ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 635416

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental []	J. G. Field, Evaluation and Planning, R2-12, 376-3753	[] Yes [X] No	1/16/97
Direct Revision [x]	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
Change ECN []	AP-103 TCR		N/A
Temporary []	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	10. Related ECN No(s).	11. Related PO No.
Standby [] Supersedure [] Cancel/Void []	WHC-SD-WM-ER-359, Rev. 0	EDT 608044	

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13a. Description of Change — 13b. Design Baseline Document? [] Yes [X] No

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14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[X]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

Revised per DOE performance agreement and direction from the Washington State Department of Ecology to revise 23 TCR's (letter dated 7/6/1995).

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

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Supplemental [] Direct Revision [x] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	J. G. Field, Evaluation and Planning, R2-12, 376-3753	[] Yes [X] No	1/16/97
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13a. Description of Change — 13b. Design Baseline Document? [] Yes [X] No

Revised to new format per DOE performance agreements

14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[X]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

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16. Design Verification Required	17. Cost Impact ENGINEERING		17. Cost Impact CONSTRUCTION		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.

Document Number/Revision	Document Number/Revision	Document Number Revision

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. J. G. Field	J. G. Field	1/16/97	PE		
Cog. Mgr. K. M. Hall	Kathleen M. Hall	1/20/97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other R. J. Cash	R J Cash	1/21/97	Other		
N. W. Kirch	NWKirch	1/20/97			

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

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Tank Characterization Report for Double-Shell Tank 241-AP-103

J. G. Field
Lockheed Martin Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 635416 UC: 2070
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Key Words: Tank 241-AP-103, AP-103, AP Farm, Tank Characterization Report, TCR, Double-Shell Tank, Waste Characterization, Waste Inventory, TPA Milestone M-44

Abstract: This document summarizes information on historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-AP-103, Sampling and Analyses Meet Safety Screening Objectives. This report supports requirements of Tri-Party Agreement Milestone M-44-05.

1/21/97

Release Approval Date

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Tank Characterization Report for Double-Shell Tank 241-AP-103

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LIST OF TERMS

°C	degrees Celsius
°F	degrees Fahrenheit
μCi/g	microcuries per gram
μCi/L	microcuries per liter
μeq/g	microequivalents per gram
μg/g	micrograms per gram
μg/L	micrograms per liter
μg/mL	micrograms per milliliter
Btu/hr	British thermal units per hour
Ci	curies
Ci/L	curies per liter
cm	centimeters
CVAA	cold vapor atomic absorption
DQO	data quality objectives
DSC	differential scanning calorimetry
FIC	Food Instrument Corporation
ft	feet
g/L	grams per liter
g/mL	grams per milliliter
HDW	Hanford defined waste
in.	inch
J/g	joules per gram
kg	kilograms
kgal	kilogallons
kL	kiloliters
LANL	Los Alamos National Laboratory
LL	lower limit
m	meters
M	moles per liter
mL	milliliters
mm	millimeters
ND	not detected
N/D	not decided
N/R	not reviewed
PASF	PUREX ammonia scrubber feed
PHMC	Project Hanford Management Contract
ppb	parts per billion
ppm	parts per million
PUREX	Plutonium-Uranium Extraction
QC	quality control
REML	restricted maximum likelihood estimation
RPD	relative percent difference

LIST OF TERMS (Continued)

SACS	Surveillance Analysis Computer System
SpG	specific gravity
TCR	tank characterization report
TIC	total inorganic carbon
TOC	total organic carbon
TRU	transuranic
TWRS	Tank Waste Remediation System
UL	upper limit
W	watts
W/Ci	watts per curie
wt%	weight percent

1.0 INTRODUCTION

One of the major functions of the Tank Waste Remediation System (TWRS) is to characterize wastes in support of waste management and disposal activities at the Hanford Site. Analytical data from sampling and analysis, along with other available information about a tank, are compiled and maintained in a tank characterization report (TCR). This report and its appendices serve as the TCR for double-shell tank 241-AP-103. The objectives of this report are: 1) to use characterization data in response to technical issues associated with 241-AP-103 waste; and 2) to provide a standard characterization of this waste in terms of a best-basis inventory estimate. The response to technical issues is summarized in Section 2.0, and the best-basis inventory estimate is presented in Section 3.0. Recommendations regarding safety status and additional sampling needs are provided in Section 4.0. Supporting data and information are contained in the appendices. This report also supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1996) milestone M-44-05.

1.1 SCOPE

Characterization information presented in this report originated from sample analyses and known (historical) sources. While the data quality objectives (DQOs) required that technical issues be resolved using results from recent sampling events (listed in Table 1-1), other information could be used to support (or challenge) conclusions derived from these results. Historical information for tank 241-AP-103, 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.

The 1991 grab sample event listed in Table 1-1, a 1994 sampling event, and a sample event before 1989, are summarized in Appendix B along with the sampling results. The 1994 sample was composited with samples from two other tanks and analyzed for organics only. The 1991 sample satisfied data requirements specified in the tank waste analysis plan (Halgren 1991) and was the basis used in this report for tank inventory estimates. Both the 1991 and 1994 samples were obtained prior to transferring the majority of the tank contents to tank 241-AW-102 as 242-A Evaporator feed. The statistical analysis and numerical manipulation of data used in issue resolution are reported in Appendix C. Appendix D contains the evaluation to establish the best basis for the inventory estimate and the statistical analysis performed for this evaluation. A bibliography that resulted from an in-depth literature search of all known information sources applicable to tank 241-AP-103 and its respective waste types is contained in Appendix E. The reports listed in Appendix E may be found in the Tank Characterization Resource Center.

Table 1-1. Summary of 1991 Grab Sampling Event.

Location	Sample/date	Phase	Segmentation	% Recovery	Volume (mL)
Riser 1, 330°	3AP891-1 (9-19-91)	Liquid	No segmentation	100	100
	3AP891-2 (9-19-91)				
	3AP891-3 (9-19-91)				
	3AP1191-1 (11-25-91)				
Riser 27, 90°	3AP891-4 (9-24-91)	Liquid	No segmentation	100	100
	3AP891-5 (9-24-91)				
	3AP891-6 (9-24-91)				
	3AP891-7 (9-24-91)				
Riser 28, 187°	3AP891-8 (10-9-91)	Liquid	No segmentation	100	100
	3AP891-9 (10-9-91)				
	3AP891-10 (10-9-91)				

1.2 TANK BACKGROUND

Tank 241-AP-103 is located in the 200 East Area AP Tank Farm on the Hanford Site. The tank went into service in 1986, receiving flush water from miscellaneous sources. The tank received plutonium-uranium extraction (PUREX) ammonia scrubber feed in 1988, which was later transferred to tank 241-AN-102 as 242-A Evaporator feed. The tank again received PUREX ammonia scrubber feed in 1989. The final series of transfers contained dilute noncomplexed waste, and occurred between 1989 and 1991. In 1994, waste was transferred to tank 241-AW-102 as 242-A Evaporator feed. There have been no further waste transfers.

A description of tank 241-AP-103 is summarized in Table 1-2. The tank has an operating capacity of 4,390 kL (1,160 kgal), and presently contains an estimated 87 kL (23 kgal) of dilute non-complexed waste (Hanlon 1996). The tank is not on the Watch List (Public Law 101-510).

Table 1-2. Description of Tank 241-AP-103.

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	87 kL (23 kgal)
Supernatant volume	83 kL (22 kgal)
Saltcake volume	0 kL (0 kgal)
Sludge volume	4 kL (1 kgal)
Drainable interstitial liquid volume	0 kL (0 kgal)
Waste surface level (9/20/96)	20.32 cm (8 in.) to 21.3 cm (8.4 in.)
Temperature (7/89 to 9/96)	7.8 °C (46 °F) to 23 °C (74 °F)
Integrity	Sound
Watch List	None
SAMPLING DATE	
Grab samples	September-November 1991
Grab sample[2]	May 1994
SERVICE STATUS	
In-service	1986-present

Note:

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

[2]This grab sample was mixed with samples from tanks 241-AW-102 and 241-AW-106 for SemiVOA analysis in support of 242-A Evaporator campaign 94-1. Results are included in Appendix B.

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2.0 RESPONSE TO TECHNICAL ISSUES

The technical issue identified for tank 241-AP-103 (Brown et al. 1995) is:

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

Data from the recent analysis of grab samples, as well as available historical information, provided the means to respond to this issue. This response is detailed in the following sections. See Appendix B for sample and analysis data for tank 241-AP-103.

Before the 1994 transfer, evaporator DQOs and compatibility DQOs also applied to tank 241-AP-103. However, compatibility DQOs no longer apply because compatibility analyses were completed and approved prior to the tank transfer. The evaporator DQO does not currently apply because no additional waste is currently available for transfer to the 242-A Evaporator. As a result, these issues are not addressed by this report.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-AP-103 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.

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 or ferrocyanide) to cause a safety hazard. Because of this requirement, energetics in the tank 241-AP-103 waste were evaluated. The threshold limit for energetics is 480 J/g on a dry weight basis. There were no exothermic reactions detected in any of the samples (WHC 1992).

2.1.2 Flammable Gas

Determination of the tank headspace flammability was not required when the tank was sampled in 1991. As a result, this safety screening DQO issue was not addressed. The concentration of flammable gases in the tank headspace is anticipated to be very low because of the low levels of radionuclides and organic compounds in the tank, and because the tank is actively ventilated.

2.1.3 Criticality

The safety threshold limit for criticality is 1 g ^{239}Pu per liter of waste. Assuming that all alpha activity is from ^{239}Pu and assuming a density of 1.5 g/mL or less, 1 g/L of ^{239}Pu is greater than or equal to 41 μCi/g of alpha activity. A composite sample was obtained from the grab samples and was analyzed for $^{239/240}Pu$. The composite results were well below this limit, with a result of < 0.00697 μCi/L (< 6.97E-06 μCi/g). Therefore, criticality is not an issue for this tank. Because the results were below analytical detection limits, a 95 percent confidence interval was not calculated.

2.2 OTHER TECHNICAL ISSUES

The determination of total organic carbon (TOC) is used to evaluate the fuel content of the tank waste. Although not required as a primary analyte by the current safety screening DQO, TOC was a required analyte of the 1991 samples. The TOC results were evaluated to the decision limits of the safety screening DQO (Dukelow et al. 1995). All results were below the action limit of 30,000 μg/g (dry weight basis), with a dry weight mean of 6,470 μg/g.

A factor in assessing tank safety is heat generation from radioactive decay. The tank heat load calculated from the best-basis inventory data of Section 3 was 2.41 W (8.22 Btu/hr) (Table 2-1). The Agnew et al. (1996) estimate of heat load was 434 W (1,480 Btu/hr). These estimates are well below the 20,500-W (70,000-Btu/hr) operating specification limit for double-shell tanks (Harris 1994).

Table 2-1. Tank 241-AP-103 Radionuclide Inventory and Projected Heat Load.

Radionuclide	Projected Inventory (Ci)	Decay Heat Generation Rate (W/Ci)	Decay Heat Generation (W)
^{137}Cs	472	0.00472	2.23
$^{89/90}Sr$	0.175	0.00669	0.00117
^{99}Tc	358	5.01E-04	0.179
Total Watts			2.41

2.3 SUMMARY

Most of the tank contents were transferred during April and May of 1994 leaving only 87 kL (23 kgal) of waste. Grab samples taken in September/November 1991 to address potential safety issues showed that no primary analyte exceeded safety decision threshold limits (Table 2-2).

Table 2-2. Summary of Safety Screening Results.

Issue	Sub-issue	Result
Safety	Fuel content/ Energetics	No exotherms observed in any sample.
	Criticality	All analyses well below 41 μCi/g (safety screening limit) and 0.810 μCi/g (waste compatibility limit).
	Flammable gas accumulation	Vapor measurement not performed. The lower flammability limit is expected to be very low because of active ventilation and low levels of radionuclides and organics in the tank.

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3.0 BEST-BASIS INVENTORY ESTIMATE

Information about the chemical and/or physical properties of tank wastes is used to perform safety analyses, engineering evaluations, and risk assessments associated with waste management activities, as well as to address regulatory issues. 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 inventory information generally is derived using two approaches: (1) component inventories are estimated using the results of sample analyses; or (2) component inventories are predicted using a model based on process knowledge and historical information. The most recent model was developed by Los Alamos National Laboratory (LANL) (Agnew et al. 1996). Information derived from these two different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as standard characterization for the various waste management activities (Hodgson et al. 1996). As a part of this effort, an evaluation of available chemical information for tank 241-AP-103 was performed that included the following:

- Data from bottle-on-a-string samples collected in September, October, and November, 1991 (De Lorenzo et al. 1994)
- The inventory estimate for this tank generated from the LANL model (Agnew et al. 1996), also referred to as the historical tank content estimate.

