landeene, 1994, *Computer Simulation of Laboratory Leaching and Washing of Tank Waste Sludges*, WHC-SD-WM-ES-312, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

OLI Systems, Inc., 1996, *Environmental Simulation Program Manual, Version 5.0*, OLI Systems, Inc., Morris Plains, New Jersey.

White, K. D., 1996, *Waste Level in 241-AP-105*, (internal memorandum 77310-96-016 to R. J. Nicklas, April 15), Westinghouse Hanford Company, Richland, Washington.

APPENDIX E

BIBLIOGRAPHY FOR TANK 241-AP-105

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-AP-105

Appendix E provides a bibliography of information that supports the characterization of tank 241-AP-105. This bibliography represents an in-depth literature search of all known information sources that provide sampling, analysis, surveillance, modeling information, and processing occurrences associated with tank 241-AP-105 and its respective waste types.

The references in this bibliography are separated into four broad categories with references contained in subgroups. These categories and their subgroups are listed below. The bibliography is broken down into the appropriate sections of material to use, with an annotation at the end of each reference describing the information source. Where possible, a reference is provided for information sources. A majority of the information listed below may be found in the Lockheed Martin Hanford Company Tank Characterization Resource Center.

I. NON-ANALYTICAL DATA

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

II. ANALYTICAL DATA

- IIa. Sampling of Tank Waste and Waste Types
- IIb. Sampling of 242-A Evaporator Streams

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

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

I. NON-ANALYTICAL DATA

Ia. Fill History/Waste Transfer Records

Agnew, S.F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1996, *Waste Status and Transaction Record Summary (WSTRS, Rev. 4)*, LA-UR-97-311, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains spreadsheets depicting all available data on tank additions/transfers for SE quadrant.

Strode, J. M., and G. M. Koreski, 1996, *Operational Waste Volume Projection*, WHC-SD-WM-ER-029, Rev. 22, Westinghouse Hanford Company, Richland, Washington.

- Contains recent waste transfer history of double-shell tanks and a projection of anticipated transfers to/from the double-shell tanks.

Ib. Surveillance/Tank Configuration

Harlow, D. G., 1980, *Heat Content in 241-AP Tank Farm*, (internal letter 65410-80-11 to R. B. Guenther, September 30), Rockwell Hanford Company, Richland, Washington.

- Contains anticipated heat loads in 241-AP tanks.

Harris, J. P., 1994, *Operating Specifications for the 241-AN, AP, AW, AY, AZ, & SY Tank Farms*, OSD-T-151-00007, Rev. Mod. H-8, Westinghouse Hanford Company, Richland, Washington.

- Contains the operating specifications for the listed double-shell tanks. These include composition, liquid levels, dome loading, headspace pressure, etc.

Leach, C. E., and S. M. Stahl, 1997, *Hanford Site Tank Farm Facilities Interim Safety Basis Volume I and II*, WHC-SD-WM-ISB-001, Rev. 0M, Westinghouse Hanford Company, Richland, Washington.

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

Lipnicki, J., 1997, *Waste Tank Risers Available for Sampling*, WHC-SD-WM-TI-710, Rev. 4, Westinghouse Hanford Company, Richland, Washington.

- Gives an assessment of all risers per tank; however, not all tanks are included/completed.

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

- Shows tank riser locations in relation to tank aerial view as well as a description of riser and its contents.

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

- Contains information pertaining to thermocouple trees installed in the Hanford Site underground waste tanks.

Ic. Sample Planning/Tank Prioritization

Bell, K. E., 1993, *Tank Waste Remediation System Tank Waste Characterization Plan,* WHC-SD-WM-PLN-047, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Early version of the characterization planning document.

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

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

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.

- Agreement between the U.S. Environmental Protection Agency, U.S. Department of Energy, and Washington State Department of Ecology that sets milestones for completing work on the Hanford Site tank farms.

EPA, 1990, "Identification and Listing of Hazardous Wastes," 40 CFR 261, U.S. Environmental Protection Agency, Washington, D.C.

- Identifies and lists hazardous wastes, and defines procedures for determining if a waste should be classified as hazardous.

