ENGINEERING CHANGE NOTICE

1. ECN 635446

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	Jaiduk Jo, Data Assessment and Interpretation, R2-12, 373-9322	[] Yes [X] No	03/10/97
	6. Project Title/No./Work Order No. Tank 241-S-104	7. Bldg./Sys./Fac. No. 241-S-104	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-370, Rev. 0	10. Related ECN No(s). N/A	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

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

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

14a. Justification (mark one)

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

14b. Justification Details

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

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

See attached distribution.

RELEASE STAMP

DATE: APR 15 1997

STA: 4

HANFORD RELEASE

ID: 2

A-7900-013-2 (05/96) GEF095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) ECN-635446

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

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

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

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

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. J. Jo	J. Jo	4-14-97	PE		
Cog. Mgr. K.M. Hall	R.R. Thompson for - K.R. Thompson	4-14-97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other R.J. Cash	R.J. Cash	4-14-97	Other		
N.W. Kirch	N.W. Kirch	4.14.97	DEPARTMENT OF ENERGY		
			Signature or a Control Number that tracks the Approval Signature		
			ADDITIONAL		

Tank Characterization Report for Single-Shell Tank 241-S-104

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

EDT/ECN: ECN-635446 UC: 2070
Org Code: 74620 Charge Code: N4G4C
B&R Code: EW 3120074 Total Pages: 214

Key Words: Waste Characterization, Single-Shell Tank, SST, Tank 241-S-104, Tank S-104, S-104, S Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-S-104. This report supports the requirements of the Tri-Party Agreement Milestone M-44-05.

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

Printed in the United States of America. To obtain copies of this document, contact: WHC/BCS Document Control Services, P.O. Box 1970, Mailstop H6-08, Richland WA 99352, Phone (509) 372-2420; Fax (509) 376-4989.

Release Approval Date

DATE: HANFORD RELEASE
STA: 4 ID: 2.
APR 15 1997
Release Stamp

Approved for Public Release

RECORD OF REVISION	(1) Document Number HNF-SD-WM-ER-370	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-S-104

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 09/29/94 on EDT-159086.	B.C. Simpson	C.S. Haller
RS 1	Incorporate per ECN-635446.	J. Jo	K.M. Hall 4/14/97 BR Thompson for ~~CR Thompson~~

A-7320-005 (08/91) WEF168

HNF-SD-WM-ER-370, Rev. 1
Formerly WHC-SD-WM-ER-370, Rev. 0

UC-2070

Tank Characterization Report for Single-Shell Tank 241-S-104

J. Jo
Lockheed Martin Hanford Corporation

R. D. Cromar
Numatec Hanford Corporation

R. T. Winward
Meier Associates

Date Published
April 1997

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Approved for public release; distribution is unlimited

CONTENTS

1.0 INTRODUCTION 1-1
1.1 SCOPE 1-1
1.2 TANK BACKGROUND 1-2

2.0 RESPONSE TO TECHNICAL ISSUES 2-1
2.1 SAFETY SCREENING 2-1
2.1.1 Exothermic Conditions (Energetics) 2-1
2.1.2 Flammable Gas 2-2
2.1.3 Criticality 2-2
2.2 OTHER TECHNICAL ISSUES 2-2
2.3 SUMMARY 2-2

3.0 BEST-BASIS STANDARD INVENTORY ESTIMATE 3-1

4.0 RECOMMENDATIONS 4-1

5.0 REFERENCES 5-1

APPENDIXES

APPENDIX A: HISTORICAL TANK INFORMATION A-1

A1.0 CURRENT TANK STATUS A-3

A2.0 TANK DESIGN AND BACKGROUND A-4

A3.0 PROCESS KNOWLEDGE A-8
A3.1 WASTE TRANSFER HISTORY A-8
A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS A-10

A4.0 SURVEILLANCE DATA A-14
A4.1 SURFACE-LEVEL READINGS A-14
A4.2 INTERNAL TANK TEMPERATURES A-14
A4.3 TANK 241-S-104 PHOTOGRAPHS A-17

A5.0 APPENDIX A REFERENCES A-19

CONTENTS (Continued)

APPENDIX B: SAMPLING OF TANK 241-S-104 . . . . . B-1

B1.0 TANK SAMPLING OVERVIEW B-3
B1.1 DESCRIPTION OF SAMPLING EVENT B-3
B1.2 SAMPLE HANDLING B-5
B1.3 SAMPLE ANALYSES B-12
B1.3.1 Sample Preparation B-13
B1.3.2 Analytical Methods B-13
B1.3.3 Physical and Rheological Tests B-16
B1.3.4 Chemical and Radionuclide Constituent Analysis B-16
B1.3.5 Organic Constituent Analysis B-17
B1.4 DESCRIPTION OF HISTORICAL SAMPLING EVENT B-17

B2.0 ANALYTICAL RESULTS B-18
B2.1 OVERVIEW B-18
B2.2 METALS B-18
B2.3 ANIONS B-19
B2.4 RADIONUCLIDES B-19
B2.4.1 Alpha Activity B-19
B2.4.2 Mass Spectrometry B-19
B2.4.3 Total Beta Activity B-19
B2.4.4 Gamma Energy Analysis B-20
B2.4.5 Liquid Scintillation Counting B-20
B2.5 PHYSICAL ANALYSES B-20
B2.5.1 Density and Percent Solids B-21
B2.5.2 Particle Size B-21
B2.5.3 Rheology B-22
B2.5.4 Thermogravimetric Analysis B-24
B2.5.5 Differential Scanning Calorimetry B-25
B2.6 ORGANIC CONSTITUENTS B-25
B2.7 VAPOR PHASE MEASUREMENT B-25
B2.8 HISTORICAL SAMPLE RESULTS B-26
B2.9 ANALYTICAL DATA TABLES B-28

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS B-113
B3.1 FIELD OBSERVATIONS B-113
B3.2 QUALITY CONTROL ASSESSMENT B-114
B3.3 DATA VALIDATION FINDINGS B-114
B3.4 DATA CONSISTENCY CHECKS B-114
B3.4.1 Comparison of Results from Different Analytical Methods . . . B-115
B3.4.2 Mass and Charge Balance B-116

CONTENTS (Continued)

B3.5 MEAN CONCENTRATIONS AND CONFIDENCE INTERVALS . . . B-119
B3.5.1 Composite Means B-119
B3.5.2 Analysis of Variance Models B-122
B3.5.3 Inventory B-123

B4.0 APPENDIX B REFERENCES B-126

APPENDIX C: STATISTICAL ANALYSIS FOR ISSUE RESOLUTION C-1

C1.0 STATISTICS FOR SAFETY SCREENING DQO C-3

C2.0 APPENDIX C REFERENCE C-4

APPENDIX D: RESULTS OF THE EVALUATION TO ESTABLISH BEST-BASIS STANDARD INVENTORY FOR TANK 241-S-104 . . . . . D-1

D1.0 CHEMICAL INFORMATION SOURCES D-3

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES D-3

D3.0 COMPONENT INVENTORY EVALUATION D-6
D3.1 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT . . . D-6
D3.2 ASSUMPTIONS USED FOR THIS ASSESSMENT D-7
D3.3 METHODOLOGY USED FOR THIS EVALUATION D-7
D3.3.1 Evaluation of Technical Flowsheet Information D-8
D3.3.2 Evaluation Of Sample Information Sources D-8
D3.4 INVENTORY COMPARISONS D-10

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES D-13

D5.0 APPENDIX D REFERENCES D-16

APPENDIX E: BIBLIOGRAPHY FOR TANK 241-S-104 . . . . . E-1

LIST OF FIGURES

A2-1 Tank 241-S-104 Cross Section and Schematic A-5

A2-2 Riser Configuration for Tank 241-S-104 . . . . . A-6

A3-1 Tank Layer Model A-11

A4-1 Tank 241-S-104 Level History A-15

A4-2 Tank 241-S-104 High Temperature Plot A-16

LIST OF TABLES

1-1 Summary of Recent Sampling 1-2

1-2 Description of Tank 241-S-104 1-3

2-1 Summary of Safety Screening Results 2-3

3-1 Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-104 (December 4, 1996) 3-2

3-2 Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-104 (December 4, 1996) 3-3

4-1 Acceptance of Tank 241-S-104 Sampling and Analysis 4-1

4-2 Acceptance of Evaluation of Characterization Data and Information for Tank 241-S-104 4-2

A1-1 Tank Contents Status Summary A-4

A2-1 Tank 241-S-104 Risers A-7

A3-1 Tank 241-S-104 Major Transfers A-9

A3-2 Historical Tank Inventory Estimate A-12

LIST OF TABLES (Continued)

B1-1 Tank 241-S-104 Sample Numbers and Locations B-4

B1-2 Sample and Extrusion Information for 241-S-104 . . . . . B-6

B1-3 Tank 241-S-104 Composite and Liquid Tracking Numbers from the 222-S Laboratory B-11

B1-4 Tank 241-S-104 Sample Numbers from Pacific Northwest Laboratory B-11

B1-5 Tank 241-S-104 Samples and Requested Analytes B-13

B1-6 Analytical Methods for Physical and Rheological Tests B-14

B1-7 Analytical Methods for Chemical and Radiochemical Analyses B-14

B1-8 Analytical Methods for Organic Analyses B-16

B2-1 Analytical Data Presentation Tables B-18

B2-2 Tank 241-S-104, Core 42 Physical Measurements B-20

B2-3 Summary of Particle Size Distribution for Tank 241-S-104 . . . . . B-21

B2-4 Flow Properties B-22

B2-5 Power Law Curve Fit Parameters B-24

B2-6 Results of Vapor Phase Measurements of Tank 241-S-104 . . . . . B-26

B2-7 Historical Sample B-27

B2-8 Tank 241-S-104 Analytical Results: Aluminum (ICP) B-28

B2-9 Tank 241-S-104 Analytical Results: Antimony (ICP) B-30

B2-10 Tank 241-S-104 Analytical Results: Arsenic (ICP) B-31

B2-11 Tank 241-S-104 Analytical Results: Arsenic (Atomic Absorption) B-33

B2-12 Tank 241-S-104 Analytical Results: Barium (ICP) B-33

B2-13 Tank 241-S-104 Analytical Results: Beryllium (ICP) B-35

LIST OF TABLES (Continued)

B2-14 Tank 241-S-104 Analytical Results: Bismuth (ICP) B-36

B2-15 Tank 241-S-104 Analytical Results: Boron (ICP) B-38

B2-16 Tank 241-S-104 Analytical Results: Cadmium (ICP) B-40

B2-17 Tank 241-S-104 Analytical Results: Calcium (ICP) B-41

B2-18 Tank 241-S-104 Analytical Results: Cerium (ICP) B-43

B2-19 Tank 241-S-104 Analytical Results: Chromium (ICP) B-44

B2-20 Tank 241-S-104 Analytical Results: Hexavalent Chromium (Cr+6) B-46

B2-21 Tank 241-S-104 Analytical Results: Cobalt (ICP) B-46

B2-22 Tank 241-S-104 Analytical Results: Copper (ICP) B-47

B2-23 Tank 241-S-104 Analytical Results: Iron (ICP) B-49

B2-24 Tank 241-S-104 Analytical Results: Lanthanum (ICP) B-51

B2-25 Tank 241-S-104 Analytical Results: Lead (ICP) B-52

B2-26 Tank 241-S-104 Analytical Results: Magnesium (ICP) B-54

B2-27 Tank 241-S-104 Analytical Results: Manganese (ICP) B-55

B2-28 Tank 241-S-104 Analytical Results: Mercury (CVAA) B-57

B2-29 Tank 241-S-104 Analytical Results: Nickel (ICP) B-57

B2-30 Tank 241-S-104 Analytical Results: Phosphorus (ICP) B-58

B2-31 Tank 241-S-104 Analytical Results: Potassium (ICP) B-60

B2-32 Tank 241-S-104 Analytical Results: Selenium (ICP) B-61

B2-33 Tank 241-S-104 Analytical Results: Selenium (Atomic Absorption) B-63

B2-34 Tank 241-S-104 Analytical Results: Silicon (ICP) B-63

LIST OF TABLES (Continued)

B2-35 Tank 241-S-104 Analytical Results: Silver (ICP) B-65

B2-36 Tank 241-S-104 Analytical Results: Sodium (ICP) B-66

B2-37 Tank 241-S-104 Analytical Results: Strontium (ICP) B-67

B2-38 Tank 241-S-104 Analytical Results: Sulfur (ICP) B-69

B2-39 Tank 241-S-104 Analytical Results: Tin (ICP) B-70

B2-40 Tank 241-S-104 Analytical Results: Titanium (ICP) B-71

B2-41 Tank 241-S-104 Analytical Results: Zinc (ICP) B-73

B2-42 Tank 241-S-104 Analytical Results: Zirconium (ICP) B-75

B2-43 Tank 241-S-104 Analytical Results: Ammonium (Distillation (NH3). B-76

B2-44 Tank 241-S-104 Analytical Results: Ammonium (Distillation) B-76

B2-45 Tank 241-S-104 Analytical Results: Carbonate (TIC) B-77

B2-46 Tank 241-S-104 Analytical Results: Chloride (IC) B-77

B2-47 Tank 241-S-104 Analytical Results: Cyanide B-78

B2-48 Tank 241-S-104 Analytical Results: Fluoride (IC) B-79

B2-49 Tank 241-S-104 Analytical Results: Hydroxide (OH Automatic) B-79

B2-50 Tank 241-S-104 Analytical Results: Nitrate (IC) B-80

B2-51 Tank 241-S-104 Analytical Results: Nitrite (IC) B-80

B2-52 Tank 241-S-104 Analytical Results: Nitrite (Spectrophotometric) B-81

B2-53 Tank 241-S-104 Analytical Results: Phosphate (IC) B-82

B2-54 Tank 241-S-104 Analytical Results: Sulfate (IC) B-83

B2-55 Tank 241-S-104 Analytical Results: Americium-241 (GEA) B-84

LIST OF TABLES (Continued)

B2-56 Tank 241-S-104 Analytical Results: Americium-241 (Alpha Spectrometry) . . . B-85

B2-57 Tank 241-S-104 Analytical Results: Carbon-14 . . . . . B-85

B2-58 Tank 241-S-104 Analytical Results: Cesium-137 (GEA) B-86

B2-59 Tank 241-S-104 Analytical Results: Cobalt-60 (GEA) B-87

B2-60 Tank 241-S-104 Analytical Results: Europium-154 (GEA) B-87

B2-61 Tank 241-S-104 Analytical Results: Europium-155 (GEA) B-88

B2-62 Tank 241-S-104 Analytical Results: Iodine-129 . . . . . B-89

B2-63 Tank 241-S-104 Analytical Results: Neptunium-237 . . . . . B-89

B2-64 Tank 241-S-104 Analytical Results: Plutonium-238 (Alpha Spectrometry) B-90

B2-65 Tank 241-S-104 Analytical Results: Plutonium-238 to Plutonium Ratio (Mass Spectrometry) B-90

B2-66 Tank 241-S-104 Analytical Results: Plutonium-239/40 (Alpha Spectrometry) B-91

B2-67 Tank 241-S-104 Analytical Results: Plutonium-239 to Plutonium Ratio (Mass Spectrometry) B-91

B2-68 Tank 241-S-104 Analytical Results: Plutonium-240 to Plutonium Ratio (Mass Spectrometry) B-92

B2-69 Tank 241-S-104 Analytical Results: Plutonium-241 to Plutonium Ratio (Mass Spectrometry) B-92

B2-70 Tank 241-S-104 Analytical Results: Plutonium-242 to Plutonium Ratio (Mass Spectrometry) B-93

B2-71 Tank 241-S-104 Analytical Results: Selenium-79 . . . . . B-93

B2-72 Tank 241-S-104 Analytical Results: Strontium-90 . . . . . B-94

B2-73 Tank 241-S-104 Analytical Results: Technetium-99 . . . . . B-94

LIST OF TABLES (Continued)

B2-74 Tank 241-S-104 Analytical Results: Tritium (Liquid Scintillation) B-95

B2-75 Tank 241-S-104 Analytical Results: Uranium-234 to Uranium Ratio (Mass Spectrometry) B-95

B2-76 Tank 241-S-104 Analytical Results: Uranium-235 to Uranium Ratio (Mass Spectrometry) B-96

B2-77 Tank 241-S-104 Analytical Results: Uranium-236 to Uranium Ratio (Mass Spectrometry) B-96

B2-78 Tank 241-S-104 Analytical Results: Uranium-238 to Uranium Ratio (Mass Spectrometry) B-97

B2-79 Tank 241-S-104 Analytical Results: Total Alpha B-97

B2-80 Tank 241-S-104 Analytical Results: Total Alpha Plutonium B-98

B2-81 Tank 241-S-104 Analytical Results: Ratio of Total Alpha to Plutonium + Americium B-98

B2-82 Tank 241-S-104 Analytical Results: Total Beta (Alpha Radiation) B-99

B2-83 Tank 241-S-104 Analytical Results: Total Beta B-99

B2-84 Tank 241-S-104 Analytical Results: Ratio of Total Beta to Cesium + Strontium B-99

B2-85 Tank 241-S-104 Analytical Results: Percent Water (TGA) B-100

B2-86 Tank 241-S-104 Analytical Results: Percent Water (Percent Solids) B-101

B2-87 Differential Scanning Calorimetry (DSC) B-102

B2-88 Tank 241-S-104 Analytical Results: pH Measurement B-104

B2-89 Tank 241-S-104 Analytical Results: Total Organic Carbon (Furnace Oxidation) B-104

B2-90 Tank 241-S-104 Analytical Results: Total Organic Carbon (Furnace Oxidation) B-105

LIST OF TABLES (Continued)

B2-91 Tank 241-S-104 Analytical Results: Specific Gravity B-105

B2-92 Tank 241-S-104 Analytical Results: Centrifuged Solids Density B-105

B2-93 Tank 241-S-104 Analytical Results: Centrifuged Supernatant Density B-105

B2-94 Tank 241-S-104 Analytical Results: Density B-106

B2-95 Tank 241-S-104 Analytical Results: Settled Solids B-106

B2-96 Tank 241-S-104 Analytical Results: Volume Percent Centrifuged Solids B-106

B2-97 Tank 241-S-104 Analytical Results: Weight Percent Centrifuged Solids B-106

B2-98 Tank 241-S-104 Analytical Results: Weight Percent Solids B-107

B2-99 Tank 241-S-104 Analytical Results: Weight Percent Undissolved Solids B-107

B2-100 Tank 241-S-104 Analytical Results: Extractible Organic Halides B-107

B2-101 Tank 241-S-104 Analytical Data: Volatile Organic Analyses B-108

B2-102 Tank 241-S-104 Analytical Results: Dodecane (VOA) B-109

B2-103 Tank 241-S-104 Analytical Results: Hexamethyl Disiloxane (VOA) B-109

B2-104 Tank 241-S-104 Analytical Results: Methoxytrimethyl Silane (VOA) B-110

B2-105 Tank 241-S-104 Analytical Results: Trimethyl Silanol (VOA) B-110

B2-106 Tank 241-S-104 Analytical Data: Semivolatile Organic Analyses (SVOA) B-111

B2-107 Tank 241-S-104 Analytical Results: Dodecane (SVOA) B-112

B2-108 Tank 241-S-104 Analytical Results: Pentadecane (SVOA) B-112

B2-109 Tank 241-S-104 Analytical Results: Tetradecane (SVOA) B-112

LIST OF TABLES (Continued)

B2-110 Tank 241-S-104 Analytical Results: Tridecane (SVOA) B-113

B3-1 Tank 241-S-104 Comparison of Gross Beta Activities with the Total of the Individual Activities B-116