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-103 for the following reasons:

1. The LANL model assumptions about the solubilities of many components in an alkaline environment have a high bias.
2. Statistical analysis of tank sample data indicated that the contents were homogeneous.
3. Laboratory analysis of dilute liquids demonstrating little or no stratification are normally precise and accurate.

Best-basis inventory estimates for tank 241-AP-103 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. A tank volume of 87 kL (23 kgal) (Hanlon 1996) was used to calculate these inventories.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-103 as of October 21, 1996.

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1,2]	Comment
Al	21.5	S	None
Cl^-	4.43	S	None
CO_3^{2-}	226	S	None
Cr	0.379	S	None
F^-	11.7	S	None
Fe	0.073	S	None
Mn	0.0026	S	None
Na^+	459	S	None
NO_2^-	113	S	None
NO_3^-	355	S	None
OH^-	132	S	None
Pb	< 0.035	S	None
PO_4^{3-}	12.0	S	None
SO_4^{2-}	31.5	S	None
TOC	9.57	S	None
U	0.32	S	None

Notes:
[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based

[2]Based on 1991 grab samples (see Appendix B).

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-103 as of October 21, 1996.

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]	Comment
^{79}Se	9.70E-04	S	None
^{90}Sr	0.23	S	None
^{99}Tc	0.094	S	None
^{137}Cs	577	S	None
^{234}U	5.70E-04	S	None
^{235}U	2.95E-05	S	None
^{238}U	1.10E-04	S	None
^{241}Am	9.87E-04	S	None

Notes:

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based

[2]Based on 1991 grab samples (see Appendix B)

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4.0 CONCLUSIONS AND RECOMMENDATIONS

Tank 241-AP-107 was characterized based on grab samples obtained in September/November 1991. The samples were obtained to satisfy safety and operations issues in support of the 94-1 Evaporator campaign, and meet most of the current safety DQOs.

All analytical results for the safety screening DQO were well within the safety notification limits; however, the flammability of the tank headspace was not determined. This issue needs to be addressed to fully satisfy the safety screening DQO. However, the tank is actively ventilated, with no evidence of flammable gas accumulation. Based on low radionuclide and organic concentrations, the concentration of flammable gases in the tank headspace is anticipated to be very low.

Analytical results from the 1991 sampling event were used to determine the best-basis inventory for the tank contents.

Table 4-1 summarizes the status of TWRS Program review and acceptance of the sampling and analysis results reported in this tank characterization report. 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. If the results/information have not yet been reviewed, "N/R" is shown in the column. If the results/information have been reviewed, but acceptance or disapproval has not been decided, "N/D" is shown in the column.

Table 4-1. Acceptance of Tank 241-AP-103 Sampling and Analysis.

Issue	Evaluation Performed	TWRS[1] Program Acceptance
Safety Screening DQO	Partial	Yes

Notes:

[1]Project Hanford Management Contract (PHMC) TWRS Program Office

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

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-AP-103.

Issue	Evaluation Performed	TWRS Program Acceptance
Safety categorization	Partial	Yes

5.0 REFERENCES

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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*.

WHC, 1994, *242-A Evaporator Project for Tanks 102-AW, 103-AP, and 106-AW*, WHC-SD-WM-DP-025, Rev. 0-B, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

HISTORICAL TANK INFORMATION

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APPENDIX A

HISTORICAL TANK INFORMATION

Appendix A describes tank 241-AP-103 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-103, including surface level readings and temperatures.
- **Section A5:** References for Appendix A.

A1.0 CURRENT TANK STATUS

As of August 31, 1996, tank 241-AP-103 contained 87 kL (23 kgal) of dilute noncomplexed waste (Hanlon 1996). The waste volumes were estimated using a Food Instrument Corporation (FIC) surface level gauge and a manual tape. The volumes of the waste phases found in the tank are shown in Table A1-1.

Tank 241-AP-103 is in service, categorized as sound, and is not on the Watch List. The tank is actively ventilated.

Table A1-1. Estimated Tank Contents.

Waste Form	Estimated Volume	
	kL	kgal
Total waste	87	23
Supernatant liquid	83	22
Sludge	4	1
Saltcake	0	0
Drainable interstitial liquid	0	0
Drainable liquid remaining	83	22
Pumpable liquid remaining	83	22

Note:

For definitions and calculation methods refer to Appendix C of Hanlon (1996).

A2.0 TANK DESIGN AND BACKGROUND

The AP Tank Farm was constructed from 1983 to 1986 in the 200 East Area (Leach and Stahl 1996). The tank farm contains eight double-shell tanks. Each tank has a capacity of 4,390 kL (1,160 kgal), a diameter of 22.9 m (75.0 ft), and an operating depth of 10.7 m (35.2 ft). These tanks were designed to hold concentrated supernatant. The maximum design temperature for liquid storage is 149 °C (300 °F) (Brevick et al. 1995).

Tank 241-AP-103 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 on all sides of the tank. The concrete walls are 460 mm (1.5 ft) thick and the dome is 380 mm (1.25 ft) thick. The tank has a flat bottom, where the bottom of the primary and secondary liners are separated by an insulating layer of concrete.

Tank 241-AP-103 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 ranging in diameter from 100 mm (4 in.) to 610 mm (24 in.) that provide access to the annulus but not to the waste. Table A2-1 shows numbers, diameters, and descriptions of the risers (annular risers not included). A plan view depicting the riser configuration is shown as Figure A2-1. Ten 100-mm (4-in.) diameter risers (three no. 1's. 15, 21, 24, three no. 27's, and no. 28), and three 305-mm (12-inch) diameter risers (two no. 10's, and no. 12), are tentatively available for sampling (Lipnicki 1996). A tank cross section showing the approximate waste level along with a schematic of the tank equipment is in Figure A2-2.

Table A2-1. Tank 241-AP-103 Risers. (2 sheets)

Riser Number	Diameter (cm)	Diameter (in.)	Description and Comments
1	10	4	Sludge measurement port
1	10	4	Sludge measurement port
1	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	30	12	Sludge measurement port
16	30	12	Sludge measurement port
16	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

Table A2-1. Tank 241-AP-103 Risers. (2 sheets)

Riser Number	Diameter (cm)	Diameter (in.)	Description and Comments
26	10	4	Liquid level indicator
27	10	4	Spare (riser plug)
27	10	4	Spare (riser plug)
27	10	4	Spare (riser plug)
28	10	4	Spare (riser plug)

Note:

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

Figure A2-1. Riser Configuration for Tank 241-AP-103.

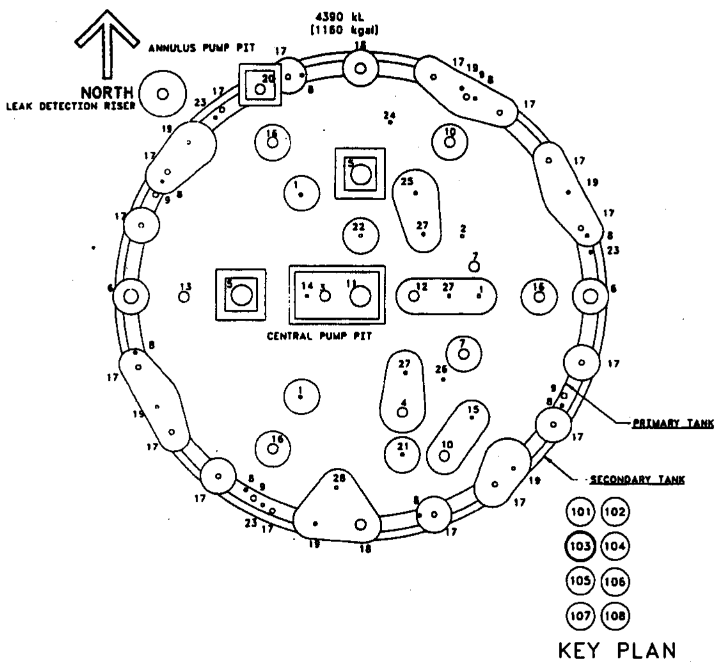
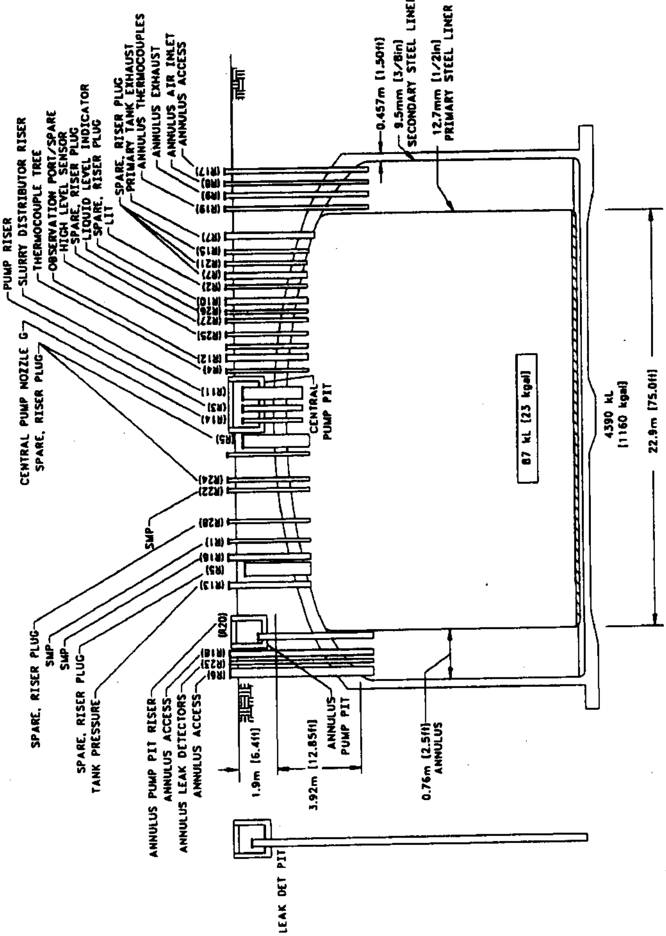


Figure A2-2. Tank 241-AP-103 Cross Section and Schematic.



A3.0 PROCESS KNOWLEDGE

The sections below: 1) provide information about the transfer history of tank 241-AP-103; 2) describe the process wastes that made up the transfers; and 3) give an estimate of the current tank contents based on transfer history.

A3.1 WASTE TRANSFER HISTORY

Table A3-1 summarizes the waste transfer history of tank 241-AP-103 (Agnew et al. 1996b). The tank was brought into service during the third quarter of 1986 with the addition of about 95 kL (25 kgal) of flush water from miscellaneous sources. The next transfer was not received until the first quarter of 1988 when the tank received the first of a series of PUREX ammonia scrubber feed (PASF) from the PUREX Plant. During the first half of 1988, tank 241-AP-103 received a total of 3,676 kL (971 kgal) of PASF, 375 kL (99 gal) of wash from tank 241-AW-102, and 53 kL (14 kgal) of flush water.

During the third quarter of 1988 the tank received 367 kL (97 kgal) of PASF and 38 kL (10 kgal) of flush water. All but 83 kL of the waste was transferred to tank 241-AW-102 for processing in the evaporator (tank 241-AW-102 is the feed tank for the 242-A Evaporator). In the fourth quarter of 1988 tank 241-AP-103 received 2,190 kL (578 kgal) of PASF from tank 241-AP-101. The next major transfer occurred during the fourth quarter of 1989 when 2,330 kL (616 kgal) of waste were sent to tank 241-AP-101.

Major transfers from the fourth quarter of 1989 through the second quarter of 1991 for tank 241-AP-103 consisted of 4,212 kL (1,113 kgal) of dilute noncomplexed waste from tank 241-AY-102.

The waste in tank 241-AP-103 was selected for concentration as part of 242-A Evaporator Campaign 94-1 (Guthrie 1994). During April and May 1994, about 4,170 kL (1,102 kgal) of waste was transferred to tank 241-AW-102. No further waste transfers have been made into or out of the tank.

Table A3-1. Summary of Tank 241-AP-103 Major Waste Transfers.