Grimes, G. W., 1977, *Hanford Long-Term Defense High-Level Waste Management Program Waste Sampling and Characterization Plan*, RHO-CD-137, Rockwell Hanford Operations, Richland, Washington.

- Contains plan for characterizing waste, short and long term goals, tank priority, analysis needs, estimates of analyte concentrations per waste type, and a characterization flowsheet.

Hendrickson, D. W., and T. L. Welsh, 1992, *Tank 241-AP-105 Sampling and Characterization Plan*, WHC-SD-WM-TP-130, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Characterization plan for tank 241-AP-105.

Mulkey, C. H., 1996, *Double-Shell Tank Waste Analysis Plan*, WHC-SD-WM-EV-053, Rev. 4, Westinghouse Hanford Company, Richland, Washington.

- Outlines the methods for sampling and analysis needed to meet specific data requirements.

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

- Creates the Safety Watch List for the Hanford Site tank farms.

Schreiber, R. D., 1996, *Tank 241-AP-105 Grab Sampling and Analysis Plan*, WHC-SD-WM-TSAP-091, Rev. 0C, Westinghouse Hanford Company, Richland, Washington.

- Outlines requirements for grab sampling and analysis for 1996 grab samples.

Tusler, L. A., 1994, *Waste Tank Characterization Sampling Limits,* WHC-SD-WM-TI-651, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Summarizes and compares the analytical data for operational limits.

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

- Identifies plans and requirements for tanks to be sampled and analyzed and TCRs to be written during fiscal year 1997.

Winters, W. I., 1993, *Technical Project Plan for the 222S Laboratory in Support of the Grout Treatment Facility Sampling and Characterization Plans for Tanks AP-102, AP106 & AP-105*, WHC-SD-WM-TPP-008, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Outlines project plans and requirements for samples taken in tank 241-AP-105 in support of the grout treatment program.

Id. Data Quality Objectives/Customers of Characterization Data

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

- Contains objectives to sample all tanks for safety concerns (ferrocyanide, organic, flammable gas, and criticality) as well as decision thresholds for energetics, criticality and flammability.

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.

- Contains data needs and requirements for the evaporator program.

II. ANALYTICAL DATA

IIa. Sampling of Tank Waste and Waste Types

De Lorenzo, D. S., A. T. DiCenso, L. C. Amato, R. H. Stephens, K. W. Johnson, B. C. Simpson, and T. L. Welsh, 1994, *Tank Characterization Report for Double-Shell Tank 241-AP-105*, WHC-SD-WM-ER-360, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Summarizes and compares the analytical data for characterization.

Miller, G. L., 1996, Tank 241-AP-105, *Grab Samples 5AP-96-1C, 5AP-96-2C, 5AP-96-3C, 5AP-96-4 and 5AP-96-1B2 Analytical Results for the 45 Day Report*, WHC-SD-WM-DP-202. Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains analytical results for grab samples obtained in 1996.

Welsh, T. L., 1994, *Tank 241-AP-105 Characterization Results*, WHC-SD-WM-TRP-169, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Statistical analysis of March, 1993 samples for tank 241-AP-105.

IIb. Sampling of 242-A Evaporator Streams

Guthrie, M. D., 1994, *242-A Campaign 94-1 Post Run Document*, WHC-SD-WM-PE-053, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains results of 242-A Evaporator Campaign 94-1.

Guthrie, M. D., 1996, *242-A Campaign 95-1 Post Run Document*, WHC-SD-WM-PE-055, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Summarizes the results of 242-A Evaporator Campaign 95-1.

Jonas, A. L., 1989, *242-A Evaporator FY 1989 Campaign Run 89-1 Post Run Document*, WHC-SD-WM-PE-037, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Summarizes the results of 242-A Evaporator Campaign 89-1.

Von Bargen, B. H., 1987, *242-A Evaporator Run Schedule for Run 88-1*, (internal memorandum 13331-87-975 to G. L. Dunford, December 28), Westinghouse Hanford Company, Richland, Washington.

- Contains 1988 evaporator run planning information.