B3-2 Tank 241-S-104 Comparison of Gross Alpha Activities with the Total of the Individual Activities B-116

B3-3 Cation Mass and Charge Data B-118

B3-4 Anion Mass and Charge Data B-118

B3-5 Mass Balance Totals B-118

B3-6 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Composite Sample Data B-120

B3-7 Analytical-Based Inventory for Composite Sample Data for Tank 241-S-104 . . . . . B-124

C1-1 95 Percent Confidence Interval Upper Limits for Total Alpha for Tank 241-S-104 . . . . . C-4

D2-1 Sampling-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-S-104 . . . . . D-4

D2-2 Sampling and HDW Model Predicted Inventory Estimates for Radioactive Components in Tank 241-S-104 (Radionuclides degraded to February 1994) . . D-5

D3-1 Technical Process Flowsheet and Los Alamos National Laboratory Defined Waste Streams D-8

D3-2 Concentrations of Components in REDOX Process Sludges and 241-S-104 Inventory Calculations D-9

D3-3 Comparison of Selected Component Inventory Estimates for Tank 241-S-104 Waste. D-11

LIST OF TABLES (Continued)

D4-1 Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-104 (December 4, 1996) D-15

D4-2 Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-104 (Radionuclides decayed to January 1, 1994) (December 4, 1996) D-16

LIST OF TERMS

AEA	alpha energy analysis
ANOVA	analysis of variance
Btu/hr	British thermal units per hour
Ci	curies
Ci/L	curies per liter
CVAA	cold vapor atomic absorption spectrometry
cm	centimeter
CWR	REDOX cladding waste
CWR1	REDOX cladding waste 1952-60
df	degrees of freedom
DQO	data quality objectives
DSC	differential scanning calorimetry
ft	feet
ft/sec	feet per second
g	gram
gal/min	gallons per minute
GEA	gamma energy analysis
g/cm^3	grams per cubic centimeter
g/L	grams per liter
g/mL	grams per milliliter
HDW	Hanford defined waste
IC	ion chromatography
ICP	inductively coupled plasma spectroscopy
in.	inch
J/g	joules per gram
kg	kilogram
kg/L	kilograms per liter
kgal	kilogallon
kL	kiloliter
kW	kilowatt
L	liter
L/min	liters per minute
LEL	lower explosive limit
LL	lower limit
m	meter
M	moles per liter
mL	milliliters
mL/L	milliliters per liter
mm	millimeter
m/sec	meters per second

LIST OF TERMS (Continued)

n/a	not applicable
n/d	not detected
n/r	not reported
OH	free hydroxide
Pa	pascals
Pa sec	pascal seconds
ppm	parts per million
ppmv	parts per million volume
pH	hydrogen potential
PHMC	Project Hanford Management Contractor
QC	quality control
R	REDOX (used to denote various REDOX wastes)
R1	REDOX waste 1952-57
R2	REDOX waste 1958-66
REDOX	reduction and oxidation
RSltCk	REDOX saltcake
SMM	supernatant mixing model
SpG	specific gravity
SVOA	semivolatile organic analysis
TCR	tank characterization report
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TLM	tank layer model
TOC	total organic carbon
TWRS	Tank Waste Remediation System
UL	upper limit
VOA	volatile organic analysis
W	watts
WSTRS	waste status and transaction record summary
wt%	weight percent
μCi/g	microcuries per gram
μCi/gal	microcuries per gallon
μCi/mL	microcuries per milliliter
μeq/g	microequivalents per gram
μg	microgram
μg/g	micrograms per gram
μg/L	micrograms per liter
μg/mL	micrograms per milliliter
μm	micrometers
°C	degrees Celsius
°F	degrees Fahrenheit

1.0 INTRODUCTION

One of the major functions of the Tank Waste Remediation System (TWRS) is to characterize wastes in support of waste management and disposal activities at the Hanford Site. Analytical data from sampling and analysis, along with other available information about a tank, are compiled and maintained in a tank characterization report (TCR). This report and its appendixes serve as the TCR for single-shell tank 241-S-104. The objectives of this report are: 1) to use characterization data in response to technical issues associated with 241-S-104 waste; and 2) to provide a standard characterization of this waste in terms of a best-basis inventory estimate. The response to technical issues is summarized in Section 2.0, and the best-basis inventory estimate is presented in Section 3.0. Recommendations regarding safety status and additional sampling needs are provided in Section 4.0. Supporting data and information are contained in the appendixes. This report also supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1996) milestone M-44-05.

1.1 SCOPE

Characterization information presented in this report originated from sample analyses and known historical sources. While only the results of recent sample events will be used to fulfill the requirements of the data quality objectives (DQOs), other information can be used to support (or question) conclusions derived from these results. Historical information for tank 241-S-104, provided in Appendix A, included surveillance information, records pertaining to waste transfers and tank operations, and expected tank contents derived from a process knowledge model.

The 1992 core sampling and 1996 vapor sampling events are described in Table 1-1. Further sampling and analysis data from these events, as well as data from earlier sampling events, are summarized in Appendix B. The sampling and analyses of 1992 core samples were performed in accordance with Winters et al. (1990) (amended by Hill et al. [1991]), and the results were originally reported in Kocher (1993). 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-S-104 and its respective waste types is contained in Appendix E. The reports listed in Appendix E may be found in the Lockheed Martin Hanford Corporation Tank Characterization Resource Center.

Table 1-1. Summary of Recent Sampling.

Sample/Date	Phase	Location	Segmentation	% Recovery
Vapor sample (March 19, 1996)	Gas	Tank headspace, 6 m (20 ft) below top of riser	n/a	n/a
Cores 42, 43, & 44 (July 29, 1992 to August 2, 1992)	Solid	Risers 3, 7, & 2	Segmentation and composite	Good recovery

Note:
n/a = not applicable

1.2 TANK BACKGROUND

Tank 241-S-104, located in the 200 West Area S Tank Farm, was constructed from 1950 to 1951 and went into service in 1953 when it received reduction and oxidation (REDOX) waste from the REDOX Plant. Throughout the service life of the tank, REDOX-process-associated waste made up the majority of the waste received. Tank 241-S-104 is the first tank in a cascade with tanks 241-S-105 and 241-S-106 (Brevick et al. 1996). The tank has an operational capacity of 2,870 kL (758 kgal), and currently contains 1,113 kgal (294 kgal) of non-complexed waste, existing primarily as sludge. Approximately 106 kL (28 kgal) of drainable interstitial liquid is in the sludge, and 4 kL (1 kgal) of supernatant remains on top of the sludge. The tank is not classified as a Watch List tank (Public Law 101-510); however, it was declared an assumed leaker in 1968, having lost nearly 90.8 kL (24 kgal) of waste. The tank was primary stabilized in 1979 and interim stabilized in 1984, and intrusion prevention was completed in 1988. There are no Unreviewed Safety Questions associated with tank 241-S-104.

Table 1-2. Description of Tank 241-S-104.

TANK DESCRIPTION	
Type	Single-shell
Constructed	1950-1951
In-service	1953
Diameter	22.9 m (75.0 ft)
Operating depth	7.0 m (23 ft)
Capacity	2,870 kL (758 kgal)
Bottom shape	Dish
Ventilation	Passive
TANK STATUS	
Waste classification	Non-complexed
Total waste volume[1]	1,113 kL (294 kgal)
Supernatant volume	4 kL (1 kgal)
Saltcake volume	0 kL (0 kgal)
Sludge volume	1,109 kL (293 kgal)
Drainable interstitial liquid volume	106 kL (28 kgal)
Waste surface level (October 2, 1996)	286 cm (112.5 in.)
Temperature (November 1991 to December 1996)	39 °C (102 °F) to 45 °C (113 °F)
Integrity	Assumed leaker
Watch List	None
SAMPLING DATE	
Core samples	July and August 1992
SERVICE STATUS	
Declared inactive	1977
Interim stabilization	1984
Intrusion prevention	1988

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

This page intentionally left blank.

2.0 RESPONSE TO TECHNICAL ISSUES

One technical issue has been identified for tank 241-S-104 (Brown et al. 1996):

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

Data from three core samples taken in 1992 and flammability screening of the headspace in 1996 provided the means to partially address this issue. The response is detailed in the following sections. See Appendix B for sample and analysis data for tank 241-S-104.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-S-104 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. Because tank 241-S-104 is not a Watch List tank, the safety screening DQO was the only safety-related DQO associated with the data analysis effort.

Even though core sampling of tank 241-S-104 preceded the implementation of the DQO process for addressing tank waste issues, the core sampling was consistent with the guidance of the DQO (two full-length cores from widely spaced risers). However, analysis of the core samples was conducted differently from the guidance of the current DQO. Nevertheless, the data collected can be used to address safety screening issues.

2.1.1 Exothermic Conditions (Energetics)

The first requirement outlined in the safety screening DQO (Dukelow et al. 1995) is to ensure that insufficient fuel exists in tank 241-S-104 to pose a safety hazard. The safety screening DQO required that the waste sample profile be tested for energetics every 24 cm (9.5 in.) to determine if the energetics exceed the safety threshold limit. The threshold limit for energetics is 480 J/g on a dry weight basis.

Even though the subsampling scheme was not the same as currently prescribed, differential scanning calorimetry (DSC) was run on each segment and core composites. All the segment samples had no exotherms, but the composite sample from core 43 and core 44 had exotherms. The core 43 composite result was 4.5 J/g (wet weight) and the rerun showed no evidence of exotherms. The core 44 composite highest result was 74.3 J/g (wet weight basis). However, this result is questionable because all the segments from core 44 showed no evidence of exotherms. Furthermore, the thermogravimetric analysis (TGA) water result was 95 percent, indicating that the core 44 composite sample was not a good sample.

Historically, there is no evidence that any exothermic agent should exist in this waste. Waste transfer records indicate that the major waste type expected to be in the tank is REDOX waste (Agnew et al. 1996a), and the REDOX waste type is expected to have few organic or ferrocyanide constituents. Analysis of a liquid sample taken in 1974 (Wheeler 1974) showed no evidence of exotherms (see Appendix B).

2.1.2 Flammable Gas

Vapor phase measurements, taken in the tank headspace on March 19, 1996, indicated that no flammable gas was detected (0 percent of the lower flammability limit).

2.1.3 Criticality

The safety threshold limit is 1 g ^{239}Pu per liter of waste. Assuming that all alpha is from ^{239}Pu and assuming a density of 1.64 g/mL, 1 g/L of ^{239}Pu is equivalent to 37.5 μCi/g of alpha activity. Waste samples were tested for total alpha activity for each composite sample. Concentrations in all composite samples ranged between 0.3 and 0.8 μCi/g, well below the limit. Additionally, as required by the DQO, the upper limit of the one-sided 95 percent confidence interval for these results was less than 1 g/L. The method used to calculate confidence limits is contained in Appendix C.

2.2 OTHER TECHNICAL ISSUES

Other factors in assessing tank safety are heat generation and temperature of the waste. Heat is generated in the tanks from radioactive decay. The heat load estimate based on the tank process history was 4,940 W (16,900 Btu/hr) (Agnew et al. 1996b). The heat load estimate based on the tank headspace temperature was 3,093 W (10,563 Btu/hr) (Kummerer 1995). An estimate of the tank heat load based on the 1992 sample event was 3,910 W (13,400 Btu/hr). These estimates are well below the limit of 11,700 W (40,000 Btu/hr) that separates high- and low-heat-load tanks (Smith 1986).

2.3 SUMMARY

The results from all analyses performed, when applied to resolve safety issues, show that no safety decision threshold limits are exceeded. Although the sampling and analysis were not conducted as prescribed in the current DQO (Dukelow et al. 1995), the data are sufficient to declare the tank safe. The analyses results are summarized in Table 2-1.

Table 2-1. Summary of Safety Screening Results.

Issue	Sub-issue	Result
Safety screening	Energetics	No exotherms observed in any segment sample. Low exotherms observed in composite samples.
	Density	Only one segment measured (1.64 g/mL).
	Flammable gas	Vapor measurement reported 0 percent of lower flammability limit (combustible gas meter).
	Criticality	All analyses were between 0.3 and 0.8 μCi/g, well below 37.5 μCi/g total alpha (within 95 percent confidence limit on the mean for each sample).

This page intentionally left blank.

3.0 BEST-BASIS STANDARD 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. Waste management activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing the wastes into a form 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; and 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 (Agnew et al. 1996b). 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 information for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available chemical information for tank 241-S-104 was performed that included:

- Data from three push-mode core samples collected in 1992. See Appendix B, Section B2.0 for data.
- Data from pre-1989 analyses, used for informational purposes only
- The inventory estimate for this tank (Agnew et al. 1996) generated from the Hanford defined waste (HDW) model. See Section A3.2 for the model estimate.
- Analytical data from TCRs for tanks with the same REDOX sludge waste types (241-S-104, this TCR), 241-S-107 (Simpson et al. 1996) and 241-S-101 (Kruger et al. 1996). A list of references used in this evaluation is provided at the end of Appendix D (Section D5.0).

Based on this evaluation and available sampling information, a best-basis inventory was developed for tank 241-S-104. For the following reasons, the sampling-based inventory was chosen as the best basis for those analytes for which sampling-based analytical values were available.

- The engineering assessment supports the assumption that the sampling-based data appear reasonable, and the assessment could not substitute any additional information.

- For those few analytes where no values were available from the sampling-based inventory, the HDW model values were used with notation that they were of lower reliability.

- Investigation of the sample-based data revealed no cause for their rejection.

- The sample-based data were consistent with this tank's process history documentation.

The best-basis inventory for tank 241-S-104 is presented in Tables 3-1 and 3-2.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-104 (December 4, 1996). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, or E)[1]	Comment[2]
Al	214,000	S	
Bi	<74.9	S	Engineering assessment = 90.4
Ca	7,700	S	
Cl	5,840	S	
TIC as CO_3	7,560	S	
Cr	4,290	S	
F	292	E	
Fe	3,140	S	
Hg	74.5	M	
K	548	S	
La	2E-06	M	
Mn	1,890	S	
Na	220,000	S	
Ni	102	S	
NO_2	38,000	S	
NO_3	349,000	S	
OH	n/r		
Pb	65.7	E	The M value = 2,240

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-104 (December 4, 1996). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, or E)[1]	Comment[2]
P as PO_4	518	S	
Si	2,430	S	
S as SO_4	4,140	S	
Sr	774	S	
TOC	2,770	S	
U_{TOTAL}	12,200	S	
Zr	61.2	S	

Notes:

n/r = not reported
TIC = total inorganic carbon
TOC = total organic carbon

[1]S = Sample-based, M = HDW model-based, E = Engineering assessment-based.
[2]See Appendix D

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-104 (December 4, 1996).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	6.15	S	
^{14}C	1.64	S	
^{90}Sr	566,000	S	
^{90}Y	566,000	S	From ^{90}Sr
^{99}Tc	44.2	S	
^{137}Cs	114,000	S	
^{137m}Ba	107,000	S	From ^{137m}Cs
^{239}Pu	515	S	*includes ^{240}Pu

Notes:

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

This page left blank intentionally.

4.0 RECOMMENDATIONS

Core sampling of tank 241-S-104 occurred prior to implementation of the DQO process for TWRS characterization. Nevertheless, the data collected may be evaluated against the requirements of the current DQO. The current DQO applicable to the tank is the safety screening DQO (Dukelow et al. 1995). Analytical results for the safety screening DQO were well within the safety notification limits. The data collected from core sampling are sufficient to conclude that the tank is safe with respect to the issues in the safety screening DQO.

Table 4-1 summarizes the status of TWRS Project Hanford Management Contractor (PHMC) Program review and acceptance of the sampling and analysis results reported in this TCR. All DQO issues required to be addressed by sampling and analysis are listed the first column of Table 4-1. The second column indicates with a "Yes" or "No" 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 responsible for the DQO that the sampling and analysis activities performed adequately meet the needs of the DQO. A "Yes" or "No" in column three indicates acceptance or disapproval of the sampling and analysis information presented in the TCR.

Table 4-1. Acceptance of Tank 241-S-104 Sampling and Analysis.

Issue	Sampling and Analysis Performed	PHMC TWRS Program Acceptance
Safety screening DQO	Yes	Yes

Table 4-2 summarizes the status of TWRS Program review and acceptance of the evaluations and other characterization information contained in this report. The evaluation specifically outlined in this report is 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.

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-S-104.

Issue	Evaluation Performed	PHMC TWRS Program Acceptance
Safety categorization (tank is safe)	Yes	Yes

The waste currently in tank 241-S-104 may continue to be safely stored in the tank without special action. In addition, no additional characterization efforts are needed at this time.

5.0 REFERENCES

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1996a, *Waste Status and Transaction Record Summary for the Northwest Quadrant of the Hanford 200 West Area*, WHC-SD-WM-TI-614, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

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

Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1996, *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 West Areas*, WHC-SD-WM-ER-352, Rev. 0B, Westinghouse Hanford Company, Richland, Washington.

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.

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

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

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

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

Kocher, K. L., 1993, *Single-Shell Waste Characterization Tank 241-S-104, Data Package*, WHC-SD-WM-DP-031, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Kruger, Albert A, B. J. Morris and L. J. Fergestrom, 1996, *Tank Characterization Report for Single-Shell Tank 241-S-101*, WHC-SD-WM-ER-613, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Kummerer, M., 1995, *Topical Report on Heat Removal Characteristics of Waste Storage Tanks*, WHC-SD-WM-SARR-010, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

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

Simpson, Brett C., J. G. Field, D. W. Engel and D. S. Daly, 1996, *Tank Characterization Report for Single-Shell Tank 241-S-107*, WHC-SD-WM-ER-589, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Smith, D. A., 1986, *Single-Shell Tank Isolation Safety Analysis Report*, WHC-SD-WM-SAR-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Wheeler, R. E., 1974, *Analysis of Tank Farm Samples, Sample T-4184 104-S*, (internal letter [number unknown] to R. L. Walser, August 12), Atlantic Richfield Company, Richland, Washington.

Winters, W. I., L. Jensen, L. M. Sasaki, R. L. Weiss, J. F. Keller, A. J. Schmidt, and M. G. Woodruff, 1990, *Waste Characterization Plan for the Hanford Site Single-Shell Tanks*, WHC-EP-0210, Rev.1, Westinghouse Hanford Company, Richland,

APPENDIX A

HISTORICAL TANK INFORMATION

This page intentionally left blank.

APPENDIX A

HISTORICAL TANK INFORMATION

Appendix A describes tank 241-S-104 based on historical information. For this report, historical information includes any information about the tank's fill history, waste types, surveillance, or modeling data. This information is necessary for providing a balanced assessment of the sampling and analytical results.

This appendix contains the following information:

- **Section A1**: Current status of the tank, including the current waste levels and the stabilization and isolation status of the tank.
- **Section A2**: Information about the design of the tank.
- **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-S-104, including surface-level readings, temperatures, and a description of the waste surface based on photographs.
- **Section A5**: References for Appendix A.

Historical sampling results (samples obtained prior to 1989) are included in Appendix B.

A1.0 CURRENT TANK STATUS

As of September 30, 1996, tank 241-S-104 contained 1,113 kL (294 kgal) of waste. The waste volumes were estimated using a manual tape surface level gauge (Hanlon 1996). The tank contents summary is contained in Table A1-1.

Tank 241-S-104 is passively vented to the atmosphere through a breather filter (Bergmann 1991) and is not on the Watch List (Public Law 101-510). All monitoring systems are currently in compliance with documented standards (Hanlon 1996). Current temperature data indicate that the maximum temperature in the tank is 45 °C (113 °F). Tank 241-S-104 is listed as a low-heat-load tank (Hanlon 1996).