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Volume[1,2]	
				kL	kgal
Miscellaneous sources		Flush water	1986 - 1988	329	87
PUREX Plant		PUREX ammonia scrubber feed	1988	4,042	1,068
241-AW-102		Supernatant	1988	375	99
	241-AW-102	Supernatant	1988	-4,512	-1,192
241-AP-101		PUREX ammonia scrubber feed and water	1988	2,190	578
	241-AP-101	Supernatant	1989	-2,330	-616
241-AY-102		Dilute noncomplexed waste from various sources and aging waste condensate	1989 - 1991	4,212	1,113
	241-AW-102	Supernatant	1994	-4,170[3]	-1,102[3]

Notes:

[1]Unless otherwise noted, data are derived from Agnew et al. (1996b).

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

[3]Derived from unvalidated data taken from the Operational Waste Volume Projection database.

A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS

This section provides an estimate of the contents of tank 241-AP-103 based on historical transfer data presented in the *Waste Status and Transaction Record Summary* (Agnew et al. 1996b) and in the *Hanford Tank Chemical and Radionuclide Inventories: Hanford Defined Wastes (HDW) Model Rev. 3* (Agnew et al. 1996a). The HDW model is composed of three parts: 1) a combination of process information and transaction information to derive compositions for about 50 Hanford Defined Wastes, each of which has both solid and supernatant layers; 2) a derivation of solids histories for each tank, called the Tank Layer

Model, that is based on the nonevaporator related primary additions of waste; and 3) a weighted percentage calculation of supernatant blending and saltcake content called the Supernatant Mixing Model.

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

The historical inventory estimate for tank 241-AP-103 defines the tank waste as consisting of 4,277 kL (1,130 kgal) of supernatant. Tank 241-AP-103 has been involved in several tank-to-tank transfers since the historical end date of the *Waste Status and Transaction Summary* data of January 1, 1994.

Table A3-2 shows the historical inventory estimate of the expected waste constituents and concentrations of tank 241-AP-103 as of January 1, 1994 (Agnew 1996b). Figure A3-1 shows a graphical representation of the current estimated waste type and volume.

Table A3-2. Tank 241-AP-103 Historical Tank Inventory Estimate. (2 Sheets)

Total Inventory Estimate[1]			
Physical Properties			
Total waste	4.59E+06 kg (1,130 kgal)		
Heat load	1.63 kW (5.57E+03 Btu/hr)		
Bulk density[2]	1.07 (g/mL)		
Water wt%[2]	88.2		
TOC wt% C (wet)[2]	0.192		
Chemical Constituents	**M**	**µg/g**	**kg**
Na^+	1.55	3.32E+04	1.52E+05
Al^{3+}	0.204	5,130	2.35E+04
Fe^{3+} (total Fe)	1.41E-03	73.4	337
Cr^{3+}	2.68E-03	130	597
Bi^{3+}	8.85E-06	1.73	7.92
La^{3+}	1.95E-07	0.0252	0.116
Hg^{2+}	2.04E-07	0.0382	0.175
Zr (as $ZrO(OH)_2$)	4.61E-05	3.92	18.0
Pb^{2+}	9.89E-06	1.91	8.77
Ni^{2+}	1.13E-03	62.2	285
Sr^{2+}	6.49E-08	5.31E-03	0.0243
Mn^{4+}	1.97E-04	10.1	46.4
Ca^{2+}	6.34E-03	237	1,090
K^+	9.53E-03	348	1,600
OH^-	0.945	1.50E+04	6.88E+04
NO_3^-	0.782	5.43E+04	2.08E+05
NO_2^-	0.0624	2,680	1.23E+04
CO_3^{2-}	0.107	5,980	2.74E+04
PO_4^{3-}	5.93E-03	525	2,410
SO_4^{2-}	0.0206	1,840	8,450
Si (as SiO_3^{2-})	0.0124	324	1,490

Table A3-2. Tank 241-AP-103 Historical Tank Inventory Estimate. (2 Sheets)

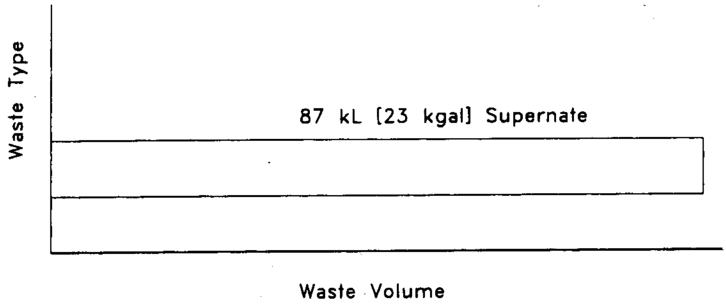
Total Inventory Estimate[1]			
Chemical Constituents	**M**	**µg/g**	**kg**
F^-	4.47E-03	79.3	364
Cl^-	0.0306	1,010	4,630
$C_6H_5O_7^{3-}$	0.00512	904	4,140
$EDTA^{4-}$	1.77E-04	47.7	219
$HEDTA^{3-}$	3.15E-04	80.6	370
$Glycolate^-$	0.0663	4,650	2.13E+04
$Acetate^-$	1.27E-04	6.99	32.1
$Oxalate^{2-}$	1.66E-07	0.0137	0.0627
DBP	2.55E-04	38.3	176
Butanol	2.55E-04	17.6	80.9
NH_3	0.0132	210	963
$Fe(CN)_6^{4-}$	0	0	0
Radiological Constituents	**Ci/L**	**µCi/g**	**Ci**
Pu	---	0.0116	0.887 (kg)
U	1.53E-03 (M)	339 µg/g	1,560 (kg)
Cs	0.0621	58.0	2.66E+05
Sr	0.0134	12.5	5.72E+04

Notes:

[1]Agnew et al. (1996a). These estimates are based on the sample volume of January 1, 1994. The estimates do not represent current tank contents and should be used with caution.

[2]Volume average for density, mass average water wt% and TOC wt% C.

Figure A3-1. Tank Layer Model for Tank 241-AP-103.



A4.0 SURVEILLANCE DATA

Tank 241-AP-103 surveillance data consist of surface level measurements (liquid and solid), temperature monitoring inside the tank (waste and vapor space), and leak detection well monitoring for radioactive liquids outside the primary tank. Surveillance data provide the basis for determining tank integrity.

A4.1 SURFACE LEVEL READINGS

Waste surface level monitoring in tank 241-AP-103 is performed with an FIC gauge in riser 2 and a manual tape in riser 26. A manual tape is used when the FIC is out of service. Because this is an active tank, the surface level is continually subject to change. The waste surface level measured on September 20, 1996 with the FIC was 213 mm (8.4 in.), which equals about 87.4 kL (23.1 kgal) (Hanlon 1996). A graphical representation of the volume measurements is presented as a level history graph in Figure A4-1. The level measured was 203 mm (8 in.) using the manual tape.

A4.2 INTERNAL TANK TEMPERATURES

In-tank temperature data for tank 241-AP-103 are recorded by 18 thermocouples on one thermocouple tree located in riser 4. Data are recorded weekly (Tran 1993). The minimum temperature on September 16, 1996, was 18.7 °C (65.7 °F) on thermocouple 17; the maximum temperature on the same date was 19.3 °C (66.8 °F) on thermocouple 1.

Temperature data were evaluated from the Computer Automated Surveillance System (Brevick et al. 1995) recorded from April 1986 to March 1995 (for all 18 thermocouples) and from the Surveillance Analysis Computer System (SACS) recorded from July 1989 to September 16, 1996 (for 12 of the thermocouples). Not all 12 thermocouples have data covering the entire period. From the data available in SACS, the average temperature between July 1989 and September 16, 1996 was 16 °C (60 °F) with a minimum of 7.8 °C (46 °F) and a maximum of 23 °C (74 °F).

A graph of the weekly high temperatures can be found in Figure A4-2.

A4.3 TANK 241-AP-103 PHOTOGRAPHS

No interior photographs are available for this tank.

Figure A4-1. Tank 241-AP-103 Level History.

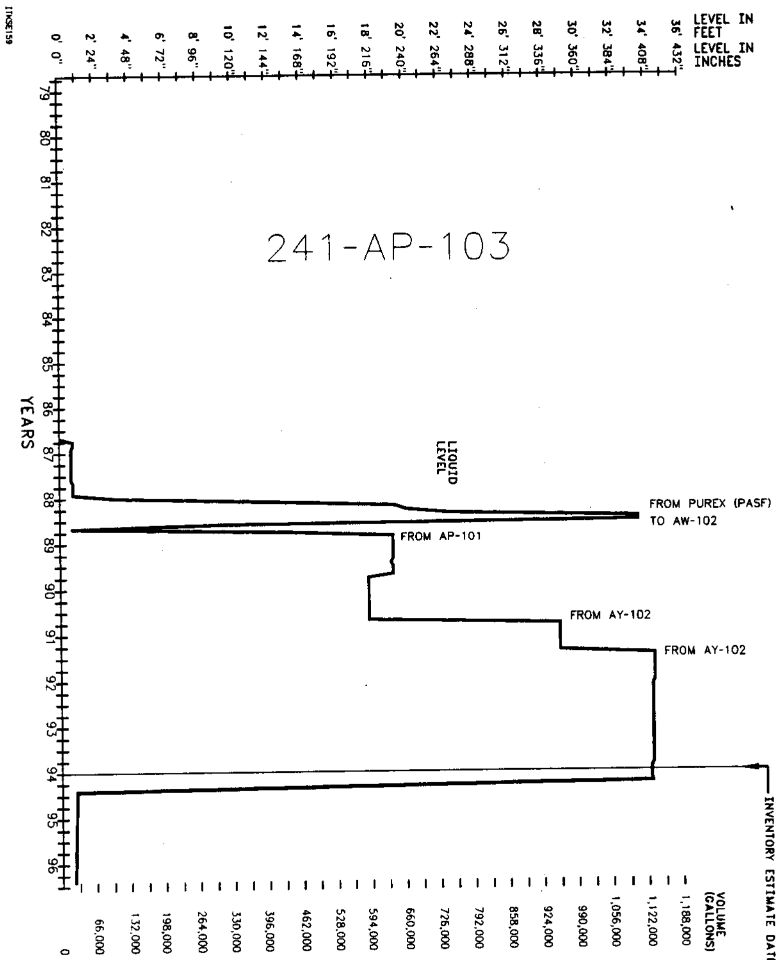
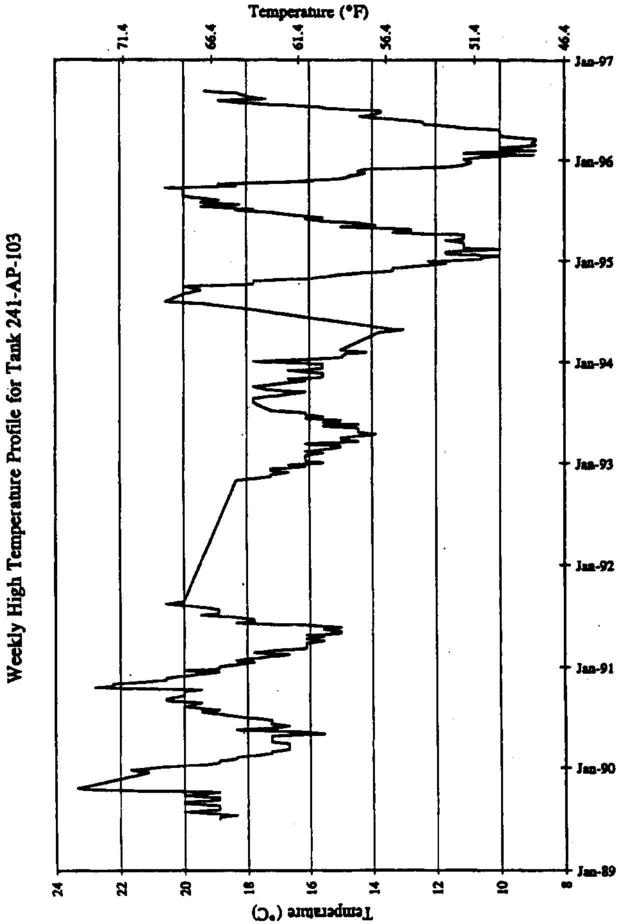


Figure A4-2. Tank 241-AP-103 Weekly High Temperature Plot.



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APPENDIX B

SAMPLING OF TANK 241-AP-103

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APPENDIX B

SAMPLING OF TANK 241-AP-103

Appendix B provides sampling and analysis information for each known sampling event for tank 241-AP-103 and provides 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-103 will be appended to the above list.