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

IIIa. Inventories from Campaign and Analytical Information

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3680, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains waste type summaries, primary chemical compound/analyte and radionuclide estimates for sludge, supernatant, and solids, as well as supernatant mixing model, tank layer model, and individual tank inventory estimates.

Agnew, S. F., 1995, *Letter Report: Strategy for Analytical Data Comparisons to HDW Model*, (letter CST-4:95-sfa272 to S. Eberlein, Westinghouse Hanford Company, September 28), Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains proposed tank groups based on TLM, and statistical method for comparing analytical information to HDW predictions.

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

- These two documents contain a global component inventory for 200 Area waste tanks. Currently, 14 chemical and 2 radionuclide components are inventoried.

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

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

IIIb. Compendium of Data from Other Sources: Physical and Chemical

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

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

Brevick, C. H., L. A. Gaddis, W. W. Pickett, 1996, *Historical Tank Content Estimate for the Southeast Quadrant of the Hanford 200 Areas*, WHC-SD-WM-ER-350, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Contains summary information from the supporting document for Tank Farms AN, AP, AW, AY, AZ, and SY as well as in-tank photo collages and the solid (including the interstitial liquid) composite inventory estimates.

Brevick, C. H., L. A. Gaddis, and S. D. Consort, 1995, *Supporting Document for the Southeast Quadrant Historical Tank Content Estimate for AP Tank Farm*, WHC-SD-WM-ER-315, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Supporting document for the Historical Tank Content Estimate spanning WHC-SD-WM-ER-308 to WHC-SD-WM-ER-325. This document contains summary tank farm and tank write-ups on historical data and solid inventory estimates, as well as appendixes for the data. The appendices contain the following information: App. C - Level History AutoCAD sketch; App. D - Temperature Graphs; App. E - Surface Level Graph; App. F, pg F-1 - Cascade/Drywell Chart; App. G - Riser Configuration Drawing and Table; App. I - In-Tank Photos; and App. K - Tank Layer Model Bar Chart and Spreadsheet.

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

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

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

- Summarizes issues surrounding characterization of nuclear wastes stored in Hanford Site waste tanks.

Foster, J. L., 1989, *Ammonia Releases from Tank Farms*, (internal memorandum 13331-89-396 to D. D. Wodrich, October 10), Westinghouse Hanford Company, Richland, Washington.

- Contains locations of ammonia gas on Hanford Site as well as background on the source of the ammonia.

Hanlon, B. M., 1997, *Tank Farm Surveillance and Waste Status Summary Report for Month Ending January 31, 1996*, HNF-EP-0182-105, Westinghouse Hanford Company, Richland, Washington.

- Contains a monthly summary of: fill volumes, Watch List tanks, occurrences, integrity information, equipment readings, equipment status, tank location, and other miscellaneous tank information.

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

- Contains a statistical evaluation of the HDW inventory estimate against analytical values from 12 existing TCR reports using a select component data set.

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

- Contains in-tank photos as well as summaries on the tank description, leak detection system, and tank status.

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

- Gives assessment of relative dryness between tanks.

Le, E. Q., 1994, *Process Control Plan for 241-A Evaporator Campaign 94-1*, WHC-S-WM-PCP-008, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Contains process control information for the 242-A Evaporator 94-1 campaign.

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

- Contains a statistical evaluation to group tanks into classes with similar waste properties.

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

- Contains a tank inventory estimate based on analytical information.

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

- Contains a tank inventory estimate based on analytical information.

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

- Contains a tank inventory estimate based on analytical information.

Van Vleet, R. J., 1993, *Radionuclide and Chemical Inventories for the Double-Shell Tanks*, WHC-SD-WM-TI-543, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Contains selected sample analysis tables prior to 1993 for double-shell tanks.

WHC, 1993, Process Aids: A Compilation of Technical Letters By Process Laboratories and Technology, WHC-IP-0711-25, Westinghouse Hanford Company, Richland, Washington.

- These documents contain a collection of internal memos and letters concerning tank or process sampling. Grouped here are all of the Process Aids documents from 1969 - 1993.

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