Table A1-1. Tank Contents Status Summary.[1]

Waste Type	kL (kgal)
Total waste	1,113 (294)
Supernatant	4 (1)
Sludge[1]	1,109 (293)
Saltcake[1]	0 (0)
Drainable interstitial liquid	106 (28)
Drainable liquid remaining	110 (29)
Pumpable liquid remaining	87 (23)

Notes:
[1]Hanlon (1996)

The current designation of the tank contents is non-complexed waste. This is a general term to describe waste that does not have a high content of carbon complexants or organic carbon. The tank is an assumed leaker, has been interim stabilized, and has undergone intrusion prevention (Hanlon 1996).

A2.0 TANK DESIGN AND BACKGROUND

Tank 241-S-104 is a carbon steel tank within a reinforced concrete shell and dome. As described in the *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 West Area* (Brevick et al. 1995), the tank has a diameter of 22.9 m (75 ft), an operating depth of 7.0 m (23 ft), and a capacity of 2,870 kL (758 kgal). The basic design of tank 241-S-104 is shown in Figure A2-1. Instruments access tank 241-S-104 through risers and monitor the pressure, temperature, sludge level, and other bulk tank characteristics (Bell 1994). The positions of these risers are shown in Figure A2-2. The tank 241-S-104 risers and their sizes and general use are listed in Table A2-1.

The 241-S Tank Farm was built in 1950 and 1951. It is located at the southern end of the 200 West Area. Figure A2-3 details the Hanford Site's 200 West Area and the location of the 241-S Tank Farm. Tank 241-S-104 is located on the eastern side of the second row of the 241-S Tank Farm.

Tank 241-S-104 is the first, or primary, tank in a "cascade" connecting it to tanks 241-S-105 and 241-S-106. A cascade is a system in which a number of tanks are connected in

Figure A2-1. Tank 241-S-104 Cross Section and Schematic.

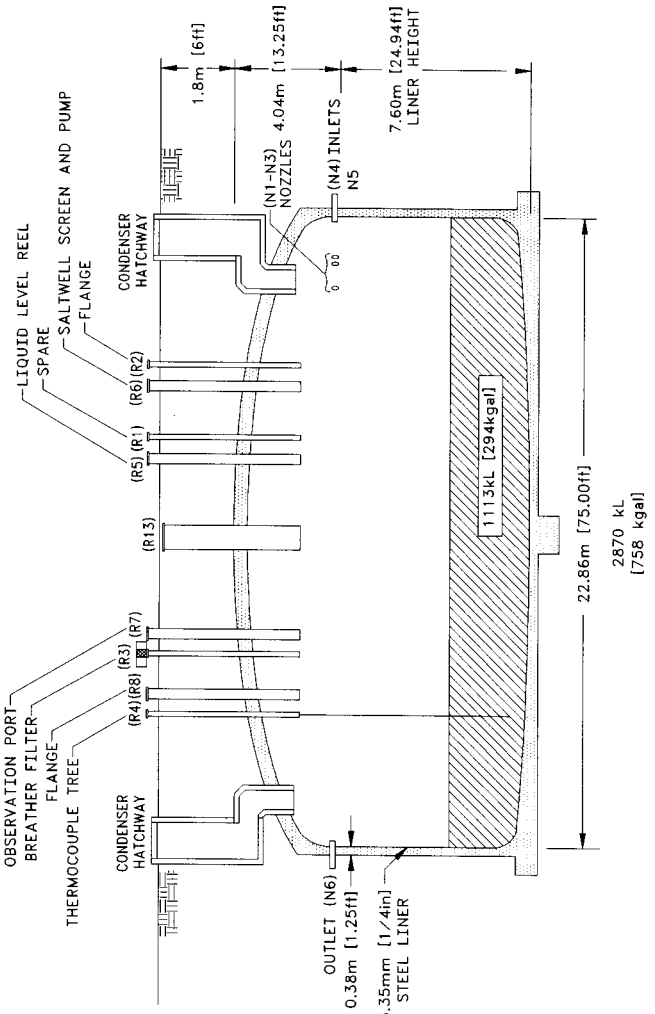


Figure A2-2. Riser Configuration for Tank 241-S-104.

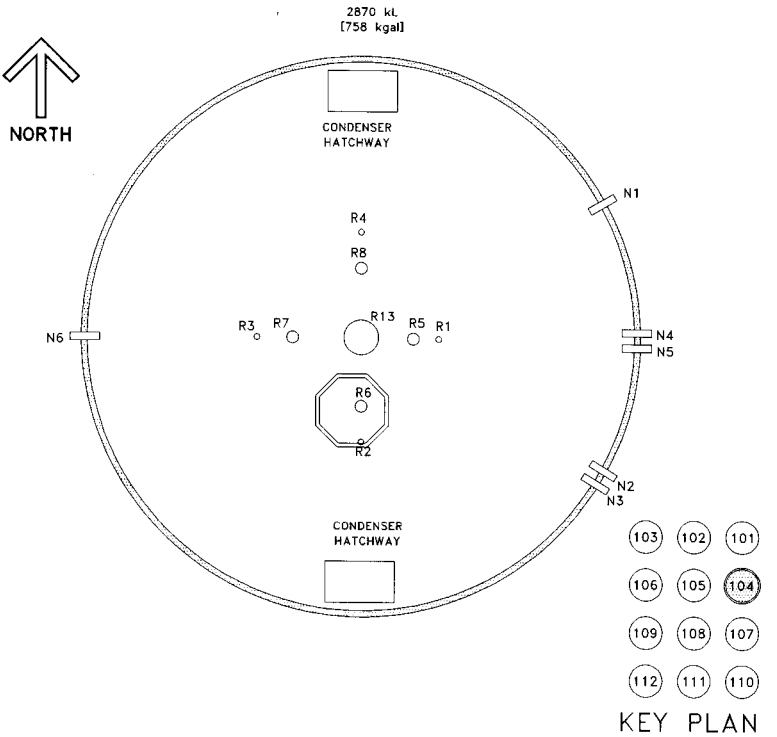


Table A2-1. Tank 241-S-104 Risers.[1] (2 sheets)

Number	Diameter (in.)	Description and Comments[2]
R1*	4	Spare (Blank CEO-41057 2/27/87)
R2	4	Flange (Benchmarked CEO-36908 12/11/86) (Steel LOW ECN-614180 9/27/94)
R3*	4	Breather filter (Breather filter CEO-41057 2/27/87) (Breather filter/vapor sampling assembly ECN-601024 8/10/93)
R4	4	Thermocouple tree
R5	12	Liquid level reel (Benchmark CEO-36908 12/11/86 and ECN-614184 10/31/94)
R6	12	Saltwell screen and pump
R7*	12	B-222 observation port (Benchmark CEO-36908 12/11/86) (Benchmark ECN-614184 10/31/94)
R8*	12	Blind flange
R13	42	Pump, weather covered in pit
N1	3	Spare nozzle, capped
N2	3	Spare nozzle, capped
N3	3	Spare nozzle, capped
N4	3	Inlet line V539, sealed in Diversion Box 241-S-151
N5	3	Inlet line V538, sealed in Diversion Box 241-S-151
N6	3	Overflow

Notes:

*Denotes risers tentatively available for sampling (Lipnicki 1996).

CEO = change engineering order
ECN = engineering change notice
LOW = liquid observation well

[1]Alstad (1993), Lipnicki (1996)
[2]Dates shown in mm/dd/yy format

series by pipes. The pipes are located at the top of the tanks' working depths. When the cascade system was in use, waste added to the primary tank would flow to the next tank without overfilling the primary tank. By using a cascade, fewer connections needed to be made during waste handling operations. The cascade method reduced waste handling requirements, personnel exposure, and the chance of a loss of tank integrity from waste overflow. Another advantage of using the cascade system was waste volume reduction from the disposal of clarified liquid waste. Entrained solids and precipitates would most likely settle in the primary tank (in this case, tank 241-S-104), and the clarified liquids would flow through the cascade to the secondary tanks (241-S-105 and 241-S-106). Historically, this practice led to the rapid accumulation of solids in the primary tank, and allowed the disposal of clarified liquid from the secondary tanks into cribs.

Tank 241-S-104 went into service in 1953 when it received REDOX process waste (Anderson 1990). This waste was produced during the recovery of plutonium from nuclear fuel. The REDOX waste cascaded to tank 241-S-105 and on to tank 241-S-106. This cascade line was not used after 1956. Waste from tank 241-S-104 has been discharged to various tanks and to cribs. Tank 241-S-104 received its last waste additions in 1965. After losing 90.8 kL (24 kgal) of waste, the tank was declared an assumed leaker and was taken out of service in 1968 (Brevick et al. 1995). Four dry wells were drilled and most of the supernatant was removed in 1970. A pump was installed in 1974, and salt well pumping was completed in 1976. In 1978, a jet pump was installed (Welty 1988). The tank was primary stabilized in 1979 (Welty 1988), and interim stabilized in December 1984 (Swaney 1994). Primary stabilization involved removal of most of the supernatant and much of the interstitial liquid in the tank. Removing liquids minimizes the risk of waste leaking out of the tank. Interim stabilization, in this case, was an administrative designation with requirements similar to primary stabilization. Intrusion prevention was completed on tank 241-S-104 in 1988. Intrusion prevention involves the completion of the physical effort required to minimize the potential for liquids to be inadvertently added to an inactive storage tank.

A3.0 PROCESS KNOWLEDGE

The sections below: 1) provide information about the transfer history of tank 241-S-104; 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-S-104 (Agnew et al. 1996a). Tank 241-S-104 began its service life in 1953 when it received REDOX process waste. This waste was produced during the recovery of plutonium and uranium from nuclear fuel. The tank also received small amounts of REDOX-process-associated wastes: salt waste,

laboratory waste, hot condensate containing moderate levels of radionuclides, coating waste, and centrifuge cake waste in multiple transfers (Anderson 1990). All these wastes were produced at the REDOX Plant. Tank 241-S-104 reached its maximum operating level during the second quarter of 1953, and further additions caused the waste to cascade to tank 241-S-105.

The wastes in tank 241-S-104 began to self-boil in 1953. In that same year, surface condensers were installed. The surface condensers allowed concentration of wastes by disposing of vapor condensate to cribs. These condensers operated between 1953 and 1956.

Waste from the REDOX Plant continued to be added to tank 241-S-104 until 1955. At that time, use of this cascade system was stopped. Flush water was also added to the tank in 1955. The tank received supernatant waste from tank 241-S-107 in the second quarter of 1965. The tank was assumed to be leaking in 1968. Approximately half of the tank volume was transferred to tank 241-TY-103 in 1970. Additional supernatant was transferred out of the tank to tank 241-S-107 in 1974 and 1975. A graphical waste volume history of tank 241-S-104 is included as Figure A4-1.

Table A3-1. Tank 241-S-104 Major Transfers.[1]

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Waste Volume	
				kL	kgal
REDOX	241-S-104	R, CWR	1953	8,502	2,244
S-104	241-S-105	R, CWR	1953	5,610	1,482
S-104	S-003 Crib	Condensate	1953-1956	2,188	578
REDOX	241-S-104	R, CWR	1954-1955	1,768	467
Miscellaneous sources	241-S-104	Water	1955	136	36
S-107	241-S-104	Supernatant	1965	363	96
S-104	Evaporator	R, CWR	1969		652
Evaporator	241-S-104	RSltCk	1969		652
S-104	241-TY-013	Supernatant	1970		474
	241-S-107	Supernatant	1974	30	8

Notes:

R = REDOX (used to denote various REDOX wastes)
RSltCk = REDOX saltcake
CWR = Coating waste from decladding of aluminum clad fuel in the REDOX Plant (REDOX cladding waste)

[1]Agnew (1996)

A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS

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

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

- *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev 4* (Agnew et al. 1997). This document contains the HDW list, the supernatant mixing model (SMM), and the tank layer model (TLM).

- *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 West Areas* (Brevick et al. 1995). This document compiles and summarizes much of the process history, design, and technical information regarding the underground waste storage tanks in the southwest quadrant of the Hanford Site 200 West Area.

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

- Supernatant mixing model (SMM). The SMM is a subroutine within the HDW model that calculates the volume and composition of certain supernatant blends and concentrates.

Using these records, the TLM defines the sludge and saltcake layers in each tank. The SMM uses information from both the WSTRS and the TLM to describe the supernatants and concentrates in each tank. Together the WSTRS, TLM, and SMM determine each tank's inventory estimate. These model predictions are considered estimates that require further evaluation using analytical data.

The major waste types received by tank 241-S-104 were REDOX process waste (R) and REDOX cladding waste (CWR).

Based on the TLM, Figure A3-1 shows a graphical representation of the estimated waste type and volume for the tank layer. The waste types present for this tank are R waste, CWR waste, and R saltcake (RSltCk). RSltCk waste is assumed to be from waste self-concentrating within the tank. R1 waste is REDOX waste generated between 1952 and 1957, and CWR1 waste is REDOX waste with aluminum-clad fuel, generated between 1952 and 1960.

Figure A3-1. Tank Layer Model.

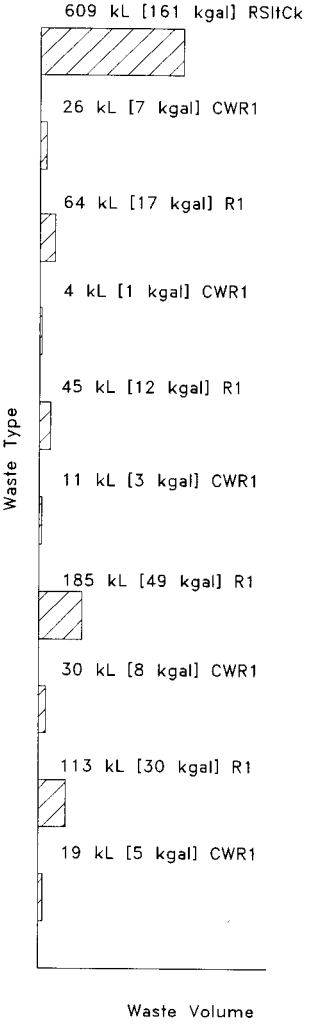


Table A3-2 shows the historical estimate of the expected waste constituents and their concentrations.

Table A3-2. Historical Tank Inventory Estimate.[1,2,3] (2 sheets)

Single-Shell Tank 241-S-104			
Total Inventory Estimate			
Physical Properties			
Total waste	1.93E+06 kg	(294 kgal)	
Heat load	4.67 kW	(1.60E+04 Btu/hr)	
Bulk density[4]	1.73 (g/cm^3)		
Water wt%[4]	31.1		
TOC wt% C (wet)[4]	2.86E-03		
Chemical Constituents	***M***	**ppm**	**kg**
Na+	11.0	1.46E+05	2.82E+05
Al^{3+}	5.34	8.32E+04	1.60E+05
Fe^{3+} (total Fe)	0.395	1.27E+04	2.46E+04
Cr^{3+}	0.473	1.42E+04	2.74E+04
Bi^{3+}	3.78E-06	0.456	0.879
La^{3+}	9.31E-12	7.47E-07	1.44E-06
Hg^{2+}	3.34E-04	38.6	74.5
Zr (as $ZrO(OH)_2$)	3.77E-07	1.99E-02	3.83E-02
Pb^{2+}	9.70E-03	1.16E+03	2.24E+03
Ni^{2+}	2.70E-02	914	1.76E+03
Sr^{2+}	0	0	0
Mn^{4+}	2.75E-05	0.873	1.68
Ca^{2+}	0.133	3.07E+03	5.42E+03
K^+	2.19E-02	494	951
OH^-	23.1[4]	2.26E+05	4.36E+05
NO_3^-	4.87	1.74E+05	3.36E+05
NO_2^-	1.64	4.36E+04	8.41E+04
CO_3^{2-}	0.135	4.69E+03	9.04E+03
PO_4^{3-}	2.45E-04	13.4	25.9
SO_4^{2-}	2.68E-02	1.48E+03	2.86E+03
Si (as SiO_3^{2-})	7.59E-02	1.23E+03	2.37E+03
F^-	1.95E-04	2.14	4.12

Table A3-2. Historical Tank Inventory Estimate.[1,2,3] (2 sheets)

Single-Shell Tank 241-S-104			
Total Inventory Estimate			
Chemical Constituents	*M*	ppm	kg
Cl^-	9.30E-02	1.90E+03	3.67E+03
$C_6H_5O_7^{3-}$	2.02E-04	22.0	42.4
$EDTA^{4-}$	7.85E-06	1.31	2.52
$HEDTA^{3-}$	6.52E-06	1.03	1.99
$glycolate^-$	2.84E-04	12.3	3.7
acetate	2.95E-05	1.01	1.94
$oxalate^{2-}$	1.22E-11	6.20E-07	1.19E-06
DBP	1.79E-04	21.7	41.8
butanol	1.79E-04	7.65	14.7
NH_3	0.114	1.12E+03	2.15E+03
$Fe(CN)_6^{4-}$	0	0	0
Radiological Constituents			
Pu	5.79E-03 g/L		6.44 (kg)
U	2.29E-02 (*M*)	3.15E+03 (μg/g)	6.07E+03 (kg)
Cs	0.199 (Ci/L)	115 (μCi/g)	2.21E+05 (Ci)
Sr	0.485 (Ci/L)	280 (μCi/g)	5.40E+05 (Ci)

Notes:

DBP = dibutyl phosphate
wt% = weight percent

[1]Unknowns in the tank solids inventory are assigned by the TLM.
[2]Volume average for density, mass average water wt% and TOC weight percent carbon (wt% C).
[3]Historical tank inventory predictions have not been validated and should be used with caution.
[4]Total OH, not free OH

A4.0 SURVEILLANCE DATA

Tank 241-S-104 surveillance consists of surface-level measurements (liquid and solid), temperature monitoring inside the tank (waste and headspace), and leak detection well (drywell) monitoring for radioactivity outside the tank. Surveillance data provide the basis for determining tank integrity.

Liquid-level measurements can indicate if the tank has a major leak. Solid surface-level measurements provide an indication of physical changes in and consistencies of the solid layers of a tank. Drywells located around the tank perimeter may show increased radioactivity as a result of leaks.

A4.1 SURFACE-LEVEL READINGS

Tank 241-S-104 is categorized as an assumed leaker. To determine the surface level of the waste, tank 241-S-104 is equipped with a manual tape gauge. The manual tape uses a conductivity probe lowered by a hand crank until contact is made with the waste surface and an electric circuit is completed. The measurement is later manually recorded on the Surveillance Analysis Computer System.

Surface-level readings are currently being taken quarterly. A recent manual tape reading was 2.86 m (112.5 in.), taken October 2, 1996. As is expected with an interim stabilized, out-of-service tank, the waste level in tank 241-S-104 has remained very consistent for several years. A level history graph of the volume measurements is presented in Figure A4-1.

A4.2 INTERNAL TANK TEMPERATURES

To measure local tank temperatures, a probe with 14 thermocouples assembled in a pipe (called a thermocouple tree) is inserted into tank 241-S-104 through riser 4. The thermocouple on the tree monitors the waste temperatures at various levels in the tank. Data are only available after January 1995 for thermocouples 1 through 6 and 11.