B1.0 TANK SAMPLING OVERVIEW

This section describes the September through November 1991 sampling and analysis event for tank 241-AP-103. These grab samples were taken and analyzed in accordance with *Double-Shell Tank Waste Analysis Plan* (Halgren 1991). Further discussions of the sampling and analysis procedures can be found in the *Tank Characterization Reference Guide* (DeLorenzo et al. 1994).

Section B1.4 presents results from grab samples obtained in support of 242-A Evaporator campaign 94-1. The AP-103 grab sample was mixed with AW-102 and AW-106 grab samples. Hence, results are presented for information only.

B1.1 DESCRIPTION OF SAMPLING EVENT

Tank 241-AP-103 was sampled on September 19 and 24, October 9, and November 25, 1991. The waste analysis plan (Halgren 1991) states that samples are to be collected from three risers. A total of ten samples (nine samples and a duplicate) were taken from risers 1, 27, and 28. Because the tank waste may stratify vertically, the analysis plan divides each tank into top, middle, and bottom vertical layers with samples taken from each layer. The "bottle-on-a-string" method (ASTM 1973) was used to collect the samples from the tank. Each glass sample bottle collected approximately 100 mL of liquid.

All analyses were performed by the Westinghouse Hanford Company 222-S Laboratory.

Table B1-1 summarizes the sample location (riser number), sample numbering, and date sampled information.

Table B1-1. Tank 241-AP-103 Sample Information.

Riser Number, Angle	Sample Date	Depth from Tank Bottom (in.)	Sample Number	Laboratory Sample Number
1, 330°	9-19-91	398	3AP891-1	R933
		182	3AP891-2	R934
		26	3AP891-3[1]	R935
27, 90°	9-24-91	338	3AP891-4	R936
		194	3AP891-5	R937
		194	3AP891-6	R941
		122	3AP891-7	R942
28, 187°	10-9-91	398	3AP891-8	R943
		218	3AP891-9	R944
		98	3AP891-10	R945
Composite	---	---	---	R949

Note:
[1]Sample 3AP891-3 was resampled (11-25-91) and replaced by sample 3AP1191-1 due to the custody seal being improperly attached.

B1.2 SAMPLE HANDLING

Tank 241-AP-103 was sampled between September 19 and November 25, 1991. The analyses of the samples by the laboratory occurred between the last quarter of 1991 and first quarter of 1992. Samples were not preserved (acidification or refrigeration) at the time of sampling. According to the data validation report, the maximum holding times for both the volatile and semivolatile organic analyses were exceeded for all samples. The violation of recommended holding times for these analyses was not expected to substantially affect the data (see Section B2.6 for further discussion).

Descriptions of the waste samples were very difficult to locate. For samples R933, R934, R935, and R936, the Extraction Log Book stated they were all a "clear liquid." No other descriptions about the samples were found.

B1.3 SAMPLE ANALYSIS

All reported analyses were performed in accordance with approved laboratory procedures. The analyses performed on the grab samples were those required by the waste analysis plan (Halgren 1991), and are listed in Table B1-2. Table B1-3 displays the analytical procedures by title and number. No deviations or modifications were noted by the laboratory.

A limited amount of quality control (QC) data was available for tank 241-AP-103. Duplicate analyses were performed on samples R933, R941, and R949. Spike analyses were run on R933. Check standards were evaluated before and after each evaluation in order to verify instrument calibration and analytical performance. An assessment of the QC procedures and data is presented in Section B3.2 of this report.

Table B1-2. Summary of Samples and Requested Analytes.

Sample Number	Laboratory Sample Numbers	Requested Analytes
3AP1191-1	R935	Ag, Al, As, Ba, Bi, Ca, Cd, Cr, Fe, Hg, K, Mg, Mn, Mo, Na, P, Pb, Se, Si, Ti, Zn, Zr, F^-, Cl^-, CN^-, OH^-, NH_3, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, SpG, DSC, TC, TOC, TIC, Volatile organic, Semivolatile organic, ^{60}Co, ^{137}Cs, ^{106}RuRh, ^{3}H, ^{14}C, ^{79}Se, ^{90}Sr, ^{99}Tc, ^{129}I, ^{241}Am, ^{237}Np, $^{239/240}$Pu, ^{244}Cm
3AP891-1	R933	
3AP891-2	R934	
3AP891-4	R936	
3AP891-5	R937	
3AP891-6	R941	
3AP891-7	R942	
3AP891-8	R943	
3AP891-9	R944	
3AP891-10	R945	
Composite	R949	

Table B1-3. General Analytical Methods.

Analyte	Method	Procedure
F^-, Cl^-, NO_2^-, NO_3^-, SO_4^{2-}, PO_4^{3-}	Ion Chromatography	LA-533-105
NH_3	Kjeldahl[1]	LA-634-102
OH^-	Titration	LA-661-102
CN^-	Distillation/Spectrometric Analysis	LA-695-101
TIC	Acidification followed by CO_2 detection	LA-622-102
TOC	Combustion/CO_2 detection by coulometry	LA-344-105
Total U	Alpha proportional counting	LA-508-101
As Se	GHAA[2]	LA-355-131 LA-362-131
Hg	CVAA[3]	LA-325-102
Total Metals	ICP[4]	LA-505-151
^{134}Cs, ^{137}Cs, ^{94}Nb, $^{106}RuRh$, ^{95}Nb, $^{144}CePr$, ^{60}Co, $^{154/55}Eu$, ^{226}Ra, ^{113}Sn	Gamma energy analysis	LA-548-121
^{3}H ^{14}C	Liquid scintillation	LA-218-114 LA-348-104
^{79}Se ^{99}Tc	Liquid scintillation	LA-365-131 LA-438-101
^{90}Sr	Separation/Beta[5]	LA-220-101
^{129}I	Low energy gamma analysis	LA-378-103
^{237}Np	Extraction/Alpha[6]	LA-933-141
$^{239/240}Pu$, ^{241}Am, $^{234/235}U$, ^{238}U	Separation/AEA[7]	LA-503-156
Specific gravity	Direct	LA-510-112
Energetics	Differential scanning calorimetry	LA-514-113
Volatile organic Semivolatile organic	Gas chromatography/mass spectroscopy	SW-846,8240

Notes:
[1]Ammonia analysis by caustic addition, distillation, and capture in a boric acid solution.
[2]Gaseous hydride atomic absorption
[3]Cold vapor atomic absorption
[4]Inductively coupled plasma
[5]Chemical separation along with beta proportional counting
[6]Extraction followed by alpha proportional counting
[7]Chemical separation followed by alpha energy analysis

B1.4 1994 EVAPORATOR CAMPAIGN GRAB SAMPLE

Grab samples were taken from three tanks in May 1994 (241-AP-107, 241-AW-102, 241-AW-106) and composited for analysis in support of the 242-A Evaporator 94-1 campaign. Analysis for semivolatile organic constituents were performed using EPA SW-846-based methodology. The samples were submitted to the 222-S Laboratory on May 5, 1994. All of the semivolatile constituents analyzed were below analytical detection levels and the quantitation limit of 1,000 μg/L except for tributyl phosphate, which had a concentration of 1,600 μg/L (Wehner 1994).

B1.5 DESCRIPTION OF HISTORICAL SAMPLING EVENT

Prior to the 1991 sampling event, the last sampling of tank 241-AP-103 occurred in April 1988. Because multiple waste transfers occurred since this last sampling event, no valid comparison between the sampling events can be made, and the data are not presented in this report.

B2.0 ANALYTICAL RESULTS

B2.1 OVERVIEW

This section summarizes the sampling and analytical results associated with the 1991 grab sampling and analysis of tank 241-AP-103. The chemical, radiochemical, physical, and organic results associated with tank 241-AP-103 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
Summary data for inorganic analyses	B2-2 through B2-24
Summary data for organic analyses	B2-25 through B2-30
Summary data for radiochemical analyses	B2-31 through B2-54
Specific gravity	B2-55
Summary data for volatile and semivolatile organic analyses	B2-27 through B2-30

The four QC parameters assessed in conjunction with the tank 241-AP-103 samples were standard recoveries, spike recoveries, duplicate analyses, and blanks.. The QC criteria applied to the data were 75 to 125 percent recovery for standards, 75 to 125 percent recovery for spikes and ≤ 20 percent for the relative percent difference (RPD) between duplicates. These criteria applied to all of the analytes. The only QC parameter for which limits are not specified is blank contamination. The limits for blanks are set forth in guidelines followed by the laboratory, and all data results presented in this report have met those guidelines. Sample and duplicate pairs in which any of the QC parameters were outside of these limits are footnoted in the sample mean column of the following data summary tables with an a, b, c, d, e, or f as follows:

- "a" indicates that the standard recovery was below the QC 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 blank contamination.

B2.2 INORGANIC ANALYSES

The following sections discuss the types of inorganic analyses performed and results. General QC requirements and results are discussed in Section B3.2.

B2.2.1 Inductively Coupled Plasma Spectroscopy

The following analytes were analyzed according to procedure LA-505-151: aluminum, barium, cadmium, chromium, iron, lead, magnesium, manganese, silver, sodium and zinc. Aluminum and sodium were the most abundant metals in tank 241-AP-103. The sample results are presented in Tables B2-2 through B2-12.

Although a historical potassium concentration could not be determined for tank 241-AP-103, it is certain that potassium is present in the tank. The majority of the tank waste was received from tank 241-AY-102, which was known to contain potassium (Van Fleet 1993). Potassium was not evaluated by the laboratory, but its estimated concentration in tank 241-AP-103 was calculated from the mass and charge balance (Section B3.3.2).

B2.2.2 Gaseous Hydride Atomic Absorption Spectroscopy

Arsenic and selenium were analyzed according to procedures LA-355-131 and LA-362-131, respectively. The results are presented in Tables B2-13 and B2-14.

B2.2.3 Cold Vapor Atomic Absorption Spectroscopy

Mercury was analyzed according to procedure LA-325-102. The results are presented in Table B2-15.

B2.2.4 Toxicity Characteristic Leaching Procedure

Arsenic, cadmium, and chromium were detected in the waste but exhibited average concentrations below their respective Toxicity Characteristic Leaching Procedure threshold values (EPA 1990). The following analytes were not detected in any of the tank 241-AP-103 samples: barium, lead, mercury, selenium, and silver.

B2.2.5 Ion Chromatography

The following anions were determined by using procedure LA-533-105: chloride, fluoride, nitrate, nitrite, phosphate, and sulfate. All of the analytes were detected in the waste samples. The results are presented in Tables B2-16 through B2-21.

B2.2.6 Kjeldahl Method

The ammonia analysis was performed by procedure LA-634-102. The sample results are presented in Table B2-22.

B2.2.7 Titration

Hydroxide was determined by using procedure LA-661-102. The sample results are presented in Table B2-23.

B2.2.8 Distillation/Spectrometric Analysis

Cyanide was determined by using procedure LA-695-101. The sample results are presented in Table B2-24.

B2.3 ORGANIC ANALYSES

Although not required by the current safety screening or waste compatibility DQOs, TOC and total inorganic carbon (TIC) were required analytes of the 1991 samples.

In addition to TOC and TIC, samples were analyzed for volatile and semivolatile organic constituents. The samples were analyzed using uncontrolled draft procedures that largely complied with analytical protocols given in the EPA Contract Laboratory Statement of Work (EPA 1991). Because of their volatile nature and relatively small contribution to the waste as indicated by historical records, the appearance of these compounds in tank 241-AP-103 is not expected.

B2.3.1 Total Inorganic Carbon

Total inorganic carbon was determined by using procedure LA-622-102. The sample results are presented in Table B2-25.

B2.3.2 Total Organic Carbon

Total organic carbon was determined using procedure LA-344-105. The sample results are presented in Table B2-26.

B2.3.3 Volatile Organic Compounds

Volatile organic compounds are listed in Tables B2-27 and B2-28. None of the volatile organic target compounds were considered to be detected in the samples except acetone. The presence of acetone may have been caused by laboratory contamination, but the observed concentrations were too high to dismiss in the absence of further evidence. The few tentatively identified volatile organic compounds that appeared during the analyses were of no concern because none of them demonstrated a concentration above 25 ppb.

The data associated with acetone are presented even though the results are questionable. Because the samples were analyzed well beyond the maximum allowable holding times for volatile organic analyses, it is likely that the acetone results are extremely low. If the actual concentration of acetone is significantly higher, the emissions from the evaporator process could become an issue under the Resource Conservation and Recovery Act.

B2.3.4 Semivolatile Organic Compounds

Semivolatile organic compounds were not detected in tank 241-AP-103. With regard to the tentatively identified semivolatile organics, a reaction between the waste matrix and the organic surrogate compounds led to the detection of nitration reaction products. These compounds, however, were not indigenous to the tank. The presence of 2,4-dichloropentane was not anticipated upon review of the available historical data, but the compound was found in appreciable concentrations in five samples (R937, R941, R942, R943, and R944). Because the detection of 2,4-dichloropentane could not be dismissed on the basis of contamination, the data were included in Table B2-30.

B2.4 RADIOCHEMICAL ANALYSES

B2.4.1 Gamma Energy Analysis

The activities of the following radionuclides were determined by gamma energy analysis according to procedure LA-548-121: ^{144}Ce/Pr, ^{134}Cs, ^{137}Cs, ^{60}Co, $^{154/155}$Eu, $^{94/95}$Nb, ^{226}Ra, ^{106}Ru/Rh, and ^{113}Sn. The activity of ^{129}I was determined by low energy gamma analysis according to procedure LA-378-103. The results from the gamma analyses are presented in Tables B2-31 through B2-43.

B2.4.2 Alpha Energy Analysis

The following radionuclides were evaluated by alpha energy analysis according to procedure LA-503-156: ^{234}U, ^{235}U, ^{238}U, $^{239/240}$Pu, and ^{241}Am. The results are presented in Table B2-44 and B2-48.

B2.4.3 Liquid Scintillation

Tritium, ^{14}C, ^{79}Se, and ^{99}Tc were analyzed by liquid scintillation according to procedures LA-218-114, LA-348-104, LA-365-131, and LA-438-101, respectively. The sample results are presented in Tables B2-49 through B2-52.

B2.4.4 Alpha Proportional Counting

Total uranium was analyzed by alpha proportional counting and reported in μg/L rather than μCi/L according to procedure LA-508-101. The results are presented in Table B2-53.

B2.4.5 Beta Proportional Counting

The activity of ^{90}Sr was evaluated by beta proportional counting according to procedure LA-220-101. The results are presented in Table B2-54.

B2.5 PHYSICAL ANALYSES

B2.5.1 Specific Gravity

As required by the safety screening DQO, the specific gravity (SpG) of the liquids was determined according to procedure LA-510-112. No other physical tests were required or performed. The results are presented in Table B2-55.

B2.6 THERMODYNAMIC ANALYSES

B2.6.1 Differential Scanning Calorimetry

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

No exothermic reactions were apparent from the DSC analyses for tank 241-AP-103. No exothermic reactions were noted, and therefore the upper limit of a 95 percent confidence interval was not calculated.

Table B2-2. Tank 241-AP-103 Analytical Results: Aluminum.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	101	103	102
R934		Whole	76	---	76
R935		Whole	307	---	307
R945		Whole	550	---	550
R936	Riser 27	Whole	103	---	103
R937		Whole	230	---	230
R941-8750		Whole	260	258	259
R942		Whole	560	---	560
R943	Riser 28	Whole	104	---	104
R944		Whole	171	---	171

Table B2-3. Tank 241-AP-103 Analytical Results: Barium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	< 0.065	< 0.065	< 0.065
R934		Whole	< 0.065	---	< 0.065
R935		Whole	< 0.065	---	< 0.065
R945		Whole	< 0.065	---	< 0.065
R936	Riser 27	Whole	< 0.065	---	< 0.065
R937		Whole	< 0.065	---	< 0.065
R941-8750		Whole	< 0.065	< 0.065	< 0.065
R942		Whole	< 0.065	---	< 0.065
R943	Riser 28	Whole	< 0.065	---	< 0.065
R944		Whole	< 0.065	---	< 0.065

Table B2-4. Tank 241-AP-103 Analytical Results: Cadmium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	0.0685	0.0745	0.0715
R934		Whole	0.048	---	0.048
R935		Whole	0.133	---	0.133
R945		Whole	0.18	---	0.18
R936	Riser 27	Whole	0.0645	---	0.0645
R937		Whole	0.124	---	0.124
R941-8750		Whole	0.126	0.125	0.1255
R942		Whole	0.183	---	0.183
R943	Riser 28	Whole	0.081	---	0.081
R944		Whole	0.097	---	0.097

Table B2-5. Tank 241-AP-103 Analytical Results: Chromium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	3.51	3.56	3.535
R934		Whole	2.05	---	2.05
R935		Whole	4.87	---	4.87
R945		Whole	6.4	---	6.4
R936	Riser 27	Whole	3.38	---	3.38
R937		Whole	4.48	---	4.48
R941-8750		Whole	5.05	4.67	4.86
R942		Whole	6.6	---	6.6
R943	Riser 28	Whole	3.53	---	3.53
R944		Whole	4.15	---	4.15

Table B2-6. Tank 241-AP-103 Analytical Results: Iron.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	< 0.435	< 0.435	< 0.435
R934		Whole	0.481	---	0.481[QC:b]
R935		Whole	0.99	---	0.99[QC:b]
R945		Whole	< 0.435	---	< 0.435
R936	Riser 27	Whole	< 0.435	---	< 0.435
R937		Whole	< 0.435	---	< 0.435
R941-8750		Whole	1.52	1.19	1.355[QC:e]
R942		Whole	2.67	---	2.67
R943	Riser 28	Whole	0.63	---	0.63
R944		Whole	< 0.435	---	< 0.435

Table B2-7. Tank 241-AP-103 Analytical Results: Lead.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	< 0.4	< 0.4	< 0.4
R934		Whole	< 0.4	---	< 0.4
R935		Whole	< 0.4	---	< 0.4
R945		Whole	< 0.4	---	< 0.4
R936	Riser 27	Whole	< 0.4	---	< 0.4
R937		Whole	< 0.4	---	< 0.4
R941-8750		Whole	< 0.4	< 0.4	< 0.4
R942		Whole	< 0.4	---	< 0.4
R943	Riser 28	Whole	< 0.4	---	< 0.4
R944		Whole	< 0.4	---	< 0.4

Table B2-8. Tank 241-AP-103 Analytical Results: Magnesium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	1.04	1.13	1.085
R934		Whole	1.03	---	1.03
R935		Whole	1.53	---	1.53
R945		Whole	< 0.255	---	< 0.255
R936	Riser 27	Whole	1.15	---	1.15
R937		Whole	1.14	---	1.14
R941-8750		Whole	< 0.255	< 0.255	< 0.255
R942		Whole	< 0.255	---	< 0.255
R943	Riser 28	Whole	< 0.255	---	< 0.255
R944		Whole	< 0.255	---	< 0.255

Table B2-9. Tank 241-AP-103 Analytical Results: Manganese.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	< 0.015	< 0.015	< 0.015
R934		Whole	< 0.015	---	< 0.015
R935		Whole	0.0515	---	0.0515
R945		Whole	0.023	---	0.023
R936	Riser 27	Whole	< 0.015	---	< 0.015
R937		Whole	0.045	---	0.045
R941-8750		Whole	0.0216	0.102	0.0618[QC:e]
R942		Whole	0.0341	---	0.0341
R943	Riser 28	Whole	< 0.015	---	< 0.015
R944		Whole	< 0.015	---	< 0.015

Table B2-10. Tank 241-AP-103 Analytical Results: Silver.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	< 0.04	< 0.04	< 0.04
R934		Whole	< 0.04	---	< 0.04
R935		Whole	< 0.04	---	< 0.04
R945		Whole	< 0.04	---	< 0.04
R936	Riser 27	Whole	< 0.04	---	< 0.04
R937		Whole	< 0.04	---	< 0.04
R941-8750		Whole	< 0.04	< 0.04	< 0.04
R942		Whole	< 0.04	---	< 0.04
R943	Riser 28	Whole	< 0.04	---	< 0.04
R944		Whole	< 0.04	---	< 0.04

Table B2-11. Tank 241-AP-103 Analytical Results: Sodium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	3,640	3,690	3,665[QC:f]
R934		Whole	2,320	---	2,320[QC:f]
R935		Whole	2,460	---	2,460[QC:f,b]
R945		Whole	12,000	---	12,000[QC:f]
R936	Riser 27	Whole	3,820	---	3,820[QC:f]
R937		Whole	2,050	---	2,050[QC:f]
R941-8750		Whole	6,510	6,570	6,540[QC:f,b]
R942		Whole	11,700	---	11,700[QC:f]
R943	Riser 28	Whole	3,700	---	3,700[QC:f]
R944		Whole	4,870	---	4,870[QC:f]

Table B2-12. Tank 241-AP-103 Analytical Results: Zinc.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: acid digest			µg/mL	µg/mL	µg/mL
R933-8750	Riser 1	Whole	0.0466	0.0204	0.0335[QC:e]
R934		Whole	< 0.02	---	< 0.02
R935		Whole	1.21	---	1.21
R945		Whole	0.309	---	0.309
R936	Riser 27	Whole	0.55	---	0.55
R937		Whole	0.221	---	0.221
R941-8750		Whole	0.041	0.055	0.048[QC:e]
R942		Whole	0.309	---	0.309
R943	Riser 28	Whole	< 0.02	---	< 0.02
R944		Whole	< 0.02	---	< 0.02

Table B2-13. Tank 241-AP-103 Analytical Results: Arsenic.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5795	Riser 1	Whole	0.048	0.056	0.052[QC:e]
R934-5795		Whole	0.035	---	0.035
R935		Whole	0.055	---	0.055
R945		Whole	0.061	---	0.061
R936	Riser 27	Whole	0.0445	---	0.0445
R937		Whole	0.049	---	0.049
R941-5795		Whole	0.042	0.036	0.039
R942		Whole	0.084	---	0.084
R943	Riser 28	Whole	0.028	---	0.028
R944-5728		Whole	0.035	---	0.035

Table B2-14. Tank 241-AP-103 Analytical Results: Selenium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5796	Riser 1	Whole	< 0.02	< 0.02	< 0.02
R934-5796		Whole	< 0.005	---	< 0.005
R935		Whole	< 0.005	---	<0.005
R945		Whole	0.0059	---	0.0059
R936	Riser 27	Whole	< 0.005	---	< 0.005
R937		Whole	< 0.005	---	< 0.005
R941-5796		Whole	< 0.02	< 0.02	< 0.02
R942		Whole	< 0.0071	---	< 0.0071
R943	Riser 28	Whole	< 0.005	---	< 0.005
R944-5728		Whole	< 0.005	---	< 0.005

Table B2-15. Tank 241-AP-103 Analytical Results: Mercury.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5797	Riser 1	Whole	< 0.0017	< 0.0017	< 0.0017
R934-5797		Whole	< 0.0017	---	< 0.0017
R935		Whole	< 0.0017	---	< 0.0017
R945		Whole	< 0.0017	---	< 0.0017
R936	Riser 27	Whole	< 0.0017	---	< 0.0017
R937		Whole	< 0.0017	---	< 0.0017
R941-5797		Whole	< 0.0017	< 0.0017	< 0.0017
R942		Whole	< 0.0017	---	< 0.0017
R943	Riser 28	Whole	< 0.005	---	< 0.005
R944-5728		Whole	< 0.0017	---	< 0.0017

Table B2-16. Tank 241-AP-103 Analytical Results: Chloride.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5772	Riser 1	Whole	35.5	37.6	36.55
R934-5772		Whole	34.5	---	34.5
R935		Whole	49.8	---	49.8
R945		Whole	103	---	103
R936	Riser 27	Whole	31	---	31
R937		Whole	17.8	---	17.8
R941-5772		Whole	51.2	51	51.1
R942		Whole	92.9	---	92.9
R943	Riser 28	Whole	38.3	---	38.3
R944-5728		Whole	39.8	---	39.8

Table B2-17. Tank 241-AP-103 Analytical Results: Fluoride.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5772	Riser 1	Whole	60.4	61.9	61.15
R934-5772		Whole	88.2	---	88.2
R935		Whole	178	---	178
R945		Whole	260	---	260
R936	Riser 27	Whole	60.3	---	60.3
R937		Whole	54.1	---	54.1
R941-5772		Whole	130	129	129.5
R942		Whole	305	---	305
R943	Riser 28	Whole	60.6	---	60.6
R944-5728		Whole	96.4	---	96.4