Temperature readings for tank 241-S-104 since 1991 are plotted in Figure A4-2. Each plotted temperature is the highest of the readings recorded by the thermocouples on the thermocouple tree. The highest temperatures observed in the tank are at 1.5 to 2.3 m (60 to 90 in.) from the bottom. No temperature readings are available before 1991, most likely because no temperature readings were taken or because temperature data sheets were misplaced and thus not available when the database was later compiled. Temperatures are taken biannually, and the last available maximum temperature reading for tank 241-S-104 was 41.1 °C (106 °F), taken on January 13, 1997. Figure A4-2 illustrates that temperatures have been stable since 1991, ranging between 39 °C and 45.5 °C (102 °F and 114 °F).

Figure A4-1. Tank 241-S-104 Level History.

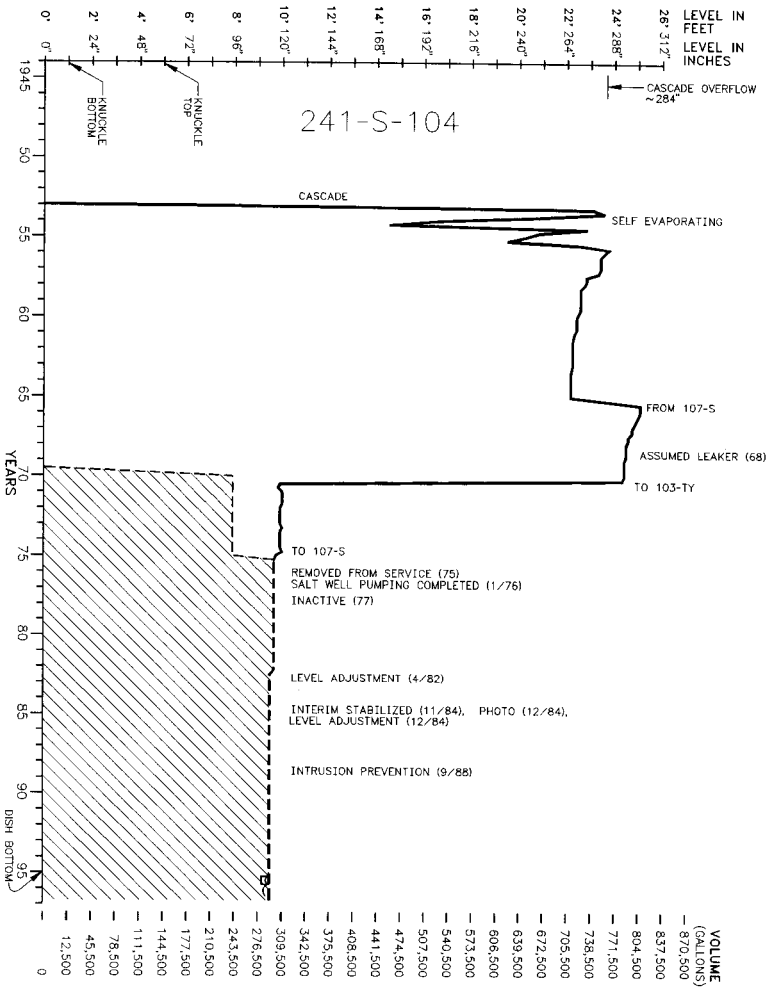
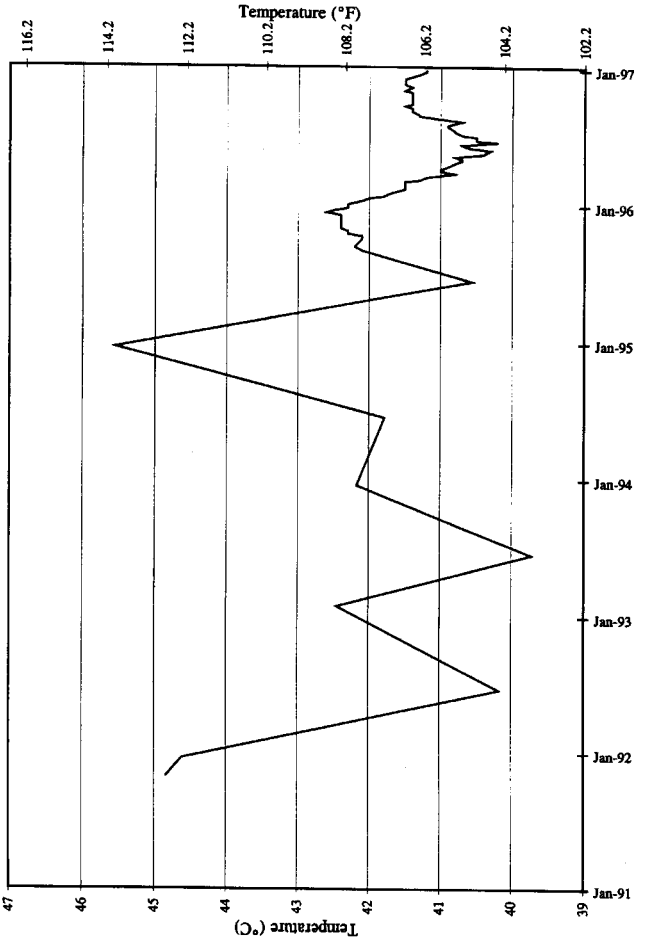


Figure A4-2. Tank 241-S-104 High Temperature Plot.



A4.3 TANK 241-S-104 PHOTOGRAPHS

The tank 241-S-104 photograph shows solid material over the entire tank surface except for a few small, randomly dispersed pools of yellow liquid. From samples taken in 1976 and 1992, the waste was described as gray, with the consistency of mud, dough, or putty. In the photograph, the waste appears brown. A salt well screen penetrates what appears to be the deepest pool of liquid remaining in the tank. A manual tape level measuring device and a temperature probe are also apparent. Because the photograph was taken after the tank was stabilized in 1984, it should represent the current tank conditions. The tank waste level has remained stable at almost 290 cm (114 in.), which equates to approximately 1,113 kL (294 kgal).

This page left blank intentionally.

A5.0 APPENDIX A REFERENCES

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, B. L. Young, 1996, *Waste Status and Transaction Record Summary for the Southwest Quadrant of the Hanford 200 West Area*, WHC-SD-WM-TI-614, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

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

Anderson, 1990, *A History of The 200 Area Tank Farms*, WHC-MR-0132, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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

Bergmann, L. M., 1991, *Single-Shell Tank Isolation Safety Analysis Report*, WHC-SD-WM-SAR-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1995, *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 West Areas*, WHC-SD-WM-ER-352, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B. L., 1996, *Tank Farm Surveillance and Waste Status Summary Report for Month Ending September 30, 1996,* WHC-EP-0182-102, Westinghouse Hanford Company, Richland, Washington.

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

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

Swaney, S. L., 1994, *Single-Shell Tank Stabilization Record,* WHC-SD-RE-TI-178, Rev. 4, Westinghouse Hanford Company, Richland, Washington.

Welty, R. K., 1988, *Waste Storage Tank Status and Leak Detection Criteria*, WHC-SD-WM-TI-356, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

APPENDIX B

SAMPLING OF TANK 241-S-104

This page intentionally left blank.

APPENDIX B

SAMPLING OF TANK 241-S-104

Appendix B provides sampling and analysis information for each known sampling event for tank 241-S-104 and provides an assessment of the core 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-S-104 will be appended to the above list.

B1.0 TANK SAMPLING OVERVIEW

This section describes the July 1992 sampling and analysis events for tank 241-S-104 core samples. These events were conducted as part of an overall plan to characterize the wastes in all underground storage tanks on the Hanford Site. The results of these analyses provide support for Tank Farm Operations and various other safety programs, aid in design of retrieval, pretreatment and disposal systems, and fulfill milestones contained in the Tri-Party Agreement (Bell 1994). Analytical data are available from two historical sampling events. The first sample was taken from tank 241-S-104 in 1974 (Wheeler 1974) and the second in was taken in 1976 (Horton 1976). These sample events are discussed in Section B1.4.

B1.1 DESCRIPTION OF SAMPLING EVENT

Samples were collected by push mode core sampling on July 29 and 30, 1992 from riser 3 (core 42), July 31 from riser 7 (core 43), and August 2 from riser 2 (core 44). Each core contained 6 segments. An additional segment, 6R, was taken for core 42. Normal paraffin hydrocarbon was used as the hydrostatic head fluid. For a diagram of riser locations, refer to Figure A2-2. Table B1-1 lists tank farm sample numbers, with the dates and sampling locations.

The core samples from tank 241-S-104 were obtained using a core sampling truck that has sampling equipment mounted on a rotating platform. A stainless-steel sampler was used to obtain a 48-cm (19-in.)-long and 2.5-cm (1-in.)-diameter core of waste (maximum volume of

187 mL). When the segment was captured within the sampler, it was sealed in a stainless-steel liner within a shipping cask to prevent sample liquid from being lost.

Although DQOs had not been formulated prior to this sampling event, the sampling locations and numbers would meet the requirements of the current DQOs. The sampling riser locations were separated radially to the maximum extent possible, and a full vertical profile of the waste was obtained from all three cores.

Table B1-1. Tank 241-S-104 Sample Numbers and Locations.

Core	Riser	Segment	Tank Farm Sample Number	Shipping Sample Number	Cask	Date Sampled
42	3	1	92-033	S92-018	1001C	7-29-92
42	3	2	92-034	S92-018	C1053	7-29-92
42	3	3	92-035	S92-018	C1017	7-29-92
42	3	4	92-036	S92-019	1012C	7-29-92
42	3	5	92-037	S92-019	C1042	7-29-92
42	3	6	92-038	S92-019	1003C	7-30-92
42	3	6R	92-038R	S92-020	C1046	7-30-92
43	7	1	92-039	S92-016	C1047	7-31-92
43	7	2	92-040	S92-016	C1033	7-31-92
43	7	3	92-041	S92-016	C1049	7-31-92
43	7	4	92-042	S92-017	1009C	7-31-92
43	7	5	92-043	S92-017	C1024	7-31-92
43	7	6	92-044	S92-017	C1032	7-31-92
44	2	1	92-045	S92-013	C1019	8-02-92
44	2	2	92-046	S92-013	C1027	8-02-92
44	2	3	92-047	S92-013	C1025	8-02-92
44	2	4	92-048	S92-014	1013C	8-02-92
44	2	5	92-049	S92-014	1011C	8-02-92
44	2	6	92-050	S92-014	C1030	8-02-92
Water samples				S92-015	1005C	

B1.2 SAMPLE HANDLING

Each sampler segment was remotely removed from the drill string, sealed within a stainless-steel liner, and placed inside a lead-shielded shipping cask. The segment number was recorded and the casks were transported to the 222-S Laboratory. All the segments were received by the laboratory on August 6 and 7, 1992. A chain-of-custody form was completed for each segment.

The samples were extruded at the 222-S Laboratory between August 11 and September 11, 1992 in preparation for inorganic and radiochemical analyses.

The samples obtained from core sampling activities in tank 241-S-104 were a mixture of air, liquids, and solids. After extrusion from the sampler, photographs were taken of the sample with the appropriate jar numbers and color chart showing in the same photograph. Visual characteristics of extruded samples were recorded in the appropriate log book, and careful attention was paid to sample volume, liquid/solid ratio, color, consistency, and homogeneity. Table B1-2 contains a description of the contents of each core segment (Kocher 1993).

Twenty-seven composite and segment samples were shipped to the Pacific Northwest National Laboratory for organic analysis. The samples received included subsamples of the composites, segments from the three cores, a field blank, and a 222-S Hot Cell blank.

Tables B1-3 and B1-4 show the Westinghouse Hanford Company's 222-S Laboratory and Pacific Northwest Laboratory sample numbers that correspond to the various composite and segment sample numbers. In Table B1-3, the heading "Percent Water" is included because the samples were used exclusively for the percent water determination. Whereas most other physical analyses were performed prior to homogenization, percent water was determined after homogenization and prior to separation of the sample into the solid and liquid fractions in preparation for performing the metal, ion, and radionuclide analyses.

Table B1-2. Sample and Extrusion Information for 241-S-104. (5 sheets)

Core	Segment	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
42	1	23.99-Drainable	190.14	Sample recovery was about 75 percent (214.13 g), including 23.99 g of drainable liquid.
	2	0.0	253.85	Sample recovery was 100 percent (253.85 g), with no drainable liquids. The consistency of the sample was like wet mud, gray in color, and homogeneous.
	3	0.0	223.96	The sampler valve was partially open. Approximately 100 g of tank waste adhered to the outside of the sampler and inside the sleeve. The waste was washed out of the sleeve with water. A total of 223.96 g of solids was recovered from the sample. There were no drainable liquids.
	4	0.0	274.45	The sampler was completely full of thick, gray solids (274.45 g). There were no drainable liquids.
	5	0.0	197.86	Sample recovery was 60 percent (197.86 g), with no drainable liquids. The segment was lighter in color on the bottom and darker and "liquidy" on the top. Except for a gradual increase in normal paraffin hydrocarbon concentration from bottom to top, the segment was homogeneous. The segment was very dry, and the volatile organic analysis sample was difficult to acquire without airspace.

Table B1-2. Sample and Extrusion Information for 241-S-104. (5 sheets)

Core	Segment	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
	6	0.0	96.95	The sampler valve was left open. The sample was 1/3 full of light gray solids (96.95 g). There were no drainable liquids. After sampling for weight percent water, segment 6 was blended with 6R (below).
42 (Cont'd)	6R	0.0	60.07	Sampler recovery was about 10 percent (60.07 g), with no drainable liquids. The solids were a light gray, very thick, and slightly moist. The waste was homogeneous, though with more normal paraffin hydrocarbon at the top of the segment. Approximately 100 mL of liner liquid, which appeared to be normal paraffin hydrocarbon, was collected and discarded.
43	1	32.93	154.32	Sample recovery was 75 percent (187.25 g) and contained about 30 mL of drainable liquids (32.93 g). Approximately 25 g of solids were at the surface, followed by approximately 50 mL of liquid. After this, there were solids to the top of the sample. Solids were liquidy, especially in the middle. A differential scanning calorimeter/thermogravimetric analysis was taken from the solids at the top. The solids possessed the consistency of butter and were gray-brown in color.
	2	0.0	266.58	Sample recovery was 100 percent (266.58 g), with no drainable liquids. The waste was gray, thicker at the bottom than at the top, appeared to be completely homogeneous, and possessed the consistency of wet mud. Gas bubbles accounted for about 2 percent of the total volume.

Table B1-2. Sample and Extrusion Information for 241-S-104. (5 sheets)

Core	Segment	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
43 (Cont'd)	3	0.0	248.03	The valve was left halfway open. Sample recovery was 100 percent (248.03 g), with no drainable liquids. Approximately 50 g of solid material escaped out of the sampler before the extruder tray was put into place. The sample was scraped from the top of the extruder table and placed in jar F-2049. Approximately 150 g of solids were washed out of the sampler sleeve. The sample was homogeneous and gray, with a mud-like consistency.
	4	0.0	287.28	Sample recovery was 100 percent (287.28 g), with no drainable liquids. The waste was very thick, and had the consistency of plaster of Paris. Solids were completely homogeneous and dark gray in color.
	5	0.0	276.83	Sample recovery was 80 percent (276.83 g), with no drainable liquids. The segment material was thicker at the bottom and gradually got thinner toward the top. The differential scanning calorimetry and thermogravimetric analysis samples were taken from both the bottom and the top. The volatile organic analysis sample contained material from the bottom and the top. The sample was light gray at the bottom and dark gray at the top.
	6	0.0	198.28	Sample recovery was about 33 percent (198.28 g), with no drainable liquids. The segment contained gray, homogeneous solids, with the consistency of setting plaster of Paris.

Table B1-2. Sample and Extrusion Information for 241-S-104. (5 sheets)

Core	Segment	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
44 (Cont'd)	1	76.87-Drainable	203.27	The sampler contained 50 percent solids (203.27 g) and 50 percent liquids (76.87 g). The sample consistency was much like wet mud but viscous enough to retain the cylindrical shape of the sampler. The solids appeared completely homogeneous and brown/gray in color. There was some different, crusty material near the top of the segment. This material was placed in vial F-2033.
	2	0.0	267.71	Sample recovery was 100 percent (267.71 g) and contained no drainable liquids. The solids were homogeneous, grayish/brown, wet, and possessed the consistency of wet mud.
	3	0.0	293.40	Sample recovery was 100 percent (293.40 g), with no drainable liquids. The solids were completely homogeneous except for the fact that the percentage of interstitial liquid was greater at the top end than at the bottom end - approximately 10 percent at the bottom and 40 percent at the top, with an even and gradual increase in water from bottom to top. The color of the solids appeared dark gray, and the consistency was dependent upon the percent water content present but generally was like wet mud.
	4	0.0	265.22	Sample recovery was 100 percent (265.22 g), with no drainable liquids. The segment possessed about 10 percent interstitial liquid. Sample was very thick and completely homogeneous and possessed the consistency of modeling clay.

Table B1-2. Sample and Extrusion Information for 241-S-104. (5 sheets)

Core	Segment	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
44 (Cont'd)	5	0.0	176.58	Sample recovery was about 33 percent (176.58 g) and contained no drainable liquids. The sample was homogeneous, gray, and very thick, like modeling clay.
	6	0.0	172.22	Sample recovery was about 50 percent (172.22 g), with no drainable liquids. Solids appeared to contain about 12 percent moisture. The material was light brown/tan, crackly, and rigid like plaster of Paris, but not as adhesive. There were light and dark areas on the surface of the solids. While the light and dark areas were not very pronounced, the solids were not perfectly homogeneous. There was a 23-cm (9-in.) void at the bottom of the sampler.

Table B1-3. Tank 241-S-104 Composite and Liquid Tracking Numbers from the 222-S Laboratory.

	Solid	Liquid	Percent Water
Core 42 Composite 1	F2171	F2247	F2199
Core 42 Composite 2	F2172		F2201
Core 43 Composite 1	F2175	F2249	F2203
Core 43 Composite 2	F2176		F2205
Core 44 Composite 1	F2177	F2248	
Core 44 Composite 2	F2178		F2210

Table B1-4. Tank 241-S-104 Sample Numbers from Pacific Northwest Laboratory. (2 sheets)

Core Number	Segment/Composite Number	PNL Number
42	Segment 1	93-01071
	Segment 2	93-01072
	Segment 3	93-01073
	Segment 4	93-01753
	Segment 5	93-01074
	Segment 6R	93-01075
	Composite 1	93-01756
	Composite 2	93-01076
43	Segment 1	93-01750
	Segment 2	93-01751
	Segment 3	93-01068
	Segment 4	93-01752
	Segment 5	93-01069
	Segment 6	93-01070
	Segment 6R	93-01755
	Composite 1	93-01757
	Composite 2	93-01758

Table B1-4. Tank 241-S-104 Sample Numbers from Pacific Northwest Laboratory. (2 sheets)

Core Number	Segment/Composite Number	PNL Number
44	Segment 1	93-01067
	Segment 2	93-01066
	Segment 3	93-01065
	Segment 5	93-01064
	Segment 6	93-01815
	Segment 6R	93-01754
	Composite 1	93-01759
	Composite 2	93-01760
	Hot cell blank	93-01077
	Field blank	93-01078

B1.3 SAMPLE ANALYSES

The requested analytes from the 222-S Laboratory are listed in Table B1-5. From the Pacific Northwest Laboratory, the requested analyses were volatile organic analysis, rheology, Pu and U isotopic, extractable halides, and semi-volatile analysis. These samples and the requested analyses are shown below (Kocher 1993).

Volatile organic analysis:

Core 42, Segments 1, 3, 5
Core 43, Segments 1, 2, 3, 4, 5, 6
Core 44, Segments 1, 2, 3, 5, 6.

Semi-volatile organic analysis and extractable organic halides:

Core 42, Composites 1, 2
Core 43, Composites 1, 2
Core 44, Composites 1, 2.

Pu and U isotopic:

Core 42, Composites 1, 2 and segment 6R
Core 43, Composites 1, 2 and segment 6R
Core 44, Composites 1, 2 and segment 6R.

Volatile and semi-volatile organic analyses:

Hot cell blank
Field blank.

Rheology and physical:

Core 42, Segments 2, 4.

Table B1-5. Tank 241-S-104 Samples and Requested Analytes.

Laboratory Sample Numbers	Requested Analytes
F2247, F2249, F2248, F2199, F2201, F2203, F22-05, F2210	Al, Sb, As, Ba, Be, Bi, B, Cd, Ca, Ce, Cr, Co, Cu, Fe, La, Pb, Mg, Mn, Ni, P, K, Se, Si, Ag, Na, Sr, S, Sn, Ti, Zn, Zr, NH_3, CO_3^{2-}, Cl^- CN^-, F^-, NO_3^-, NO_2^-, PO_4^{3-}, SO_4^{2-}, ^{241}Am, ^{137}Cs, ^{60}Co, ^{154}Eu, ^{155}Eu, $^{239/240}Pu$, ^{79}Se, ^{90}Sr, Total alpha, Total beta, % Water, pH, TGA, TOC, DSC, OH, SpG
F2171, F2172, F2175, F2176, F2177, F2178	Al, Sb, As, Ba, Be, Bi, B, Cd, Ca, Ce, Cr, Co, Cu, Fe, La, Pb, Mg, Mn, Hg, Ni, P, K, Se, Si, Ag, Na, Sr, S, Sn, Ti, U, Zn, Zr, NH_3, CO_3^{2-}, Cl^- CN^-, F^-, NO_3^-, NO_2^-, PO_4^{3-}, SO_4^{2-}, ^{241}Am, ^{14}C, ^{137}Cs, ^{60}Co, ^{154}Eu, ^{155}Eu, ^{129}I, ^{237}Np, ^{238}Pu, $^{239/240}Pu$, ^{79}Se, ^{90}Sr, ^{99}Tc, ^{3}H, Total alpha, Total beta, pH, TGA, TOC

Notes:

OH = free hydroxide
pH = hydrogen potential
SpG = specific gravity

B1.3.1 Sample Preparation

When a sample contained more than 25 mL of drainable liquid, the liquid was analyzed separately from the solids. When the volume of the liquid was less than 25 mL, a determination was made whether the liquid sample was actually normal paraffin hydrocarbon. When it was found to be normal paraffin hydrocarbon, it was drained off. When the liquid was not normal paraffin hydrocarbon, it was retained with the sample for eventual homogenization. For a further discussion of sample preparation procedures, see the *Tank Characterization Reference Guide* (De Lorenzo et al. 1994).

B1.3.2 Analytical Methods

This section lists the analytes and the respective analytical procedures that were used to characterize the waste in tank 241-S-104. Procedures for physical, and rheological analyses are listed in Table B1-6. Procedures for inorganic and radiochemical analyses are listed in Table B1-7. Procedures for organic analyses are listed in Table B1-8. Two composites from each core were analyzed in accordance with the complete baseline case core composite scenario detailed in Winters et al. (1990) and as amended by Hill (1991). Several of the analytical tests performed on the composites were also done on the segments, but only for those analytes of importance to a program. Because the drainable liquids obtained were not enough to perform all the analyses requested, only highest priority analyses were performed and no duplicate analyses were run on the liquid composite.

Table B1-6. Analytical Methods for Physical and Rheological Tests.

Analyte	Procedure
Shear strength	PNL-ALO-501
Shear stress/shear rate	PNL-ALO-501/502
Weight percent solids	PNL-ALO-504
Particle size	T044-A-01712F
TGA	LA-560-112
DSC	LA-514-113
SpG	LA-510-112
Weight percent water	LA-564-101
pH	LA-212-103
Settling velocity	PNL-ALO-501
Settling behavior	PNL-ALO-501

Table B1-7. Analytical Methods for Chemical and Radiochemical Analyses. (2 sheets)

Analyte	Method	Procedure
F^-, Cl^-, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}	Ion chromatography	LA-533-105
NO_2^-	Spectrophotometry	LA-645-001
NH_3	Kjeldahl[1]	LA-634-102
OH^-	Titration	LA-212-103

Table B1-7. Analytical Methods for Chemical and Radiochemical Analyses. (2 sheets)

Analyte	Method	Procedure
CN^-	Distillation/spectrophotometric	LA-695-102
As, Se	GHAA[2]	LA-355-131
Hg	CVAA[3]	LA-325-102
Total metals	ICP/AES	LA-505-151
U	Laser fluorimetry	LA-925-106
^{60}Co, ^{137}Cs, ^{154}Eu, ^{155}Eu, ^{241}Am	Gamma energy analysis	LA-548-121
^{238}Pu, $^{239/240}Pu$, ^{241}Am	Separation/Alpha/AEA	LA-503-156
^{14}C ^{3}H ^{79}Se ^{99}Tc	Liquid scintillation	LA-348-104 LA-218-113 LA-365-132 LA-438-101
^{90}Sr	Separation/beta[2]	LA-220-101
^{129}I	Gamma energy analysis	LA-378-101
^{237}Np	Alpha proportional counting	LA-933-141
^{244}Cm	Separation/alpha/AEA[3]	LA-508-051
Total alpha	Proportional counting	LA-508-101
CO_3^{-2}/C	Total inorganic carbon	LA-622-102
TOC	Total organic carbon	LA-344-105
Pu Isotopic	Fusion/mass spectrometry	PNL-ALO-423 PNL-MA-597
U Isotopic	Mass spectrometry	PNL-ALO-445
Total beta	Proportional counting	LA-508-101

Notes:

AEA = alpha energy analysis
AES = atomic emission spectroscopy
CVAA = cold vapor atomic absorption spectrometry
ICP = inductively coupled plasma
GHAA = gaseous hydride atomic absorption spectrometry

[1]Ammonia analysis by caustic addition, distillation, and capture in a boric acid solution
[2]Chemical separation along with total beta proportional counting
[3]Chemical separation along with alpha proportional counting and alpha energy analysis.

Table B1-8. Analytical Methods for Organic Analyses.

Analysis	Method	Procedure
Volatile organic	Gas chromatography/mass spectrometry	PNL-ALO-335
Semi-volatile organic	Gas chromatography/mass spectrometry	PNL-ALO-345
Extractable organic halides	Microcoulometric titration	PNL-ALO-320.2
Total organic halides	Microcoulometric titration	PNL-ALO-321

B1.3.3 Physical and Rheological Tests

Physical and rheological tests were conducted at the Pacific Northwest National Laboratory on segments 2 and 4 of core 42 of tank 241-S-104 core samples. The rheological testing on these samples included shear strength and shear stress, both as a function of shear rate. Physical properties measured settling behavior, density, weight percent solids and weight percent dissolved solids. Settling behavior measurements included volume percent settled solids and both weight percent and volume percent centrifuged solids. The settling velocity and volume percent settled solids measurements were performed on 1:1 and 3:1 water:sample dilutions.

Physical tests completed at 222-S Laboratory included particle size analysis, TGA, DSC, SpG, and percent water analyses. Table B1-6 lists the analytical methods used for physical and rheological properties.

B1.3.4 Chemical and Radionuclide Constituent Analysis

Chemical and radionuclide analyses were performed at the 222-S Laboratory and at the Pacific Northwest National Laboratory. Duplicate analyses were performed on every sample. Table B1-7 lists the analytical methods used.

Quality control procedures were conducted in accordance with the requirements listed in Bell (1994). In summary, those requirements are:

- One laboratory control standard per analytical batch
- One blank per batch
- One matrix spike per core per matrix
- 100 percent duplicates on all homogenization test samples and core composite samples

- One duplicate per analytical batch for direct segment samples
- A duplicate to verify each detected exotherm for DSC analysis.

Exceptions are allowed for specific analytes or procedures:

- Percent water is always run in duplicate
- ^{90}Sr, ^{79}Se, ^{99}Tc, ^{129}I, Pu, and Am have a tracer or carrier added to each sample; no additional matrix spikes are required
- Gamma energy analysis and pH do not require a spike
- A matrix spike for Np is requested on each sample.

B1.3.5 Organic Constituent Analysis

All organic analyses of the samples from tank 241-S-104 were performed at the Pacific Northwest National Laboratory. A U.S. Environmental Protection Agency Contract Laboratory Procedure-type organics speciation analysis was performed on the core composites. The organic analyses performed were volatile, semi-volatile organic, and extractable organic halides. Duplicates were performed for all of these analyses. Table B1-8 lists the analyses and procedure numbers, and Table B1-4 lists the core and segment numbers used for the organic analyses.

B1.4 DESCRIPTION OF HISTORICAL SAMPLING EVENT

Sample T-4184, taken in 1974, was described as yellow in color, and contained 10 percent solids (Wheeler 1974). It appears to be a supernatant sample. No information was available regarding sample handling for this sampling event. Sludge sampling data for tank 241-S-104 have been obtained for one sample and were reported on February 24, 1976 (Horton 1976). The sample was reported as being the texture of a stiff dough or putty, with a tendency to be sticky, and was grayish in color. No information was available regarding sample handling for this sampling event.

The data are presented in Section B2.8. Pre-1989 analytical data have not been validated and should be used with caution.

B2.0 ANALYTICAL RESULTS

B2.1 OVERVIEW

The chemical, radiochemical, and physical results associated with tank 241-S-104 are presented in this document as indicated in Table B2-1. The samples from which these results were derived were collected from July 29, 1992 through August 2, 1992. This sampling event was the most recent regarding tank 241-S-104 and reflects the most accurate characterization of the tank waste available at the present time.

Table B2-1. Analytical Data Presentation Tables.

Analysis	Tabulated Results
Metals	Tables B2-8 through B2-42
Anions	Tables B2-46 through B2-54
Radionuclides	Tables B2-55 through B2-84
Physical properties and miscellaneous chemical data	Tables B2-85 through B2-94
Volatile organics	Tables B2-101 through B2-105
Semivolatile organics	Tables B2-106 through B2-110

The projected tank inventory value for tank 241-S-104 was calculated by multiplying the mean analyte concentration by the volume of solid phase waste. The appropriate conversion factors were included in the calculations to obtain the reported units. The supernatant liquid was not included in the tank inventory estimate because of its small (0.34 percent) contribution to the waste volume.

B2.2 METALS

Sodium was the major metal constituent in the liquid phase of the waste and exhibited a concentration of 1.55E+05 μg/g; aluminum and chromium concentrations exceeded 1,000 μg/g and were relatively high compared to other metals. Although analyzed, the following elements were not detected in the liquid portion of the tank waste: As, Ba, Bi, Ce, Ni, Se, Ag, Ti, and Zr.

In the solid samples from tank 241-S-104, Al, Ca, Cr, Fe, Mn, Ni, Si, Na, and U were all detected in concentrations exceeding 1,000 μg/g; however, of these, sodium and aluminum were by far the most abundant. Of the evaluated analytes, only Be, Bi, La, and Hg were not

detected in the solid samples. This is consistent with what is known about REDOX process chemistry and the transfer activity of this tank. The sample results for anions and other chemicals are given in Tables B2-8 through B2-42.

B2.3 ANIONS

The most abundant anion in both the liquid and solid phases of the waste was reported to be nitrate. However, judging from the liquid phase hydroxide concentration and the historical data, it is reasonable to assume that the solid phase contains a substantial amount of hydroxide salts, and possibly oxides as well. Ammonia was not present in the tank above detection limits. The sample results for anions and other chemicals are given in Tables B2-46 through B2-54.

B2.4 RADIONUCLIDES

B2.4.1 Alpha Activity

Analyses for total alpha activity were performed on the samples recovered from tank 241-S-104. The samples were analyzed according to procedure LA-508-101. The highest result determined was 0.957 μCi/g. The sample results for total alpha are given in Table B2-79 and Table B2-80, and the results are compared to the sum of the individual alpha isotopes in Table B2-81.

Separation and alpha energy analysis (AEA) were used to determine the ^{238}Pu and $^{239/240}$Pu ratios for Pu and the ^{241}Am and $^{243/244}$Cm ratios for Am. These ratios were then used to report separate activities for each of the isotopes.

B2.4.2 Mass Spectrometry

Thermal ionization mass spectrometry was used to determine the presence of all isotopes of Pu and U. Uranium and plutonium values were consistent with typical fuel burnup.

B2.4.3 Total Beta Activity

Analysis of the total beta activity was performed on the composite samples from cores after a fusion digestion. The total beta values were determined by drying a small aliquot of each solution and counting in a beta proportional counter. Tables B2-82 through B2-84 display the data for the total beta results for drainable liquid and solid composites and compare the beta results to the sum of individual beta-emitting isotopes.

B2.4.4 Gamma Energy Analysis

A gamma energy analysis (GEA) was performed on core composite samples and homogenization test samples after fusion digestion. Results were obtained for ^{241}Am, ^{60}Co, ^{137}Cs, ^{154}Eu, and ^{155}Eu. Not all of the listed radionuclides were measured in every sample. Tables B2-55 and B2-58 through B2-67 present the GEA data. ^{129}I is determined by separation and counting on a low-energy gamma system separate from other gamma isotopes.

B2.4.5 Liquid Scintillation Counting

Tritium was measured on core composite samples. Table B2-74 presents the tritium results. Liquid scintillation counting was also used to determine the concentration of ^{79}Se. The ^{79}Se results are presented in Table B2-71. The ^{14}C and ^{99}Tc samples were counted with a scintillation counter. Results from this analysis are shown in Table B2-57 and B2-73, respectively.

B2.5 PHYSICAL ANALYSES

The physical measurements were primarily performed on core 42, segments 2 and 4. Results of the physical measurements are presented in Table B2-2. Particle size analysis was performed on cores 42, 43 and 44. Some physical properties were not measured on segment 4 because an accurate volume could not be measured on the centrifuged sample and no centrifuged supernatant was obtained.

Table B2-2. Tank 241-S-104, Core 42 Physical Measurements.

Physical Property		Segment 2	Segment 4
Density (g/mL)	Sample	1.64	n/a
	Centrifuged supernatant	1.28	n/a
	Centrifuged solid	1.71	n/a
Settled solids	Vol%	100 (no dilution)	100 (no dilution)
		88 (1:1 dilution)	100 (1:1 dilution)
		60 (3:1 dilution)	80 (3:1 dilution)
Centrifuged solids	wt% solids	62.3	67.7
	wt% undissolved solids	55.4	n/a

Note:
[1]Kocher (1993)

B2.5.1 Density and Percent Solids

The density measurement was performed on segment 2 only. The overall sample density was 1.64 g/mL. The centrifuged supernatant density was determined to be 1.28 g/mL and the centrifuged solid density was 1.71 g/mL.

The volume percent settled solids measured on the as-received segments did not exhibit settling over a 3-day period. Two dilutions (1:1 and 3:1 water to sample) were prepared for each of the segments. No settling was observed for the 1:1 dilution of segment 4. The 3:1 dilution of segment 4 settled to a final volume percent of 80. Segment 2 dilutions of 1:1 and 3:1 reached a final volume percent settled solids of 88 and 60, respectively.

Weight percent of solids and undissolved solids was performed on the centrifuged samples. For wt% solids segment 2 was 62.3 percent and segment 4 was 67.7 percent. Only segment 2 was measured for weight percent undissolved solids at 55.4 percent.

B2.5.2 Particle Size

Particle size analysis was performed using a particle size analyzer. The acquisition range was 0.5 to 150 microns. Table B2-3 summarizes the results of the analysis. The analysis reveals that 92 percent of the particles are between 0.5 to 2.0 microns in diameter and 83 percent of the particle volume is comprised of particles 2 to 150 microns in diameter.

Table B2-3. Summary of Particle Size Distribution for Tank 241-S-104.

Particle Size Intervals (μm)	Number Distribution Range	Average Number Distribution %	Volume Distribution Range	Average Volume Distribution %
0.5-1.0	52.2-86	72.9	0-11.2	3.53
1-2	11.2-27.6	18.77	0-12.2	6.24
2-5	0.8-10.3	5.83	2.2-42.4	23.14
5-10	0.6-5.4	2.06	1.4-33.6	15.23
10-20	2-3	0.38	1.4-32.6	15.23
20-50	0	0	5-30	15.09
50-150	0	0	0-80	14.58

B2.5.3 Rheology

Shear stress as a function of shear rate was measured for 1:1, 1.3:1, and 3:1 dilutions of samples from core 42, segments 2 and 4. All dilutions for both segments exhibited yield psuedoplastic behavior, and their flow properties are presented in Table B2-4. Table B2-5 shows the power law curve fit parameters.

Table B2-4. Flow Properties. (2 sheets)

					Critical		
Segment	Dilution Water: Sample	Temp (°C)	Run	Pipe Diameter cm (in.)	Velocity m/sec (ft/sec)	Flow Rate L/min (gal/min)	Reynolds Number
2	1: 1	30	1	5.08 (2)	1.16 (3.8)	148 (39)	6,400
				7.62 (3)	1.04 (3.4)	295 (78)	7,600
			2	5.08 (2)	1.07 (3.5)	140 (37)	7,200
				7.62 (3)	0.098 (3.2)	276 (73)	8,800
		95	3	5.08 (2)	0.88 (2.9)	114 (30)	7,900
				7.62 (3)	0.79 (2.6)	227 (60)	10,100
			4	5.08 (2)	0.85 (2.8)	110 (29)	9,300
				7.62 (3)	0.76 (2.5)	220 (58)	11,500
		28	5	5.08 (2)	7.19 (23.6)	935 (247)	2,800
				7.62 (3)	6.07 (19.9)	1730 (458)	3,100
			7	5.08 (2)	4.66 (15.3)	605 (160)	2,900
				7.62 (3)	4.08 (13.4)	1170 (308)	3,200
4	1.3: 1	30	1	5.08 (2)	2.59 (8.5)	337 (89)	31,100
				7.62 (3)	2.35 (7.7)	670 (177)	40,800
			2	5.08 (2)	2.32 (7.6)	303 (80)	18,600
				7.62 (3)	2.10 (6.9)	598 (158)	24,600
		95	1	5.08 (2)	1.74 (5.7)	227 (60)	9,300
				7.62 (3)	1.55 (5.1)	447 (118)	11,900
			2	5.08 (2)	1.58 (5.2)	204 (54)	11,100
				7.62 (3)	1.43 (4.7)	405 (107)	14,100

Table B2-4. Flow Properties. (2 sheets)

					Critical		
Segment	Dilution Water: Sample	Temp (°C)	Run	Pipe Diameter cm (in.)	Velocity m/sec (ft/sec)	Flow Rate L/min (gal/min)	Reynolds Number
2	3: 1	30	1	5.08 (2)	0.73 (2.4)	95 (25)	6,600
				7.62 (3)	0.64 (2.1)	185 (49)	8,000
			2	5.08 (2)	0.70 (2.3)	91 (24)	6,800
				7.62 (3)	0.64 (2.1)	182 (48)	8,400
		95	3	5.08 (2)	0.67 (2.2)	87 (23)	10,100
				7.62 (3)	0.61 (2.0)	174 (46)	13,300
			4	5.08 (2)	0.67 (2.2)	87 (23)	10,400
				7.62 (3)	0.61 (2.0)	174 (46)	13,800
4	3: 1	30	1	5.08 (2)	1.37 (4.5)	178 (47)	6,200
				7.62 (3)	1.25 (4.1)	356 (94)	7,400
			2	5.08 (2)	1.37 (4.5)	178 (47)	6,500
				7.62 (3)	1.25 (4.1)	356 (94)	7,700
		95	1	5.08 (2)	1.25 (4.1)	159 (42)	9,600
				7.62 (3)	1.10 (3.6)	314 (83)	12,500
			2	5.08 (2)	1.22 (4.0)	155 (41)	6,900
				7.62 (3)	1.10 (3.6)	310 (82)	8,300

Table B2-5. Power Law Curve Fit Parameters.