Table B2-18. Tank 241-AP-103 Analytical Results: Nitrate.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5772	Riser 1	Whole	1,690	1,670	1,680
R934-5772		Whole	2,060	---	2,060
R935		Whole	3,500	---	3,500
R945		Whole	9,790	---	9,790
R936	Riser 27	Whole	1,720	---	1,720
R937		Whole	3,250	---	3,250
R941-5772		Whole	4,460	4,500	4,480
R942		Whole	9,440	---	9,440
R943	Riser 28	Whole	1,620	---	1,620
R944-5728		Whole	2,850	---	2,850

Table B2-19. Tank 241-AP-103 Analytical Results: Nitrite.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5772	Riser 1	Whole	1,130	1,140	1,135[QC:d]
R934-5772		Whole	983	---	983
R935		Whole	1,380	---	1,380
R945		Whole	1,810	---	1,810
R936	Riser 27	Whole	1,130	---	1,130
R937		Whole	1,280	---	1,280
R941-5772		Whole	1,260	1,250	1,255
R942		Whole	1,700	---	1,700
R943	Riser 28	Whole	1,120	---	1,120
R944-5728		Whole	1,200	---	1,200

Table B2-20. Tank 241-AP-103 Analytical Results: Phosphate.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5772	Riser 1	Whole	134	120	127
R934-5772		Whole	147	---	147
R935		Whole	151	---	151
R945		Whole	166	---	166
R936	Riser 27	Whole	121	---	121
R937		Whole	139	---	139
R941-5772		Whole	134	140	137
R942		Whole	149	---	149
R943	Riser 28	Whole	112	---	112
R944-5728		Whole	134	---	134

Table B2-21. Tank 241-AP-103 Analytical Results: Sulfate.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5772	Riser 1	Whole	420	483	451.5
R934-5772		Whole	502	---	502
R935		Whole	318	---	318
R945		Whole	163	---	163
R936	Riser 27	Whole	414	---	414
R937		Whole	196	---	196
R941-5772		Whole	395	396	395.5
R942		Whole	162	---	162
R943	Riser 28	Whole	418	---	418
R944-5728		Whole	482	---	482

Table B2-22. Tank 241-AP-103 Analytical Results: Ammonia.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
R933-5728	Riser 1	Whole	< 45	---	< 45
R934-5728		Whole	< 22.5	---	< 22.5
R935		Whole	< 35	---	< 35
R945		Whole	< 65.7	---	< 65.7
R936	Riser 27	Whole	< 22.5	---	< 22.5
R937		Whole	< 22.5	---	< 22.5
R941-5728		Whole	< 90	< 90	< 90
R942		Whole	< 90	---	< 90
R943	Riser 28	Whole	< 90	---	< 90
R944-5728		Whole	< 13.1	< 13.1	< 13.1

Table B2-23. Tank 241-AP-103 Analytical Results: Hydroxide.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
R933-5729	Riser 1	Whole	549	542	545.5
R934-5729		Whole	850	---	850
R935		Whole	1,890	---	0.189
R945		Whole	3,350	---	3,350
R936	Riser 27	Whole	1,120	---	1,120
R937		Whole	1,500	---	1,500
R941-5729		Whole	1,610	1,400	1,505
R942		Whole	3,430	---	3,430
R944-5728	Riser 28	Whole	991	---	991

Table B2-24. Tank 241-AP-103 Analytical Results: Cyanide.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids: water digest			µg/mL	µg/mL	µg/mL
R933-5778	Riser 1	Whole	< 1	---	< 1
R934-5778		Whole	0.495	---	0.495
R935		Whole	0.584	---	0.584
R945		Whole	0.61	---	0.61
R936	Riser 27	Whole	0.469	---	0.469
R937		Whole	0.527	---	0.527
R941-5778		Whole	0.6	0.61	0.605
R942		Whole	0.61	---	0.61
R943	Riser 28	Whole	0.511	---	0.511
R944-5728		Whole	0.552	---	0.552

Table B2-25. Tank 241-AP-103 Analytical Results: Total Inorganic Carbon.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5726	Riser 1	Whole	544	---	544
R934-5726		Whole	498	---	498
R935		Whole	522	---	522
R945		Whole	512	---	512
R936	Riser 27	Whole	430	---	430
R937		Whole	460	---	460
R941-5726		Whole	443	455	449
R942		Whole	650	---	650
R943	Riser 28	Whole	530	---	530
R944		Whole	545	---	545

Table B2-26. Tank 241-AP-103 Analytical Results: Total Organic Carbon.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
R933-5727	Riser 1	Whole	99	120	109.5
R934-5727		Whole	150	---	150
R935		Whole	130	---	130
R945		Whole	90.8	---	90.8
R936	Riser 27	Whole	120	---	120
R937		Whole	150	---	150
R941-5727		Whole	90.7	91.5	91.1
R942		Whole	91.5	---	91.5
R943	Riser 28	Whole	87.7	---	87.7
R944		Whole	99.7	---	99.7

Table B2-27. Tank 241-AP-103 Analytical Data: Volatile Organics. (2 sheets)

Analyte	Result	Analyte	Result
Liquids	µg/L	Liquids	µg/L
Chloromethane	ND	cis-1,3-Dichloropropene	ND
Bromomethane	ND	Trichloroethane	ND
Vinyl Chloride	ND	Dibromochloromethane	ND
Chloroethane	ND	1,1,2-Trichloroethane	ND
Methylene Chloride	ND	Benzene	ND
Acetone	ND	trans-1,3-Dichloropropene	ND
Carbon Disulfide	ND	Bromoform	ND
1,1-Dichloroethene	ND	4-Methyl-2-Pentanone	ND
1,1-Dichloroethane	ND	2-Hexanone	ND
1,2-Dichloroethene (total)	ND	Tetrachloroethane	ND
Chloroform	ND	1,1,2,2-Tetrachloroethane	ND
1,2-Dichloroethane	ND	Toluene	ND
2-Butanone	N/A	Chlorobenzene	ND
1,1,1-Trichloroethane	ND	Ethylbenzene	ND

Table B2-27. Tank 241-AP-103 Analytical Data: Volatile Organics. (2 sheets)

Analyte	Result	Analyte	Result
Liquids	µg/L	Liquids	µg/L
Carbon Tetrachloride	ND	Styrene	ND
Bromodichloromethane	ND	Xylene (total)	ND
1,2-Dichloropropane	ND	---	---

Note:

ND = Not Detected

Table B2-28. Tank 241-AP-103 Analytical Data: Acetone.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/L	µg/L	µg/L
R935	Riser 1	Whole	970	---	970
R933		Whole	895	---	895
R934		Whole	720	---	720
R945		Whole	555	---	555
R936	Riser 27	Whole	660	---	660
R937		Whole	685	---	685
R941		Whole	720	---	720
R942		Whole	1,000	---	1,000
R943	Riser 28	Whole	665	---	665
R944		Whole	440	---	440

Table B2-29. Tank 241-AP-103 Analytical Data: Semivolatile Organics.

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

Note:
ND = Not Detected

Table B2-30. Tank 241-AP-103 Analytical Data: 2,4-Dichloropentane.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/L	µg/L	µg/L
R937	Riser 27	Whole	5,500	---	5,500
R941		Whole	20,000	---	20,000
R942		Whole	9,900	---	9,900
R943	Riser 28	Whole	62,000	---	62,000
R944		Whole	12,000	---	12,000

Table B2-31. Tank 241-AP-103 Analytical Results: Ce/Pr-144.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R942	Riser 27	Whole	< 0.17	---	< 0.17
R949-5730	Riser NA	Composite	< 0.0967	< 0.0946	< 0.09565

Table B2-32. Tank 241-AP-103 Analytical Results: Cesium-134.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R933-5730	Riser 1	Whole	< 1.110E-07	< 0.0224	< 0.0112001
R934-5730		Whole	< 0.0104	---	< 0.0104
R935		Whole	< 0.00969	---	< 0.00969
R945		Whole	< 0.0113	---	< 0.0113
R936	Riser 27	Whole	< 0.00994	---	< 0.00994
R937		Whole	< 0.00832	---	< 0.00832
R941-5730		Whole	< 0.00994	< 0.0107	< 0.01032
R942		Whole	< 0.00943	---	< 0.00943
R943	Riser 28	Whole	< 0.00917	---	< 0.00917
R944-5728		Whole	< 0.00862	---	< 0.00862
R949-5730	Riser NA	Composite	< 0.00915	< 0.00989	< 0.00952

Table B2-33. Tank 241-AP-103 Analytical Results: Cesium-137.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R933-5730	Riser 1	Whole	7.07	6.88	6.975
R934-5730		Whole	7.2	---	7.2
R935		Whole	5.8	---	5.8
R945		Whole	4.23	---	4.23
R936	Riser 27	Whole	7.02	---	7.02
R937		Whole	6.59	---	6.59
R941-5730		Whole	6.41	6.42	6.415
R942		Whole	8.5	---	8.5
R943	Riser 28	Whole	6.59	---	6.59
R944-5728		Whole	6.93	---	6.93
R949-5730	Riser NA	Composite	6.03	5.99	6.01

Table B2-34. Tank 241-AP-103 Analytical Results: Cobalt-60.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R945	Riser 1	Whole	< 0.011	---	< 0.011
R942	Riser 27	Whole	< 0.01	---	< 0.01
R944-5728	Riser 28	Whole	< 0.012	---	< 0.012
R949-5730	Riser NA	Composite	< 0.0096	< 0.00932	< 0.00946

Table B2-35. Tank 241-AP-103 Analytical Results: Eu-154/155.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R942	Riser 27	Whole	< 0.022	---	< 0.022
R944-5728	Riser 28	Whole	< 0.032	---	< 0.032

Table B2-36. Tank 241-AP-103 Analytical Results: Europium-154.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R945	Riser 1	Whole	< 0.032	---	< 0.032
R949-5730	Riser NA	Composite	< 0.0248	< 0.0271	< 0.02595

Table B2-37. Tank 241-AP-103 Analytical Results: Europium-155.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R933-5730	Riser 1	Whole	< 4.330E-07	< 0.0875	< 0.0437502
R934-5730		Whole	< 0.0521	---	< 0.0521
R935		Whole	< 0.0483	---	< 0.0483
R936	Riser 27	Whole	< 0.05	---	< 0.05
R937		Whole	< 0.0502	---	< 0.0502
R941-5730		Whole	< 0.026	< 0.026	< 0.026
R943	Riser 28	Whole	< 0.0474	---	< 0.0474
R949-5730	Riser NA	Composite	< 0.0252	< 0.0255	< 0.02535

Table B2-38. Tank 241-AP-103 Analytical Results: Niobium-94.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R942	Riser 27	Whole	< 0.0093	---	< 0.0093

Table B2-39. Tank 241-AP-103 Analytical Results: Niobium-95.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R949-5730	Riser NA	Composite	< 0.0784	< 0.00825	< 0.008045

Table B2-40. Tank 241-AP-103 Analytical Results: Radium-226.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R942	Riser 27	Whole	< 0.043	---	< 0.043
R949-5730	Riser NA	Composite	< 0.247	< 0.241	< 0.244

Table B2-41. Tank 241-AP-103 Analytical Results: Ruthenium/Rhodium-106.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R942	Riser 27	Whole	< 0.34	---	< 0.34
R949-5730	Riser NA	Composite	< 0.189	< 0.195	< 0.192

Table B2-42. Tank 241-AP-103 Analytical Results: Tin-113.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R942	Riser 27	Whole	< 0.03	---	< 0.03
R949-5730	Riser NA	Composite	< 0.0176	< 0.0176	< 0.0176

Table B2-43. Tank 241-AP-103 Analytical Results: Iodine-129.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R949-5785	Riser NA	Composite	< 3.030E-05	< 3.340E-05	< 3.185E-05[QC:b]

Table B2-44. Tank 241-AP-103 Analytical Data: Uranium-234.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R949	Riser NA	Composite	6.56E-06	---	6.56E-06

Table B2-45. Tank 241-AP-103 Analytical Data: Uranium-235.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R949	Riser NA	Composite	3.39E-07	---	3.39E-07

Table B2-46. Tank 241-AP-103 Analytical Data: Uranium-238.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R949	Riser NA	Composite	1.26E-06	---	1.26E-06

Table B2-47. Tank 241-AP-103 Analytical Results: Americium-241.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R949-5781	Riser NA	Composite	< 1.140E-05	< 1.130E-05	< 1.135E-05

Table B2-48. Tank 241-AP-103 Analytical Results: Plutonium-239/240.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R949-5781	Riser NA	Composite	< 6.970E-06	< 6.970E-06	< 6.970E-06