Segment	Dilution Water: Sample	Temp. (°C)	Run	Yield Point (Pa)	Consistency Factor (Pa sec)	Flow Behavior Index
2	1: 1	30	1	3.60	4.07×10^{-2}	0.741
			2	3.45	2.39×10^{-2}	0.810
		95	3	2.42	1.01×10^{-2}	0.927
			4	2.73	1.25×10^{-2}	0.834
4	1: 1	28	5	32.0	6.55×10^{-1}	0.792
			7	14.1	9.26×10^{-1}	0.649
	1.3: 1	30	1	17.2	9.96×10^{-2}	0.760
			2	15.5	4.74×10^{-2}	0.842
		95	3	10.4	1.66×10^{-2}	0.933
			4	10.2	1.46×10^{-2}	0.902
2	3: 1	30	1	1.26	1.45×10^{-2}	0.812
			2	1.26	1.23×10^{-2}	0.838
		95	3	1.55	4.20×10^{-3}	0.981
			4	1.59	3.78×10^{-3}	1.00
4	3: 1	30	1	4.35	4.26×10^{-2}	0.762
			2	4.54	4.07×10^{-2}	0.761
		95	3	4.83	8.37×10^{-3}	0.974
			4	3.77	2.97×10^{-2}	0.779

B2.5.4 Thermogravimetric Analysis

Thermogravimetric analysis measures the mass of a sample while its temperature is increased at a constant rate. Nitrogen is passed over the sample during heating to remove any released gases. Any decrease in the weight of a sample during TGA represents a loss of gaseous matter from the sample, either through evaporation or through a reaction that forms gas phase products. The moisture content is estimated by assuming that all TGA sample weight loss up to a certain temperature (typically 150 to 200 °C [300 to 390 °F]) is the result of water evaporation. The temperature limit for moisture loss is chosen by the operator at an inflection point on the TGA plot. Other volatile matter fractions can often be differentiated by inflection points as well.

Tank 241-S-104 samples were analyzed by TGA using procedure LA-514-112, and the results are presented in Table B2-85. The weight percent water values for the segment samples were between 7.66 and 53.8. However, the weight percent water values for the core 44 composite samples were between 93.8 and 95.2. The results from the core 44 composites are questionable because segment results were between 21.6 and 42.3 percent.

B2.5.5 Differential Scanning Calorimetry

In a DSC analysis, heat absorbed or emitted by the sample is measured while 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.

The DSC analyses for tank 241-S-104 were performed using procedure LA-514-313. No segment sample exceeded the safety screening DQO decision criteria of -480 J/g. All the segment samples had no exotherms. However, the composite samples from cores 43 and 44 had exotherms. The core 43 composite result was 4.5 J/g (wet weight basis), and the rerun showed no evidence of exotherms. The highest core 44 composite result was 74.3 J/g (wet weight basis). However, this result is questionable because all the segments from core 44 showed no exotherms. Furthermore, the TGA water results for the core 44 composite were approximately 95 percent, which indicates that the analytical results from the core 44 composites are questionable.

B2.6 ORGANIC CONSTITUENTS

None of the target analytes associated with the volatile and semi-volatile organic analyses were detected, as indicated by Tables B2-101 and B2-110, during the evaluation of samples from tank 241-S-104. Because of their volatile nature and relatively small contribution to the waste as indicated by the historical records, the appearance of these compounds was not expected. The appearance of several normal paraffin hydrocarbons was reported by the laboratory as tentatively identified compounds, but these constituents may be the result of hydrostatic fluid contamination from the sampling process. Several silicone derivatives were also detected during the sample analyses. These compounds were most likely column degradation products, caused by the high pH of the sample matrix.

B2.7 VAPOR PHASE MEASUREMENT

A vapor phase measurement was taken on March 19, 1996 for tank 241-S-104. This measurement supported the safety screening DQO (Dukelow et al. 1995). The vapor phase screening was taken for flammability issues. The vapor phase measurements were taken 6 m

(20 ft) below a riser in the headspace of the tank and results were obtained in the field (i.e., no gas sample was sent to the laboratory for analysis). The results of the vapor phase measurements are provided in Table B2-6.

Table B2-6. Results of Vapor Phase Measurements of Tank 241-S-104.

Measurement	Result March 19, 1996
Total organic carbon (TOC)	0 ppm
Lower explosive limit (LEL)	0.0% of LEL
Oxygen	n/a
Ammonia	25 ppmv

B2.8 HISTORICAL SAMPLE RESULTS

Analytical data from two historical sampling events of tank 241-S-104 are available. Sample T-4184, taken in 1974, was described as yellow with 10 percent solids (Wheeler 1974), and appears to be a supernatant sample. The results of the 1974 sample are shown in Table B2-7. Because supernatant was removed from tank 241-S-104 in transfers and salt well pumping after 1974, this sample is likely not representative of the sludge that makes up nearly all of the tank waste. The analytical data for Sample T-4184 will thus not be further discussed in this report.

A sludge sampling from 1976 resulted in the sludge in tank 241-S-104 being described as grayish in color and sticky, with the consistency of stiff dough or putty (Horton 1976). These observations are consistent with contemporary observations. The results of the 1976 sample are shown in Table B2-7. These data have not been validated and should be used with caution.

Table B2-7. Historical Sample.[1]

Physical Data			
Sample Date	1974	1976	
Sample Description	Yellow, 10% solid	Grayish, sticky sludge	
pH	>12.6	n/a	
Particle density	---	2.45 g/cm^3	
Specific gravity/density	1.45	1.21 g/mL	
Water	56.14	30.3	%
DTA	No exotherms		
Chemical Analysis			
OH	2.23	n/a	*M*
Al	0.485	3.2	*M*
Ba	n/a	<0.09	*M*
Ca	n/a	0.09	*M*
Fe	n/a	0.06	*M*
Mg	n/a	0.01	*M*
Mn	n/a	0.02	*M*
Si	n/a	0.3	*M*
Na	13.82	n/a	*M*
NO_2	1.10	n/a	*M*
NO_3	5.07	13.2	*M*
Pu		4.46E-03	g/L
SO_4	2.78E-2	n/a	*M*
PO_4	1.08E-4	<0.01	*M*
F	7.53E-3	n/a	*M*
CO_3	7.55E-2	n/a	*M*
Radiological Analysis			
$^{89/90}Sr$	n/a	3.80E+05	μCi/L
^{137}Cs	5.98E+05 μCi/gal	1.10E+05	μCi/L

Notes:

DTA = differential thermal analysis

[1]Pre-1989 analytical data have not been validated and should be used with caution.

B2.9 ANALYTICAL DATA TABLES

For most analytes (except for some physical and rheological measurements), the data tables consist of six columns. The first column lists the sample number. Note that for each primary/duplicate pair, the sample number is for the primary result. The second column lists the core from which the samples were derived. The third column lists the sample portion from with the aliquots were taken. The final three columns display the primary and duplicate analytical values and a mean for each sample/duplicate pair.

Quality control (QC) footnotes:

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

Table B2-8. Tank 241-S-104 Analytical Results: Aluminum (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	20,400	18,800	19,600[QC:e]
2089		Homogenized Test 2	18,600	24,100	21,350[QC:e]
2092	43: 4	Homogenized Test 1	35,700	72,400	54,050[QC:e]
2093		Homogenized Test 2	84,200	52,800	68,500[QC:e]
2096	43: 6	Homogenized Test 1	51,800	49,900	50,850[QC:e]
2097		Homogenized Test 2	49,300	55,900	52,600[QC:e]
2171	Core 42	Solid composite	42,300	30,000	36,150[QC:e]
2172		Solid composite	42,900	58,200	50,550[QC:e]
2175	Core 43	Solid composite	21,400	22,200	21,800[QC:e]
2176		Solid composite	29,400	26,800	28,100[QC:e]
2177	Core 44	Solid composite	63,100	61,500	62,300[QC:e]
2178		Solid composite	34,900	33,800	34,350[QC:e]

Table B2-8. Tank 241-S-104 Analytical Results: Aluminum (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	1.160E+05	1.110E+05	1.135E+05[QC:c]
2172		Solid composite	1.190E+05	1.130E+05	1.160E+05[QC:c]
2175	Core 43	Solid composite	1.190E+05	1.220E+05	1.205E+05
2176		Solid composite	1.220E+05	1.140E+05	1.180E+05
2177	Core 44	Solid composite	1.150E+05	1.230E+05	1.190E+05
2178		Solid composite	1.170E+05	1.130E+05	1.150E+05
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	6,670	6,310	6,490
2172		Solid composite	6,540	5,930	6,235
2175	Core 43	Solid composite	6,080	6,070	6,075[QC:c]
2176		Solid composite	5,980	6,300	6,140[QC:c]
2177	Core 44	Solid composite	1,190	1,890	1,540
2178		Solid composite	1,930	1,260	1,595
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	9,687.5		9,687.5
2249	43: 1	Drainable liquid	8,593.75		8,593.75
2248	44: 1	Drainable liquid	9,765.62		9,765.62
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	5,120	4,940	5,030
2006	44: 6	Water dilution	5,100	5,300	5,200
2007	44: 6	Water dilution	4,740	4,760	4,750
2008	44: 6	Water dilution	5,490	5,230	5,360
2010	44: 6	Water dilution	1,860	1,980	1,920

Table B2-9. Tank 241-S-104 Analytical Results: Antimony (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 14.5	22	< 18.25
2089		Homogenized Test 2	< 14.8	< 14.5	< 14.65
2092	43: 4	Homogenized Test 1	35	< 34.5	< 34.75
2093		Homogenized Test 2	< 35	41.3	< 38.15
2096	43: 6	Homogenized Test 1	< 36.3	< 34.5	< 35.4
2097		Homogenized Test 2	< 53.1	52.6	< 52.85
2171	Core 42	Solid composite	< 35.1	< 35.4	< 35.25
2172		Solid composite	< 36.2	< 35	< 35.6
2175	Core 43	Solid composite	< 34.4	34	< 34.2
2176		Solid composite	< 34.9	< 35.1	< 35
2177	Core 44	Solid composite	35.8	38.1	36.95
2178		Solid composite	< 34.5	40.5	< 37.5
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 183	< 183	< 183
2172		Solid composite	< 180	< 182	< 181
2175	Core 43	Solid composite	< 75.5	< 75.1	< 75.3
2176		Solid composite	< 74.5	< 74.2	< 74.35
2177	Core 44	Solid composite	< 176	< 178	< 177
2178		Solid composite	< 176	< 177	< 176.5
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 37.2	< 37	< 37.1
2172		Solid composite	< 37.2	< 37.3	< 37.25
2175	Core 43	Solid composite	< 35.6	< 35.6	< 35.6
2176		Solid composite	< 36	< 36	< 36
2177	Core 44	Solid composite	< 36.2	< 36.3	< 36.25
2178		Solid composite	< 36.2	< 36.3	< 36.25

Table B2-9. Tank 241-S-104 Analytical Results: Antimony (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	6.07812		6.08[QC:f]
2249	43: 1	Drainable liquid	< 5.84375		< 5.84
2248	44: 1	Drainable liquid	< 8.04688		< 8.05
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 29.6	< 36.6	< 33.1
2006		Water dilution	< 37	< 37.1	< 37.05
2007		Water dilution	< 36.9	< 36.7	< 36.8
2008		Water dilution	< 34.7	< 34.9	< 34.8
2010		Water dilution	< 14.9	< 15	< 14.95[QC:f]

Table B2-10. Tank 241-S-104 Analytical Results: Arsenic (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 3.73	< 3.73	< 3.73
2089		Homogenized Test 2	< 3.79	< 3.71	< 3.75
2092	43: 4	Homogenized Test 1	< 2.84	< 3	< 2.92
2093		Homogenized Test 2	< 3.05	< 3.1	< 3.075
2096	43: 6	Homogenized Test 1	< 2.97	< 2.82	< 2.90
2097		Homogenized Test 2	< 4.62	6.32	< 5.47
2171	Core 42	Solid composite	< 2.87	< 2.9	< 2.88
2172		Solid composite	< 2.97	< 2.87	< 2.92
2175	Core 43	Solid composite	< 2.99	< 2.96	< 2.98
2176		Solid composite	< 3.04	< 3.06	< 3.05
2177	Core 44	Solid composite	< 3.05	< 2.98	< 3.02
2178		Solid composite	5.08	5.83	5.46

Table B2-10. Tank 241-S-104 Analytical Results: Arsenic (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 15	< 15	< 15
2172		Solid composite	< 14.8	< 14.9	< 14.85
2175	Core 43	Solid composite	< 19.4	< 19.3	< 19.35
2176		Solid composite	< 19.1	< 19	< 19.05
2177	Core 44	Solid composite	< 15.3	< 15.5	< 15.4
2178		Solid composite	< 15.3	< 15.4	< 15.35
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 3.05	< 3.03	< 3.04
2172		Solid composite	< 3.05	< 3.06	< 3.06
2175	Core 43	Solid composite	< 3.1	< 3.1	< 3.1
2176		Solid composite	< 3.14	< 3.13	< 3.14
2177	Core 44	Solid composite	< 3.16	< 3.16	< 3.16
2178		Solid composite	< 3.16	< 3.16	< 3.16
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.761719		< 0.76
2249	43: 1	Drainable liquid	< 0.304688		< 0.30
2248	44: 1	Drainable liquid	< 0.304688		< 0.30
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	8.48	8.44	8.46
2006		Water dilution	14.5	14	14.25[QC:f]
2007		Water dilution	< 3.02	< 3.01	< 3.02
2008		Water dilution	< 2.84	< 2.86	< 2.85
2010		Water dilution	< 3.81	< 3.85	< 3.83
		Water dilution	3.74	4.59	4.17

Table B2-11. Tank 241-S-104 Analytical Results: Arsenic (Atomic Absorption).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 0.25	< 0.25	< 0.25
2172		Solid composite	< 0.25	< 0.25	< 0.25
2175	Core 43	Solid composite	< 0.25	< 0.25	< 0.25
2176		Solid composite	< 0.25	< 0.25	< 0.25
2177	Core 44	Solid composite	< 0.25	< 0.25	< 0.25
2178		Solid composite	< 0.25	< 0.25	< 0.25

Table B2-12. Tank 241-S-104 Analytical Results: Barium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	16.1	17	16.55
2089		Homogenized Test 2	16.9	17.3	17.1
2092	43: 4	Homogenized Test 1	34.7	36.6	35.65
2093		Homogenized Test 2	38.2	33.8	36
2096	43: 6	Homogenized Test 1	18.3	22.1	20.2
2097		Homogenized Test 2	21.9	20.6	21.25
2171	Core 42	Solid composite	20.8	20	20.4
2172		Solid composite	22.1	22.9	22.5
2175	Core 43	Solid composite	20.5	19.2	19.85
2176		Solid composite	20.4	19.4	19.9
2177	Core 44	Solid composite	25.9	25.8	25.85
2178		Solid composite	21.4	20.3	20.85
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	29.3	26.9	28.1
2172		Solid composite	31.5	30.6	31.05

Table B2-12. Tank 241-S-104 Analytical Results: Barium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion (Cont'd)			µg/g	µg/g	µg/g
2175	Core 43	Solid composite	33.4	34.3	33.85
2176		Solid composite	35.1	34.1	34.6
2177	Core 44	Solid composite	33.6	38.8	36.2
2178		Solid composite	36.7	33.3	35
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 0.305	1.61	< 0.96
2172		Solid composite	< 0.305	< 0.306	< 0.31
2175	Core 43	Solid composite	0.314	< 0.3	< 0.31
2176		Solid composite	< 0.304	0.319	< 0.31
2177	Core 44	Solid composite	< 0.305	< 0.306	< 0.31
2178		Solid composite	0.329	< 0.306	< 0.32
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.078		< 0.078
2249	43: 1	Drainable liquid	3.12E-04		3.12E-04
2248	44: 1	Drainable liquid	0.031		0.031
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 0.24	< 0.3	< 0.27
2006		Water dilution	0.30	< 0.304	< 0.30
2007		Water dilution	0.41	< 0.301	< 0.36
2008		Water dilution	< 0.28	< 0.286	< 0.28
2010		Water dilution	< 0.39	< 0.395	< 0.39

Table B2-13. Tank 241-S-104 Analytical Results: Beryllium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 0.29	< 0.29	< 0.29
2089		Homogenized Test 2	0.44	< 0.28	< 0.36
2092	43: 4	Homogenized Test 1	< 0.27	< 0.29	< 0.28
2093		Homogenized Test 2	< 0.30	< 0.3	< 0.30
2096	43: 6	Homogenized Test 1	< 0.30	< 0.28	< 0.29
2097		Homogenized Test 2	< 0.45	< 0.39	< 0.42
2171	Core 42	Solid composite	< 0.29	< 0.29	< 0.29
2172		Solid composite	< 0.230	< 0.29	< 0.29
2175	Core 43	Solid composite	< 0.29	< 0.29	< 0.29
2176		Solid composite	< 0.29	< 0.30	< 0.30
2177	Core 44	Solid composite	< 0.30	< 0.29	< 0.29
2178		Solid composite	< 0.29	< 0.29	< 0.29
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 1.5	< 1.5	< 1.5
2172		Solid composite	< 1.48	< 1.49	< 1.485
2175	Core 43	Solid composite	< 1.49	< 1.48	< 1.485
2176		Solid composite	< 1.47	< 1.46	< 1.465
2177	Core 44	Solid composite	< 1.48	< 1.5	< 1.49
2178		Solid composite	< 1.49	< 1.49	< 1.49
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 0.305	< 0.303	< 0.304
2172		Solid composite	< 0.305	< 0.306	< 0.3055
2175	Core 43	Solid composite	< 0.3	< 0.3	< 0.3
2176		Solid composite	< 0.304	< 0.303	< 0.3035
2177	Core 44	Solid composite	< 0.305	< 0.306	< 0.3055
2178		Solid composite	< 0.305	< 0.306	< 0.3055

Table B2-13. Tank 241-S-104 Analytical Results: Beryllium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	0.17		0.17
2249	43: 1	Drainable liquid	0.13		0.13
2248	44: 1	Drainable liquid	0.14		0.14
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 0.24	< 0.3	< 0.27
2006		Water dilution	< 0.30	< 0.30	< 0.30
2007		Water dilution	< 0.30	< 0.30	< 0.30
2008		Water dilution	< 0.28	< 0.29	< 0.29
2010		Water dilution	< 0.29	< 0.30	< 0.29
		Water dilution	< 0.30	< 0.31	< 0.31 0.3055[QC:f]

Table B2-14. Tank 241-S-104 Analytical Results: Bismuth (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 8.8	< 8.8	< 8.8
2089		Homogenized Test 2	< 8.94	< 8.75	< 8.845
2092	43: 4	Homogenized Test 1	< 7.79	< 8.23	< 8.01
2093		Homogenized Test 2	< 8.35	< 8.5	< 8.425
2096	43: 6	Homogenized Test 1	< 5.75	< 5.46	< 5.605
2097		Homogenized Test 2	< 12.7	< 11	< 11.85
2171	Core 42	Solid composite	< 5.56	< 5.61	< 5.585
2172		Solid composite	< 5.74	< 5.55	< 5.645
2175	Core 43	Solid composite	< 8.2	< 8.1	< 8.15
2176		Solid composite	< 8.33	< 8.38	< 8.355
2177	Core 44	Solid composite	< 8.37	< 8.17	< 8.27
2178		Solid composite	< 8.23	< 8.09	< 8.16