Table B2-49. Tank 241-AP-103 Analytical Results: Carbon-14.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R949-5788	Riser NA	Composite	6.330E-06	2.610E-06	4.470E-06[QC:e]

Table B2-50. Tank 241-AP-103 Analytical Results: Selenium-79.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
R949-5789	Riser NA	Composite	1.320E-05	9.100E-06	1.115E-05[QC:e]

Table B2-51. Tank 241-AP-103 Analytical Results: Tritium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μCi/mL	μCi/mL	μCi/mL
R949-5787	Riser NA	Composite	0.00523	0.00525	0.00524

Table B2-52. Tank 241-AP-103 Analytical Results: Technetium-99.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μCi/mL	μCi/mL	μCi/mL
R949-5784	Riser NA	Composite	0.00112	0.00104	0.00108

Table B2-53. Tank 241-AP-103 Analytical Results: Total Uranium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
R949-5740	Riser NA	Composite	3.9	3.48	3.69

Table B2-54. Tank 241-AP-103 Analytical Results: Strontium-90.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μCi/mL	μCi/mL	μCi/mL
R949-5786	Riser NA	Composite	0.00262	0.00262	0.00262

Table B2-55. Tank 241-AP-103 Analytical Results: Specific gravity.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			unitless	unitless	unitless
R933-5706	Riser 1	Whole	0.995	1.00	0.9975
R934-5706		Whole	1.01	---	1.01
R935		Whole	1.018	---	1.018
R945		Whole	1.01	---	1.01
R936	Riser 27	Whole	1.002	---	1.002
R937		Whole	1.017	---	1.017
R941-5706		Whole	0.995	0.995	0.995
R942		Whole	1.0044	---	1.0044
R943	Riser 28	Whole	0.992	---	0.992
R944		Whole	0.994	---	0.994

B2.7 HISTORICAL SAMPLE RESULTS

Prior to the 1991 sampling event, the most recent sampling of tank 241-AP-103 occurred in April 1988. Because multiple waste transfers have occurred since this last sampling event, no valid comparison between the sampling events can be made.

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS

The purpose of this chapter is to discuss the overall quality and consistency of the 1991 sampling results for tank 241-AP-103. This section also evaluates sampling and analysis factors that may impact interpretation of the data. These factors are used to assess the overall quality and consistency of the data and to identify any limitations in the use of the data.

B3.1 FIELD OBSERVATIONS

The safety screening DQO requirement that at least two widely spaced risers be sampled was fulfilled, allowing a horizontal comparison of the analytical results. Sample 3AP891-3 was resampled and replaced by sample 3AP1191-1 because the custody seal was improperly attached.

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 1991 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. Iron, Manganese, Zinc, ^{14}C, and ^{79}Se each had duplicates which exceeded the defined limit.

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

Comparisons of different analytical methods can help to assess the consistency and quality of the data. The quantity of data from the grab sampling event made possible the calculation of mass and charge balances, along with the comparison between total uranium by alpha proportional counting and total uranium from isotopic data.

B3.3.1 Comparison of Results from Different Analytical Methods

The following data consistency check compares the results from two different analytical methods for uranium. A close correlation between the two methods strengthens the credibility of both results, whereas a poor correlation brings the reliability of the data into question. All mean results were taken from tables in Section B2. 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 due to data limitations.

The total uranium value from alpha proportional counting was 3,690 μg/L. This compared well with the total uranium from isotopic results of 3,900 μg/L. The comparison is presented in Table B3-1.

Table B3-1. Comparison of Total Uranium Results from Different Analytical Methods.

Analyte	Concentration (μg/L)
^{234}U	1.05
^{235}U	157
^{238}U	3,740
Total Uranium from Isotopic Data	3,900
Total Uranium from Alpha Proportional Counting	3,690

B3.3.2 Mass and Charge Balance

The principle objective in performing mass and charge balances is to determine if the measurements were consistent. It also provides a method of estimating the weight percent water in the tank, since it was not determined by the laboratory. In calculating the balances, only analytes listed in Section B2 detected at a concentration of 1 μg/g or greater were considered.

The cation and anion results are shown in Table B3-2 and Table B3-3, respectively. Examination of the data revealed an excess negative charge, as shown in Table B3-4. The net charge balance was 89 percent, with an excess negative charge. This indicates that some cations, such as potassium or calcium, may not be accounted for in the analyses. Although some analytes may not be fully accounted for, these are expected to be minor contributions to the overall mass balance.

As shown in Table B3-4, the total analyte concentration was 15,740 μg/g and was subtracted from 1,000,000 μg/g to obtain an estimated value for the weight percent water. In other words, mass not accountable to the analyte concentrations is attributed to water. The tank is estimated to contain approximately 98.4 percent water.

Table B3-2. Cation Mass and Charge Data.

Analyte	Assumed Species	Concentration (wet weight)	Charge
		μg/g	μeq/g
Aluminum	Al^{3+}	247	27.4
Chromium	Cr^{6+}	4.36	0.503
Sodium	Na^{+}	5,280	230
Uranium	U^{6+}	3.69	0.0930
Total		5,540	258

Table B3-3. Anion Mass and Charge Data.

Analyte	Assumed Species	Concentration (wet weight)	Charge
		μg/g	μeq/g
Chloride	Cl^{-}	50.9	1.44
Fluoride	F^{-}	134	7.05
Hydroxide	OH^{-}	1,520	89.4
Nitrate	NO_3^{-}	4,080	65.8
Nitrite	NO_2^{-}	1,300	28.3
Phosphate	PO_4^{3-}	138	4.36
Sulfate	SO_4^{2-}	362	7.54
TIC	CO_3^{2-}	2,600	86.7
Total		10,200	291

Table B3-4. Charge Balance and Calculation of Weight Percent Water.

Totals	Concentrations μg/g	Charge μeq/g
Total from Table B3-2	5,540	258
Total from Table B3-3	10,200	291
Percent water (est.)	984,000	N/A

B3.4 CALCULATION OF ANALYTICAL BASED MEANS AND INVENTORY

The following evaluation was performed on the analytical data from the grab samples from double-shell tank 241-AP-103. The statistical analysis and inventory estimates are used to support the characterization best-basis inventory given in Appendix D.

In addition to the mean, two-sided 95 percent confidence intervals on the mean inventory are computed.

The lower limit (LL) to a two-sided 95 percent confidence interval for the mean is

$$LL = \hat{\mu} - t_{(df,0.025)} \times \sqrt{\sigma^2_{\hat{\mu}}}$$

and the upper limit (UL) to a two-sided 95 percent confidence interval for the mean is

$$UL = \hat{\mu} + t_{(df,0.025)} \times \sqrt{\sigma^2_{\hat{\mu}}}.$$

In these equations, $\hat{\mu}$ is the estimate of the mean concentration, $\sigma^2_{\hat{\mu}}$ is the estimate of the variance of the mean concentration, and $t_{(df,0.025)}$ is the quantile from the student t distribution with *df* degrees of freedom for a two-sided 95 percent confidence interval.

The mean, $\hat{\mu}$, and the variance, $\sigma^2_{\hat{\mu}}$, were estimated using restricted maximum likelihood estimation (REML) methods. The degrees of freedom (*df*) for tank 241-AP-103 are the number of locations sampled minus one (i.e., one sample location for R933-8750 result and duplicate; samples R930 and R941-8750 [result and duplicate] were obtained from the same location).

Table B3-5 gives the upper and lower limits to the 95 percent confidence intervals on the mean for analytes detected in tank 241-AP-103. Some analytes had a computed lower limit less than 0. Because a concentration estimate less than 0 is not possible, the lower limit was recorded as 0 whenever the lower limit was negative.

Table B3-5. 95 Percent Two-Sided Confidence Interval for the Mean Concentration.

Analyte	$\hat{\mu}$	$\hat{\sigma}^2_{\hat{\mu}}$	*df*	95% LL	95% UL
Aluminum (μg/L)	2.47E+05	4.03E+06	8	1.00E+05	3.93E+05
Arsenic (μg/mL)	0.0485	3.10E-05	8	0.0357	0.0613
Cadmium (μg/mL)	109	269	8	71.4	147
Chromium (μg/L)	4,360	2.39e+05	8	3,230	5,490
Cyanide[1] (μg/mL)	0.601	0.00273	8	0.480	0.722
Iron[1] (μg/L)	837	51,900	8	610	2,430
Magnesium[1] (μg/L)	714	21,700	8	374	1,050
Manganese[1] (μg/L)	29.8	58.8	8	12.1	47.5
Sodium (μg/L)	5.28E+06	9.60E+11	8	3.02E+06	7.54E+06
Zinc[1] (μg/L)	285	17,000	8	0	586
Chloride (μg/mL)	50.9	72.8	8	31.2	70.6
Fluoride (μg/mL)	134	913	8	64.1	204
Hydroxide (μg/mL)	1,520	1.56E+05	8	610	2,430
Nitrate (μg/mL)	4,080	1.17E+06	8	1,580	6,570
Nitrite (μg/mL)	1,300	8,700	8	1,090	1,520
Phosphate (μg/mL)	138	30.3	8	125	151
Sulfate (μg/mL)	362	1,440	8	275	450
TIC (μgC/mL)	520	436	8	472	568
TOC (μgC/mL)	110	45.1	8	94.6	126
Cesium-137 (μCi/L)	6,640	1.48E+05	8	5,750	7,520
SpG	1.00	7.00E-06	8	0.997	1.01

Note:

[1]Some "less-than detection" values are included in the mean calculation.

A statistical model is needed to account for the spatial and measurement variability in $\sigma^2_{\hat{\mu}}$. This cannot be done using an ordinary standard deviation of the data.(Snedecor and Cochran 1980).

The statistical model used to describe the structure of the data is

$$Y_{ijk} = \mu + L_i + A_{ij},$$
$$i=1,\ldots,a,\ j= 1,\ldots,n_i,$$

where

Y_{ij} = laboratory results from the k[th] duplicate from the i[th] location in the tank,

μ = the grand mean

L_i = the effect of the i[th] location (measuring spatial variability)

A_{ij} = the effect of the j[th] analytical result from the i[th] location (measurement variability)

a = the number of sample locations

n_i = the number of analytical results from the i[th] location.

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

Confidence intervals could not be performed on the DSC data, because all of the results were zero.

After the REML sample means are estimated for the tank for each analyte, the sampling based inventory may be calculated. Because the analyte concentrations above are presented in terms of a mass basis concentration, the total mass of waste in the tank is needed to estimate inventories. The total mass of waste is derived from the tank volume (from surveillance). The total tank volume is 87 kL (23 kgal) (Hanlon 1996). The inventory of each of the analytes is presented in Appendix D.

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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 applicable data quality objective (DQO) reports for tank 241-AP-103 are performed. Specifically, statistical and other numerical manipulations required in the DQO reports are performed and documented in this appendix. The two analyses required for tank 241-AP-103 are documented in the following sections:

- **Section C1**: Statistical analysis and numerical manipulations supporting the Safety Screening DQO (Dukelow et al. 1995).
- **Section C2**: References for Appendix C.

C1.0 STATISTICS FOR SAFETY SCREENING DQO

The safety screening DQO (Dukelow et al. 1995) defines acceptable decision confidence limits in terms of one-sided 95 percent confidence intervals on the mean for each subsample. All of the analytes evaluated for the safety screening DQO were below the detection limit. As a result, the calculation of confidence intervals was not required.

C2.0 APPENDIX C REFERENCES

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APPENDIX D

EVALUATION TO ESTABLISHED BEST-BASIS INVENTORY FOR TANK 241-AP-103

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AP-103

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson et al. 1996). As part of this effort, an evaluation of available chemical information for tank 241-AP-103 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.

The following evaluation provides a best-basis inventory estimate for chemical and radionuclide components in tank 241-AP-103.

Expected Waste Type

Dilute Noncomplexed (DN)

D1.0 CHEMICAL INFORMATION SOURCES

Available composition information for the waste in tank 242-AP-103 is as follows:

- Characterization results from the 1991 "bottle-on-a-string" sampling event.
- The HDW model document (Agnew et al. 1996). A complete list of data sources used in this evaluation is provided at the end of this section.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Sample-based inventories derived from 1991 analytical concentration data, and HDW model inventories generated by the HDW model (Agnew et al. 1996), are compared in Tables D2-1 and D2-2. Sample-based inventories derived for comparison with HDW values are based on a tank volume of 4,315 kL (1,140 kgal). This was the tank inventory in 1991 when samples were taken. The HDW model tank volume is slightly lower at 4,277 kL (1,130 kgal). The density calculated by the HDW model is 1.07 g/mL compared to a mean analytical result of 1.00 g/mL.