Table B2-14. Tank 241-S-104 Analytical Results: Bismuth (ICP).
(2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
2171	Core 42	Solid composite	< 29	< 29	< 29
2172		Solid composite	< 28.6	< 28.8	< 28.7
2175	Core 43	Solid composite	< 45.7	< 45.5	< 45.6
2176		Solid composite	< 45.1	< 44.9	< 45
2177	Core 44	Solid composite	< 41.9	< 42.5	< 42.2
2178		Solid composite	< 42.1	< 42.2	< 42.15
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
2171	Core 42	Solid composite	< 5.89	< 5.86	< 5.875
2172		Solid composite	< 5.89	< 5.92	< 5.905
2175	Core 43	Solid composite	< 8.5	< 8.5	< 8.5
2176		Solid composite	< 8.6	< 8.58	< 8.59
2177	Core 44	Solid composite	< 8.65	< 8.67	< 8.66
2178		Solid composite	< 8.65	< 8.66	< 8.655
Drainable liquid: acid digest			**µg/g**	**µg/g**	**µg/g**
2249	43: 1	Drainable liquid	0.72		0.72[QC:f]
2248	44: 1	Drainable liquid	0.72		0.72[QC:f]
Water dilution			**µg/g**	**µg/g**	**µg/g**
2005	44: 6	Water dilution	< 4.7	< 5.8	< 5.25
2006		Water dilution	< 5.87	< 5.88	< 5.88
2007		Water dilution	< 5.85	< 5.81	< 5.83
2008		Water dilution	< 5.5	< 5.53	< 5.52
2010		Water dilution	< 8.99	< 9.09	< 9.04[QC:f]

Table B2-15. Tank 241-S-104 Analytical Results: Boron (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43:2	Homogenized Test 1	14.6	14.8	14.7
2089		Homogenized Test 2	12.1	14.6	13.35
2092	43: 4	Homogenized Test 1	26	22.4	24.2
2093		Homogenized Test 2	17.5	7.39	12.44
2096	43: 6	Homogenized Test 1	9.71	10.6	10.15
2097		Homogenized Test 2	16.4	18.5	17.45
2171	Core 42	Solid composite	10.5	13.5	12
2172		Solid composite	8.82	10.5	9.66
2175	Core 43	Solid composite	9.13	9.48	9.305
2176		Solid composite	15.5	9.95	12.72
2177	Core 44	Solid composite	21.6	17.5	19.55
2178		Solid composite	21.2	25.3	23.25

Table B2-15. Tank 241-S-104 Analytical Results: Boron (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 5	< 5	< 5
2172		Solid composite	< 4.93	< 4.96	< 4.945
2175	Core 43	Solid composite	40.5	29.9	35.2
2176		Solid composite	165	20	92.5
2177	Core 44	Solid composite	< 9.37	10.6	< 9.985
2178		Solid composite	10.2	14.1	12.15
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	10.9	10.8	10.85
2172		Solid composite	9.2	9.33	9.265
2175	Core 43	Solid composite	10	11	10.5
2176		Solid composite	10.9	10.7	10.8
2177	Core 44	Solid composite	5.62	7.92	6.77
2178		Solid composite	7.35	5.27	6.31
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	6.390		6.39
2249	43: 1	Drainable liquid	< 4.023		< 4.02
2248	44: 1	Drainable liquid	< 4.91		< 4.91
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	10.4	10.3	10.35[QC:f]
2006		Water dilution	12.9	13.2	13.05[QC:f]
2007		Water dilution	26	26.4	26.2[QC:f]
2008		Water dilution	14.3	12.1	13.2[QC:f]
2010		Water dilution	3.43	3.08	3.25

Table B2-16. Tank 241-S-104 Analytical Results: Cadmium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 0.67	< 0.67	< 0.67
2089		Homogenized Test 2	0.826	2.41	1.618
2092	43: 4	Homogenized Test 1	< 0.642	< 0.678	< 0.66
2093		Homogenized Test 2	0.745	< 0.7	< 0.7225
2096	43: 6	Homogenized Test 1	< 0.694	0.888	< 0.791
2097		Homogenized Test 2	1.25	1.26	1.255
2171	Core 42	Solid composite	< 0.67	< 0.677	< 0.6735
2172		Solid composite	0.735	< 0.67	< 0.7025
2175	Core 43	Solid composite	< 0.676	< 0.667	< 0.6715
2176		Solid composite	< 0.686	< 0.69	< 0.688
2177	Core 44	Solid composite	0.754	0.917	0.8355
2178		Solid composite	0.687	0.937	0.812
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 3.5	< 3.5	< 3.5
2172		Solid composite	< 3.45	< 3.47	< 3.46
2175	Core 43	Solid composite	3.93	3.57	3.75
2176		Solid composite	< 3.43	3.58	< 3.505
2177	Core 44	Solid composite	< 3.45	< 3.5	< 3.475
2178		Solid composite	< 3.47	< 3.47	< 3.47
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 0.711	0.9	< 0.8055
2172		Solid composite	< 0.711	< 0.714	< 0.7125
2175	Core 43	Solid composite	< 0.7	< 0.7	< 0.7
2176		Solid composite	< 0.708	< 0.707	< 0.7075
2177	Core 44	Solid composite	< 0.713	< 0.714	< 0.7135
2178		Solid composite	< 0.713	< 0.713	< 0.713
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.14		< 0.14
2249	43: 1	Drainable liquid	< 0.060		< 0.060[QC:f]
2248	44: 1	Drainable liquid	< 0.070		< 0.070[QC:f]

Table B2-16. Tank 241-S-104 Analytical Results: Cadmium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 0.57	< 0.7	< 0.63
2006		Water dilution	< 0.71	< 0.71	< 0.71
2007		Water dilution	< 0.71	< 0.70	< 0.70
2008		Water dilution	< 0.66	< 0.67	< 0.67
2010		Water dilution	< 0.68	< 0.69	< 0.69

Table B2-17. Tank 241-S-104 Analytical Results: Calcium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	241	272	256.5
2089		Homogenized Test 2	206	265	235.5
2092	43: 4	Homogenized Test 1	222	221	221.5
2093		Homogenized Test 2	225	215	220
2096	43: 6	Homogenized Test 1	339	271	305[QC:b]
2097		Homogenized Test 2	331	314	322.5
2171	Core 42	Solid composite	196	178	187
2172		Solid composite	213	202	207.5
2175	Core 43	Solid composite	327	330	328.5[QC:b]
2176		Solid composite	269	203	236[QC:b]
2177	Core 44	Solid composite	277	265	271
2178		Solid composite	264	236	250

Table B2-17. Tank 241-S-104 Analytical Results: Calcium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	972	423	697.5
2172		Solid composite	555	530	542.5
2175	Core 43	Solid composite	833	696	764.5
2176		Solid composite	1,910	888	1,399
2177	Core 44	Solid composite	4,050	3,450	3,750
2178		Solid composite	31,600	4,820	18,210
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	121	747	434
2172		Solid composite	67.2	148	107.6
2175	Core 43	Solid composite	102	128	115
2176		Solid composite	108	90.9	99.45
2177	Core 44	Solid composite	115	92.3	103.65
2178		Solid composite	78.9	67.8	73.35
2247	42: 1	Drainable liquid	3.03		3.03[QC:f]
2249	43: 1	Drainable liquid	0.039		0.039
2248	44: 1	Drainable liquid	0.039		0.039
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	71.1	75.4	73.25[QC:f]
2006		Water dilution	521	73.9	297.45[QC:f]
2007		Water dilution	116	113	114.5[QC:f]
2008		Water dilution	72.6	90.5	81.55[QC:f]
2010		Water dilution	180	164	172[QC:f]
		Water dilution	81.7	74.3	78[QC:f]

Table B2-18. Tank 241-S-104 Analytical Results: Cerium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 12.2	< 12.2	< 12.2
2089		Homogenized Test 2	< 12.4	15.3	< 13.85
2092	43: 4	Homogenized Test 1	25.1	27.5	26.3
2093		Homogenized Test 2	33.6	26.6	30.1
2096	43: 6	Homogenized Test 1	23.3	24.1	23.7
2097		Homogenized Test 2	20.7	19	19.85
2171	Core 42	Solid composite	20.4	18.4	19.4
2172		Solid composite	25.1	23	24.05
2175	Core 43	Solid composite	29.3	25.8	27.55
2176		Solid composite	21.8	19.9	20.85
2177	Core 44	Solid composite	20.3	25.3	22.8
2178		Solid composite	16.5	19.5	18
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 49	< 49	< 49
2172		Solid composite	< 48.3	< 48.6	< 48.45
2175	Core 43	Solid composite	< 63.6	< 63.2	< 63.4
2176		Solid composite	< 62.7	< 62.5	< 62.6
2177	Core 44	Solid composite	< 42.4	< 43	< 42.7
2178		Solid composite	< 42.6	< 42.7	< 42.65
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 9.96	< 9.9	< 9.93
2172		Solid composite	< 9.96	< 10	< 9.98
2175	Core 43	Solid composite	< 8.6	< 8.6	< 8.6
2176		Solid composite	< 8.7	< 8.69	< 8.70
2177	Core 44	Solid composite	< 8.75	< 8.77	< 8.76
2178		Solid composite	< 8.75	< 8.76	< 8.76
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 2.5		< 2.5
2249	43: 1	Drainable liquid	1		1
2248	44: 1	Drainable liquid	1		1

Table B2-18. Tank 241-S-104 Analytical Results: Cerium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 7.93	< 9.8	< 8.865
2006		Water dilution	< 9.92	< 9.94	< 9.93
2007		Water dilution	< 9.88	< 9.82	< 9.85
2008		Water dilution	< 9.29	< 9.34	< 9.315
2010		Water dilution	< 12.5	< 12.7	< 12.6
		Water dilution	< 8.75	< 8.76	< 8.755

Table B2-19. Tank 241-S-104 Analytical Results: Chromium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	1,950	2,070	2,010
2089		Homogenized Test 2	2,060	2,060	2,060
2092	43: 4	Homogenized Test 1	2,510	2,450	2,480[QC:e]
2093		Homogenized Test 2	2,340	2,250	2,295[QC:e]
2096	43: 6	Homogenized Test 1	2,140	2,350	2,245[QC:e]
2097		Homogenized Test 2	2,920	2,330	2,625[QC:e]
1171	Core 42	Solid composite	2,550	2,490	2,520[QC:e]
2172		Solid composite	2,500	2,370	2,435[QC:e]
2175	Core 43	Solid composite	2,290	2,190	2,240
2176		Solid composite	2,280	2,390	2,335
2177	Core 44	Solid composite	2,170	2,200	2,185
2178		Solid composite	2,450	2,330	2,390[QC:e]

Table B2-19. Tank 241-S-104 Analytical Results: Chromium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	2,530	2,470	2,500[QC:c]
2172		Solid composite	2,620	2,460	2,540[QC:c]
2175	Core 43	Solid composite	2,300	2,400	2,350
2176		Solid composite	2,300	2,300	2,300
2177	Core 44	Solid composite	2,100	2,270	2,185
2178		Solid composite	2,200	2,290	2,245
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	2,700	2,550	2,625
2172		Solid composite	2,680	2,420	2,550
2175	Core 43	Solid composite	2,440	2,530	2,485[QC:c]
2176		Solid composite	2,540	2,610	2,575[QC:c]
2177	Core 44	Solid composite	439	724	581.5
2178		Solid composite	685	438	561.5
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	2,800		2,800
2249	43: 1	Drainable liquid	2,390		2,390
2248	44: 1	Drainable liquid	2,730		2,730
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	2,870	2,790	2,830
2006		Water dilution	2,730	2,820	2,775
2007		Water dilution	2,730	2,780	2,755
2008		Water dilution	3,210	2,970	3,090
2010		Water dilution	1,100	1,160	1,130

Table B2-20. Tank 241-S-104 Analytical Results: Hexavalent Chromium (Cr+6).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Water dilution			µg/g	µg/g	µg/g
2012	44: 6	Water dilution	2,690	2,600	2,645
2035		Water dilution	2,420	2,540	2,480
2155		Water dilution	2,320	2,400	2,360
2212		Water dilution	2,440	2,400	2,420
2236		Water dilution	960	1,180	1,070
2237		Water dilution	3,840	4,350	4,095

Table B2-21. Tank 241-S-104 Analytical Results: Cobalt (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 1.82	1.97	< 1.895
2089		Homogenized Test 2	< 1.85	< 1.81	< 1.83
2092	43: 4	Homogenized Test 1	2.6	2.95	2.775
2093		Homogenized Test 2	2.96	2.36	2.66
2096	43: 6	Homogenized Test 1	1.89	2.66	2.28
2097		Homogenized Test 2	2.46	3.06	2.76
2171	Core 42	Solid composite	2.62	2.49	2.56
2172		Solid composite	3.15	2.53	2.84
2175	Core 43	Solid composite	3.03	2.3	2.67
2176		Solid composite	2.81	2.57	2.69
2177	Core 44	Solid composite	1.8	2.1	1.95
2178		Solid composite	2.17	2.7	2.44
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 5	< 5	< 5
2172		Solid composite	< 4.93	< 4.96	< 4.95
2175	Core 43	Solid composite	< 9.44	< 9.39	< 9.42
2176		Solid composite	< 9.31	< 9.28	< 9.30
2177	Core 44	Solid composite	< 5.92	< 6	< 5.96
2178		Solid composite	< 5.94	7.34	< 6.64

Table B2-21. Tank 241-S-104 Analytical Results: Cobalt (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 1.02	< 1.01	< 1.015
2172		Solid composite	< 1.02	< 1.02	< 1.02
2175	Core 43	Solid composite	< 1.2	< 1.2	< 1.2
2176		Solid composite	< 1.21	< 1.21	< 1.21
2177	Core 44	Solid composite	< 1.36	< 1.22	< 1.29
2178		Solid composite	< 1.22	< 1.22	< 1.22
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.37		< 0.37
2249	43: 1	Drainable liquid	0.17		0.17[QC:f]
2248	44: 1	Drainable liquid	0.18		0.18[QC:f]
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	1.27	< 1	< 1.135
2006		Water dilution	< 1.01	1.55	< 1.28
2007		Water dilution	< 1.01	< 1	< 1.00
2008		Water dilution	< 0.95	1.18	< 1.06[QC:f]
2010		Water dilution	< 1.86	< 1.88	< 1.87

Table B2-22. Tank 241-S-104 Analytical Results: Copper (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	10.9	11.7	11.3
2089		Homogenized Test 2	12.3	11.4	11.85
2092	43: 4	Homogenized Test 1	19.4	18.9	19.15
2093		Homogenized Test 2	21.1	19.3	20.2
2096	43: 6	Homogenized Test 1	13.2	15.9	14.55
2097		Homogenized Test 2	21.1	16.4	18.75
2171	Core 42	Solid composite	31.5	31.3	31.4
2172		Solid composite	33.9	32.9	33.4

Table B2-22. Tank 241-S-104 Analytical Results: Copper (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest (Cont'd)			µg/g	µg/g	µg/g
2175	Core 43	Solid composite	13.5	12.4	12.95
2176		Solid composite	12.5	12.2	12.35
2177	Core 44	Solid composite	13.5	13.9	13.7
2178		Solid composite	13	12.5	12.75
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	56.7	61.9	59.3
2172		Solid composite	37	110	73.5
2175	Core 43	Solid composite	85.4	37.7	61.55
2176		Solid composite	32.8	30.3	31.55
2177	Core 44	Solid composite	63.1	80.4	71.75
2178		Solid composite	35.7	25.7	30.7
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	0.832	8.88	4.856
2172		Solid composite	1.35	1.32	1.335
2175	Core 43	Solid composite	0.691	< 0.6	< 0.65
2176		Solid composite	0.621	< 0.606	< 0.61
2177	Core 44	Solid composite	< 0.611	< 0.612	< 0.61
2178		Solid composite	0.945	< 0.611	< 0.78
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.117188		< 0.117188[QC:f]
2249	43: 1	Drainable liquid	0.247656		0.247656[QC:f]
2248	44: 1	Drainable liquid	0.142187		0.142187[QC:f]
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 0.324	< 0.4	< 0.36
2006		Water dilution	< 0.405	< 0.406	< 0.41
2007		Water dilution	< 0.403	< 0.401	< 0.40
2008		Water dilution	< 0.379	< 0.381	< 0.38
2010		Water dilution	< 0.586	< 0.593	< 0.59[QC:f]

Table B2-23. Tank 241-S-104 Analytical Results: Iron (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	1,590	1,580	1,590[QC:c]
2089		Homogenized Test 2	1,400	712	1,060[QC:c]
2092	43: 4	Homogenized Test 1	1,100	1,470	1,290[QC:c]
2093		Homogenized Test 2	1,660	1,230	1,450[QC:c]
2096	43: 6	Homogenized Test 1	751	1,010	880
2097		Homogenized Test 2	758	849	803
2171	Core 42	Solid composite	755	617	686
2172		Solid composite	850	958	904
2175	Core 43	Solid composite	617	639	628
2176		Solid composite	656	620	638
2177	Core 44	Solid composite	1,030	1,080	1,060
2178		Solid composite	740	686	713

Table B2-23. Tank 241-S-104 Analytical Results: Iron (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	1,560	1,450	1,505[QC:c]
2172		Solid composite	1,900	1,630	1,765[QC:c]
2175	Core 43	Solid composite	1,740	1,810	1,775
2176		Solid composite	1,760	1,690	1,725
2177	Core 44	Solid composite	1,660	1,850	1,755
2178		Solid composite	1,670	1,860	1,765
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	4.18	106	55.09
2172		Solid composite	3.26	13.5	8.38
2175	Core 43	Solid composite	3.76	< 2	< 2.88
2176		Solid composite	4.59	3.24	3.915
2177	Core 44	Solid composite	< 2.04	< 2.04	< 2.04
2178		Solid composite	< 2.04	< 2.04	< 2.04
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	3.18		3.18[QC:f]
2248	43: 1	Drainable liquid	2.22		2.22
2249	44: 1	Drainable liquid	3.45		3.45
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 1.21	< 1.5	< 1.36
2006		Water dilution	< 1.52	< 1.52	< 1.52
2007		Water dilution	1.99	< 1.5	< 1.75[QC:f]
2008		Water dilution	< 1.42	< 1.43	< 1.43
2010		Water dilution	1.66	< 1.58	< 1.62