During 1994, all but 87 kL (23 kgal) of the waste in tank 241-AP-103 was transferred to tank 241-AW-102 to be concentrated in the 242-A Evaporator.

Table D2-1. Sampling and Hanford Defined Waste Model Inventory Estimates for Nonradioactive Components in DST 241-AP-103.

Analyte	Sampling inventory estimate[1] (MT)	HDW inventory estimate[2] (MT)	Analyte	Sampling inventory estimate[1] (MT)	HDW inventory estimate[2] (MT)
Al	1.05	23.5	NO_3	17.3	23.5
As	2.07E-04	NR	Ni	NR	0.285
Ba	< 2.78E-04	NR	Pb	0.00171	0.475
Be	NR	NR	Se	8.56E-05	NR
B	NR	NR	Si	NR	4.35
Cd	4.75E-04	NR	Ti	NR	NR
Ca	NR	1.09	U	0.0158	5.41
Ce	NR	NR	Zn	0.00189	NR
Cr	0.0188	0.597	Zr	NR	NR
Cu	NR	NR	NH_3	0.164	NR
Fe	0.00528	0.337	CO_3	11.0	59.6
K	NR	1.60	Cl	0.212	15.0
Mg	0.00511	NR	NO_2	5.56	216
Mn	1.85E-04	0.0464	PO_4	0.595	53.3
Na	22.7	152	SO_4	1.50	51.2
CN	0.00236	NR	TOC	0.479	35.1
F	0.552	0.364	---	---	---

Notes:

MT = metric ton
NR = not reported

[1]Based on a 1991 tank volume of 4,315 kL (1,140 kgal) for comparison with HDW only. The current tank volume is 87 kL (23 kgal).
[2]Agnew et al. (1996)

Table D2-2. Sampling and Hanford Defined Waste Model Inventory Estimates for Radioactive Components in Double-Shell Tank 241-AP-103. (decayed to January 1, 2000)

Analyte	Sampling inventory estimate[1] (Ci)	HDW inventory estimate[2] (Ci)	Analyte	Sampling inventory estimate[1] (Ci)	HDW inventory estimate[2] (Ci)
^{241}Am	0.0488	---	$^{239/240}Pu$	---	55.0
^{14}C	0.0191	---	^{79}Se	0.0479	---
^{137}Cs	28,000	2.66E+05	$^{89/90}Sr$	11.2	57,200
^{60}Co	---	---	^{99}Tc	4.62	---
^{242}Cm	---	---	^{3}H	22.4	---
^{243}Cm	---	---	---	---	---

Notes:

[1]Based on a 1991 tank volume of 4,315 kL (1,140 kgal) for comparison with HDW only. The current tank volume is 87 kL (23 kgal).

[2]Agnew et al. (1996)

Tables D2-1 and D2-2 show that the HDW model estimates are higher for all components except fluoride. In many cases, estimates generated by the model are over one order of magnitude higher than the analytical result. This is true for major and minor components alike. The amount of Al predicted by the HDW model is over 22 times higher than the analytical result; the estimate for PO_4 is almost 90 times higher than the analytical result. Comparisons for sodium and nitrate fare better; the HDW model estimates are higher than the analytical results by factors of 6.7 and 1.4, respectively.

D3.0 COMPONENT INVENTORY EVALUATION

Some of the waste mixtures added to tank 241-AP-103 were fairly complex; consequently, any estimate based on transfer information would have a large uncertainty. For example, waste added to the tank often included miscellaneous wastes from B plant and T plant via tank 241-AY-102, for which there are only poorly defined mean compositions.

Except for the high range of values for analyte concentrations in some instances, there is little reason to suspect that the analytical results for tank 241-AP-103 did not accurately reflect the waste's composition when the tank was nearly full. Thus, the mean sample-based inventories from the 1991 grab sample event are considered the best-basis inventory for the small liquid heel remaining.

D4.0 DEFINE THE BEST BASIS AND ESTABLISH COMPONENT INVENTORIES

The sampling data should be considered the best basis for the inventory in tank 241-AP-103 for the following reasons:

1. The HDW model predicts concentrations far in excess of both the mean concentrations and upper bounding concentrations reported by the laboratories.

2. No other representative sample data exist, nor is there enough historical or flowsheet information to derive a reliable historical estimate.

3. The existing data indicate adequate precision, and an analysis of variance showed that the waste was not vertically stratified before the bulk of it was pumped out of the tank.

Best-basis inventory estimates for tank 241-AP-103 are presented in Tables D4-1 and D4-2. These estimates are based on reported mean concentration values from the 1991 sampling event and a residual heel volume of 87 kL (23 kgal). The quality of the estimates has been designated as medium. As mentioned earlier, the sample data suggest that some stratification of the waste may have existed when the tank was nearly full, so that when it was emptied from the bottom, the composition of the remaining heel was commensurate with samples taken from the top of the tank. However, the evidence for this, upon inspection, is inconclusive. This uncertainty forces the quality of the estimate to be medium rather than high.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-103 as of October 21, 1996.

Analyte	Total inventory (kg)	Basis (S, M, or E)[1,2]
Al	21.5	S
Bi	NR	
Ca	NR	
Cl	4.43	S
CO_3	226	S
Cr	0.379	S
F	11.7	
Fe	0.073	S
Hg	< 0.00015	
K	NR	
La	NR	
Mn	0.0026	S
Na	459	S
Ni	NR	
NO_2	113	S
NO_3	355	S
OH	132	S
Pb	< 0.035	S
PO_4	12.0	S
Si	NR	
SO_4	31.5	S
Sr	NR	S
TOC	9.57	S
U	0.32	S
Zr	NR	

Notes:

NR = Not reported

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based

[2]Based on 1991 grab samples (see Appendix B).

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-103 as of October 21, 1996. (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1,2]
^{3}H	NR	
^{14}C	NR	
^{59}Ni	NR	
^{60}Co	< 0.96	S
^{63}Ni	NR	
^{79}Se	9.70E-04	S
^{90}Sr	0.23	S
^{90}Y	NR	
^{93}Zr	NR	
^{93m}Nb	NR	
^{99}Tc	0.094	S
^{106}Ru	NR	
^{113m}Cd	NR	
^{125}Sb	NR	
^{126}Sn	NR	
^{129}I	NR	
^{134}Cs	NR	
^{137}Cs	577	S
^{137m}Ba	NR	
^{151}Sm	NR	
^{152}Eu	NR	
^{154}Eu	< 1.46	S
^{155}Eu	< 2.31	S
^{226}Ra	< 21.5	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-103 as of October 21, 1996. (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]
^{233}U	NR	
^{234}U	5.70E-04	S
^{235}U	2.95E-05	S
^{236}U	NR	
^{237}Np	NR	
^{238}Pu	NR	
^{238}U	1.00E-04	S
$^{239/240}Pu$	< 6.06E-04	S
^{241}Am	9.87E-04	S
^{241}Pu	NR	
^{242}Cm	NR	
^{242}Pu	NR	
^{243}Am	NR	
^{243}Cm	NR	
^{244}Cm	NR	

Notes:

NR = Not reported

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based

[2]Based on 1991 grab samples (see Appendix B).

D5.0 REFERENCES

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-AP-103

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-AP-103

Appendix E provides a bibliography of information that supports the characterization of tank 241-AP-103. 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-103 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 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
IIc. Sampling of PUREX Ammonia Scrubber Feed

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 for the Southeast Quadrant*, WHC-SD-WM-TI-689, Rev. 1, Los Alamos National Laboratory, Los Alamos, New Mexico.

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

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.

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

Mollusky, J. P., 1988, *Cladding Removal Waste (CRW) Segregation Routing Status*, (internal memorandum 13331-88-645 to D. W. Bergmann, October 24), Westinghouse Hanford Company, Richland, Washington.

- Internal memorandum contains planned transfer information of ammonia scrubber feed into tanks AP-101 and AP-103.

Koreski, G. M., 1991, *Operational Waste Volume Projection*, WHC-SD-WM-ER-029, Westinghouse Hanford Company, Richland, Washington.

- Document contains spreadsheets depicting all available data on tank additions/transfers from 1981 up to 1991.

Ib. Surveillance/Tank Configuration

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

- Internal memorandum contains locations of ammonia gas on Hanford Site as well as background on the source of the ammonia.

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.

- Internal letter 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.

- Document contains the operating specifications for the listed double-shell tanks. This includes composition, liquid levels, dome loading, vapor space pressure, etc.

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

- Document provides a ready reference to the tank farms safety envelope.

Lipnicki, J., 1995, *Waste Tank Risers Available for Sampling*, WHC-SD-WM-TI-710, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Document 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.

- Document 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.

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

Ic. Sample Planning/Tank Prioritization

Bell, K. E., 1994, *Tank Waste Remediation System Tank Waste Analysis Plan,* WHC-SD-WM-PLN-077, Rev. 0, 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.

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

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.

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.

- Document contains 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.

- Document 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.

- Document 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.

Halgren, D. L., 1991, *Double-Shell Tank Waste Analysis Plan*, WHC-SD-WM-EV-053, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Document 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*.

- Document creates the Safety Watch List for the Hanford Site tank farms.

Winters, W. I., L. Jensen, L. M. Sasaki, R. L. Weiss, J. F. Keller, A. J. Schmidt, and M. G. Woodruff, 1989, *Waste Characterization Plan for the Hanford Site Single-Shell Tanks*, WHC-EP-0210, Westinghouse Hanford Company, Richland, Washington.

- Early version of characterization planning document.

Winkelman, W. D., 1996, *Fiscal Year 1994 Tank Waste Analysis Plan*, WHC-SD-WM-PLN-120, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document identifies plans and requirements for tanks to be sampled and analyzed and tank characterization reports to be written during FY 1997.

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.

- Document 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.

- Document 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, D. B. Hiller, L. C. Amato, J. D. Franklin, R. W. Lambie, and B. C. Simpson, 1994, *Tank Characterization Report for Double-Shell Tank 241-AP-103*, WHC-SD-WM-ER-359, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document summarizes and compares the analytical data for characterization.

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

- Document summarizes and compares the analytical data for operational limits.

Wehner, K. B., 1994, *Semivolatile Analytical Results - T734*, (internal memorandum to E. Q. Le, May 23), Westinghouse Hanford Company, Richland, Washington.

- Letter contains data results for semivolatile analytes for a mixture of samples from three tanks.

WHC, 1992, *Summary Data Report*, WHC-SD-WM-DP-025, Addendum 5A Rev. 0 to Addendum 14A Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains the analytical results from the 1991 sampling of tank 241-AP-103.

WHC, 1992, *222-S Analytical Laboratory 242-A Evaporator Feed Characterization Validation Report*, WHC-SD-WM-DP-025, Addendum 20A Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains the data validation report for the 1991 grab sampling of tank 241-AP-103.

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.

- Document contains results of 242-A Evaporator Campaign 94-1.

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.

- Internal memorandum contains 1988 evaporator run planning information.

IIc. PUREX Ammonia Scrubber Feed

Berglund, C. J., 1987, *PUREX Ammonia Scrubber Pilot Plant Testing*, (internal memorandum 65455-87-082 to K. E. Plummer, September 23), Westinghouse Hanford Company, Richland, Washington.

- Internal memorandum contains information on chemical concentration used as feed to test PUREX Ammonia Scrubber.

Weiss, R. L., and A. L. Prignano, 1987, *Report on Ammonia Treatment of PUREX Streams*, (internal memorandum 12221-PCL87-035 to Distribution, December 15), Westinghouse Hanford Company, Richland, Washington.

- Internal memorandum contains alternate methods of reducing ammonium concentrations in ammonia scrubber waste streams.

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, 1996, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 3*, LA-UR-96-858, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Document 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.

- Document 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.

- 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.

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

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.

- Document 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.

- Document 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 appendices 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.

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

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

- These documents contain a monthly summary of: fill volumes, Watch List tanks, occurrences, integrity information, equipment readings, equipment status, tank location, and other miscellaneous tank information. Grouped here are all the monthly summaries from Dec. 1947 - present; however, Hanlon has only authored the monthly summaries from Nov. 1989 to present.

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.

- Document 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.

- Document gives assessment of relative dryness between tanks.

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.

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

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

- Document 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.

- Memo 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.

- Memo 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.

- Memo 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.

- Document 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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