Table B2-24. Tank 241-S-104 Analytical Results: Lanthanum (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 1.91	< 1.91	< 1.91
2089		Homogenized Test 2	< 1.94	< 1.9	< 1.92
2092	43: 4	Homogenized Test 1	< 1.92	< 2.03	< 1.975
2093		Homogenized Test 2	< 2.06	< 2.1	< 2.08
2096	43: 6	Homogenized Test 1	< 1.59	< 1.51	< 1.55
2097		Homogenized Test 2	< 3.13	< 2.71	< 2.92
2171	Core 42	Solid composite	< 1.53	< 1.55	< 1.54
2172		Solid composite	< 1.58	< 1.53	< 1.555
2175	Core 43	Solid composite	< 2.03	< 2	< 2.02
2176		Solid composite	< 2.06	< 2.07	< 2.07
2177	Core 44	Solid composite	< 2.07	< 2.02	< 2.05
2178		Solid composite	< 2.03	< 2	< 2.02
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 8	< 8	< 8
2172		Solid composite	< 7.89	< 7.94	< 7.92
2175	Core 43	Solid composite	< 9.94	< 9.88	< 9.91
2176		Solid composite	< 9.8	< 9.77	< 9.79
2177	Core 44	Solid composite	< 10.4	< 10.5	< 10.45
2178		Solid composite	< 10.4	< 10.4	< 10.4
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 1.63	< 1.62	< 1.63
2172		Solid composite	< 1.63	< 1.63	< 1.63
2175	Core 43	Solid composite	< 2.1	< 2.1	< 2.1
2176		Solid composite	< 2.12	< 2.12	< 2.12
2177	Core 44	Solid composite	< 2.14	< 2.14	< 2.14
2178		Solid composite	< 2.14	< 2.14	< 2.14
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.39		< 0.39
2249	43: 1	Drainable liquid	0.21		0.21
2248	44: 1	Drainable liquid	0.19		0.19

Table B2-24. Tank 241-S-104 Analytical Results: Lanthanum (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 1.3	< 1.6	< 1.45
2006		Water dilution	< 1.62	< 1.62	< 1.62
2007		Drainable liquid	< 1.61	< 1.6	< 1.61
2008		Water dilution	< 1.52	< 1.53	< 1.53
2010		Water dilution	< 1.95	< 1.98	< 1.96

Table B2-25. Tank 241-S-104 Analytical Results: Lead (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	19.4	25.5	22.45
2089		Homogenized Test 2	20.1	19.6	19.85
2092	43: 4	Homogenized Test 1	45.2	< 8.23	< 26.72
2093		Homogenized Test 2	< 8.35	< 8.5	< 8.43
2096	43: 6	Homogenized Test 1	< 7.04	< 6.69	< 6.87
2097		Homogenized Test 2	29.9	< 11	< 20.45
2171	Core 42	Solid composite	37.3	43.6	40.45
2172		Solid composite	42.6	16.3	29.45
2175	Core 43	Solid composite	36.6	52.1	44.35
2176		Solid composite	11.9	15.6	13.75
2177	Core 44	Solid composite	< 8.37	< 8.17	< 8.27
2178		Solid composite	21.4	18.1	19.75

Table B2-25. Tank 241-S-104 Analytical Results: Lead (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 35.5	< 35.5	< 35.5
2172		Solid composite	< 35	< 35.2	< 35.1
2175	Core 43	Solid composite	< 38.8	< 38.5	< 38.65
2176		Solid composite	< 38.2	< 38.1	< 38.15
2177	Core 44	Solid composite	< 41.9	< 42.5	< 42.2
2178		Solid composite	< 42.1	< 42.2	< 42.15
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 7.21	< 7.17	< 7.19
2172		Solid composite	< 7.21	< 7.24	< 7.225
2175	Core 43	Solid composite	< 8.5	< 8.5	< 8.5
2176		Solid composite	< 8.6	< 8.58	< 8.59
2177	Core 44	Solid composite	< 8.65	< 8.67	< 8.66
2178		Solid composite	< 8.65	< 8.66	< 8.66
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	13.52		13.52
2248	43: 1	Drainable liquid	7.59		7.59[QC:f]
2249	44: 1	Drainable liquid	9.61		9.61[QC:f]
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 5.75	< 7.1	< 6.43
2006		Water dilution	< 7.18	< 7.2	< 7.19
2007		Water dilution	< 7.16	< 7.11	< 7.14
2008		Water dilution	< 6.73	< 6.77	< 6.75
2010		Water dilution	< 7.62	< 7.71	< 7.67

Table B2-26. Tank 241-S-104 Analytical Results: Magnesium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	44.7	46.7	45.7
2089		Homogenized Test 2	40.8	67.6	54.2
2092	43: 4	Homogenized Test 1	65.3	73.8	69.55
2093		Homogenized Test 2	73.5	64.6	69.05
2096	43: 6	Homogenized Test 1	27.4	32.9	30.15
2097		Homogenized Test 2	30.3	28.8	29.55
2171	Core 42	Solid composite	33.7	33.9	33.8
2172		Solid composite	36.3	39.4	37.85
2175	Core 43	Solid composite	38.4	35.1	36.75
2176		Solid composite	45.2	39.8	42.5
2177	Core 44	Solid composite	58.7	58.3	58.5
2178		Solid composite	51.6	42.9	47.25
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	80.5	69.4	74.95
2172		Solid composite	79.3	76.1	77.7
2175	Core 43	Solid composite	92.5	91.4	91.95
2176		Solid composite	109	89.9	99.45
2177	Core 44	Solid composite	150	149	149.5
2178		Solid composite	709	185	447
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	2.44	44.5	23.47
2172		Solid composite	1.89	5.76	3.83
2175	Core 43	Solid composite	6.39	7.99	7.19
2176		Solid composite	6.15	6.1	6.13
2177	Core 44	Solid composite	4.93	5.09	5.01
2178		Solid composite	5.11	3.74	4.43
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	0.69		0.69[QC:f]
2249	43: 1	Drainable liquid	0.17		0.17
2248	44: 1	Drainable liquid	< 0.34		< 0.34

Table B2-26. Tank 241-S-104 Analytical Results: Magnesium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	2.23	2.97	2.6[QC:f]
2006		Water dilution	22.9	2.63	12.77[QC:f]
2007		Water dilution	2.86	2.85	2.86[QC:f]
2008		Water dilution	2.04	1.99	2.02[QC:f]
2010		Water dilution	6.25	5.94	6.10[QC:f]

Table B2-27. Tank 241-S-104 Analytical Results: Manganese (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	1,030	1,100	1,065
2089		Homogenized Test 2	1,100	1,090	1,095
2092	43: 4	Homogenized Test 1	2,320	2,280	2,300[QC:e]
2093		Homogenized Test 2	2,310	2,170	2,240[QC:e]
2096	43: 6	Homogenized Test 1	28.7	34.1	31.4
2097		Homogenized Test 2	72.1	28	50
2171	Core 42	Solid composite	681	905	793
2172		Solid composite	813	760	787
2175	Core 43	Solid composite	835	710	773[QC:e]
2176		Solid composite	838	783	811[QC:e]
2177	Core 44	Solid composite	1,340	1,310	1,330[QC:e]
2178		Solid composite	1,100	1,050	1,080

Table B2-27. Tank 241-S-104 Analytical Results: Manganese (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	815	1,090	953[QC:c]
2172		Solid composite	1,220	1,130	1,180[QC:c]
2175	Core 43	Solid composite	1,070	990	1,030
2176		Solid composite	653	583	618
2177	Core 44	Solid composite	1,520	1,960	1,740
2178		Solid composite	1,290	1,480	1,390
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 0.31	2.58	< 1.44
2172		Solid composite	< 0.31	0.51	< 0.41
2175	Core 43	Solid composite	< 0.3	< 0.3	< 0.3
2176		Solid composite	< 0.30	< 0.3	< 0.30
2177	Core 44	Solid composite	< 0.31	< 0.31	< 0.31
2178		Solid composite	< 0.31	< 0.31	< 0.31
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.059		< 0.059
2249	43: 1	Drainable liquid	< 0.031		< 0.031
2248	44: 1	Drainable liquid	< 0.023		< 0.023
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 0.24	< 0.3	< 0.27
2006		Water dilution	0.74	< 0.30	< 0.52
2007		Water dilution	< 0.30	< 0.30	< 0.30
2008		Water dilution	< 0.28	< 0.29	< 0.29
2010		Water dilution	< 0.29	< 0.30	< 0.29

Table B2-28. Tank 241-S-104 Analytical Results: Mercury (CVAA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 0.123	< 0.126	< 0.1245
2172		Solid composite	< 0.126	< 0.121	< 0.1235
2175	Core 43	Solid composite	< 0.125	< 0.125	< 0.125
2176		Solid composite	< 0.125	< 0.125	< 0.125
2177	Core 44	Solid composite	< 0.125	< 0.125	< 0.125
2178		Solid composite	< 0.125	< 0.125	< 0.125

Table B2-29. Tank 241-S-104 Analytical Results: Nickel (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	38.5	41	39.75
2089		Homogenized Test 2	41.7	41.3	41.5
2092	43: 4	Homogenized Test 1	93.3	94.7	94
2093		Homogenized Test 2	97.8	88	92.9
2096	43: 6	Homogenized Test 1	43.5	55.2	49.35
2097		Homogenized Test 2	47.5	50.8	49.15
2171	Core 42	Solid composite	52	50.3	51.15
2172		Solid composite	57.3	58.5	57.9
2175	Core 43	Solid composite	52	47.9	49.95
2176		Solid composite	55.3	55.8	55.55
2177	Core 44	Solid composite	65.6	68.7	67.15
2178		Solid composite	56.7	52.1	54.4
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	4,260	5,350	4,805[QC:c]
2172		Solid composite	5,160	4,580	4,870[QC:c]
2175	Core 43	Solid composite	5,910	5,190	5,550
2176		Solid composite	5,420	4,310	4,865
2177	Core 44	Solid composite	5,750	2,880	4,315
2178		Solid composite	2,800	8,460	5,630

Table B2-29. Tank 241-S-104 Analytical Results: Nickel (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 1.42	1.78	< 1.6
2172		Solid composite	< 1.42	1.61	< 1.52
2175	Core 43	Solid composite	< 1.8	< 1.8	< 1.8
2176		Solid composite	< 1.82	< 1.82	< 1.82
2177	Core 44	Solid composite	< 1.83	< 1.84	< 1.84
2178		Solid composite	< 1.83	< 1.83	< 1.83
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.292969		< 0.292969
2249	43: 1	Drainable liquid	0.12		0.12
2248	44: 1	Drainable liquid	0.12		0.12
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 1.13	< 1.4	< 1.265
2006		Water dilution	< 1.42	< 1.42	< 1.42
2007		Water dilution	< 1.41	< 1.4	< 1.41
2008		Water dilution	< 1.33	< 1.33	< 1.33
2010		Water dilution	< 1.47	< 1.48	< 1.48[QC:f]

Table B2-30. Tank 241-S-104 Analytical Results: Phosphorus (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	16.5	17.2	16.85
2089		Homogenized Test 2	19.4	16.6	18
2092	43: 4	Homogenized Test 1	22.4	24.3	23.35
2093		Homogenized Test 2	25.6	25.1	25.35
2096	43: 6	Homogenized Test 1	13.2	18.8	16
2097		Homogenized Test 2	20.8	26.1	23.45
2171	Core 42	Solid composite	25.2	25	25.1
2172		Solid composite	19.2	20.8	20

Table B2-30. Tank 241-S-104 Analytical Results: Phosphorus (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2175	Core 43	Solid composite	18.2	22.4	20.3
2176		Solid composite	13.1	19.3	16.2
2177	Core 44	Solid composite	21.6	20.8	21.2
2178		Solid composite	22.8	25.7	24.25
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	147	73.6	110.3
2172		Solid composite	119	87.2	103.1
2175	Core 43	Solid composite	102	56.5	79.25
2176		Solid composite	74.1	115	94.55
2177	Core 44	Solid composite	61.4	109	85.2
2178		Solid composite	74.5	97.6	86.05
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 10.1	16	< 13.05
2172		Solid composite	< 10.1	< 10.1	< 10.1
2175	Core 43	Solid composite	8.44	< 8	< 8.22
2176		Solid composite	9.67	< 8.08	< 8.88
2177	Core 44	Solid composite	< 8.14	< 8.16	< 8.15
2178		Solid composite	< 8.14	< 8.15	< 8.15
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	7.03906		7.03
2249	43: 1	Drainable liquid	5.95312		5.95[QC:f]
2248	44: 1	Drainable liquid	5.80469		5.80[QC:f]
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 8.01	< 9.9	< 9.0
2006		Water dilution	17.2	24.4	20.8
2007		Water dilution	10.1	< 9.92	< 10.01
2008		Water dilution	< 9.38	< 9.44	< 9.41
2010		Water dilution	< 6.84	< 6.92	< 6.88
		Water dilution	< 8.14	< 8.15	< 8.145

Table B2-31. Tank 241-S-104 Analytical Results: Potassium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2092	43: 4	Homogenized Test 1	303	302	301
2093		Homogenized Test 2	300	277	289
2096	43: 6	Homogenized Test 1	200	216	208
2097		Homogenized Test 2	268	213	241
2171	Core 42	Solid composite	357	361	359
2172		Solid composite	355	353	354
2175	Core 43	Solid composite	279	257	268
2176		Solid composite	267	274	271
2177	Core 44	Solid composite	253	264	259
2178		Solid composite	289	288	289
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	336	351	344
2172		Solid composite	321	313	317
2175	Core 43	Solid composite	326	311	319[QC:c]
2176		Solid composite	287	317	302[QC:c]
2177	Core 44	Solid composite	108	119	114
2178		Solid composite	139	102	121
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	519		519
2249	43: 1	Drainable liquid	< 641		< 641
2248	44: 1	Drainable liquid	< 740		< 740
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	242	223	233
2006		Water dilution	256	264	260
2007		Water dilution	270	288	279
2008		Water dilution	304	307	306
2010		Water dilution	177	181	179[QC:f]

Table B2-32. Tank 241-S-104 Analytical Results: Selenium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 13.5	< 13.5	< 13.5
2089		Homogenized Test 2	< 13.7	< 13.4	< 13.55
2092	43: 4	Homogenized Test 1	< 12	< 12.7	< 12.35
2093		Homogenized Test 2	< 12.9	< 13.1	< 13
2096	43: 6	Homogenized Test 1	25.8	31.8	28.8
2097		Homogenized Test 2	84.7	58.7	71.7
2171	Core 42	Solid composite	< 7.95	< 8.03	< 7.99
2172		Solid composite	< 8.22	< 7.94	< 8.08
2175	Core 43	Solid composite	< 12.6	< 12.5	< 12.55
2176		Solid composite	< 12.8	< 12.9	< 12.85
2177	Core 44	Solid composite	16.2	< 12.6	< 14.4
2178		Solid composite	91.8	58.3	75.05

Table B2-32. Tank 241-S-104 Analytical Results: Selenium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 41.5	< 41.5	< 41.5
2172		Solid composite	< 40.9	< 41.2	< 41.05
2175	Core 43	Solid composite	< 70.1	< 69.7	< 69.9
2176		Solid composite	< 69.1	< 68.8	< 68.95
2177	Core 44	Solid composite	< 64.6	< 65.5	< 65.05
2178		Solid composite	< 64.9	< 65	< 64.95
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 8.43	< 8.38	< 8.405
2172		Solid composite	< 8.43	< 8.47	< 8.45
2175	Core 43	Solid composite	< 13.1	< 13.1	< 13.1
2176		Solid composite	< 13.3	< 13.2	< 13.25
2177	Core 44	Solid composite	26.6	48.3	37.45
2178		Solid composite	32.2	19.8	26
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 2.75		< 2.75
2249	43: 1	Drainable liquid	< 1.10		< 1.10[QC:f]
2248	44: 1	Drainable liquid	< 1.10		< 1.10[QC:f]
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	739	696	718
2006		Water dilution	925	937	931
2007		Water dilution	< 8.37	< 8.32	< 8.34
2008		Water dilution	< 7.87	< 7.91	< 7.89[QC:f]
2010		Water dilution	90.7	109	99.85

Table B2-33. Tank 241-S-104 Analytical Results: Selenium (Atomic Absorption).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 2.5E-04	< 0.25	< 0.13
2172		Solid composite	< 0.25	< 0.25	< 0.25
2175	Core 43	Solid composite	< 0.25	< 0.25	< 0.25
2176		Solid composite	< 0.25	< 0.25	< 0.25
2177	Core 44	Solid composite	< 0.25	< 0.25	< 0.25
2178		Solid composite	0.30	< 0.25	< 0.27
Solids			µg/mL	µg/mL	µg/mL
2231	Core 44	Solid composite	1.34		1.34

Table B2-34. Tank 241-S-104 Analytical Results: Silicon (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	212	211	211.5[QC:c]
2089		Homogenized Test 2	206	159	182.5[QC:c]
2092	43: 4	Homogenized Test 1	287	80.6	183.8
2093		Homogenized Test 2	< 2.26	107	< 54.63
2096	43: 6	Homogenized Test 1	103	61.1	82.05
2097		Homogenized Test 2	199	193	196
2171	Core 42	Solid composite	160	175	167.5
2172		Solid composite	165	145	155
2175	Core 43	Solid composite	167	189	178
2176		Solid composite	202	196	199
2177	Core 44	Solid composite	301	209	255
2178		Solid composite	205	187	196

Table B2-34. Tank 241-S-104 Analytical Results: Silicon (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	1,030	1,040	1,035
2172		Solid composite	1,180	1,090	1,135
2175	Core 43	Solid composite	1,230	1,130	1,180
2176		Solid composite	2,310	947	1,630
2177	Core 44	Solid composite	1,440	1,400	1,420
2178		Solid composite	1,570	1,550	1,560
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	44.6	146	95.3
2172		Solid composite	55.8	43.4	49.6
2175	Core 43	Solid composite	46.6	21.6	34.1
2176		Solid composite	27.7	29.6	28.65
2177	Core 44	Solid composite	15.2	18.1	16.65
2178		Solid composite	16.7	12.7	14.7
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	41		41[QC:f]
2249	43: 1	Drainable liquid	< 11		< 11
2248	44: 1	Drainable liquid	7.45		7.45
Drainable liquid: water digest			µg/g	µg/g	µg/g
2005	44: 1	Drainable liquid	< 3.48	< 4.3	< 3.89[QC:f]
2006		Drainable liquid	32	20.6	26.3[QC:f]
2007		Drainable liquid	23.3	24.8	24.05[QC:f]
2008		Drainable liquid	18.3	< 4.1	< 11.2[QC:f]
2010		Drainable liquid	10.5	8.41	9.46[QC:f]
		Drainable liquid	10.7	16.6	13.65[QC:f]

Table B2-35. Tank 241-S-104 Analytical Results: Silver (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	< 0.86	< 0.86	< 0.86
2089		Homogenized Test 2	< 0.88	< 0.86	< 0.87
2092	43: 4	Homogenized Test 1	< 0.92	< 0.97	< 0.94
2093		Homogenized Test 2	< 0.98	< 1	< 0.99
2096	43: 6	Homogenized Test 1	< 0.99	< 0.94	< 0.97
2097		Homogenized Test 2	< 1.49	< 1.29	< 1.39
2171	Core 42	Solid composite	< 0.96	< 0.97	< 0.96
2172		Solid composite	< 0.99	< 0.96	< 0.97
2175	Core 43	Solid composite	< 0.97	< 0.95	< 0.96
2176		Solid composite	< 0.98	< 0.97	< 0.98
2177	Core 44	Solid composite	< 0.98	< 0.96	< 0.97
2178		Solid composite	< 0.97	< 0.95	< 0.96
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 5	< 5	< 5
2172		Solid composite	< 4.93	< 4.96	< 4.95
2175	Core 43	Solid composite	< 4.47	< 4.45	< 4.46
2176		Solid composite	< 4.41	< 4.39	< 4.4
2177	Core 44	Solid composite	< 4.93	< 5	< 4.97
2178		Solid composite	< 4.95	< 4.96	< 4.96
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	1.43	2.03	1.73
2172		Solid composite	< 1.02	< 1.02	< 1.02
2175	Core 43	Solid composite	1.42	< 1	< 1.21
2176		Solid composite	< 1.01	< 1.01	< 1.01
2177	Core 44	Solid composite	< 1.02	< 1.02	< 1.02
2178		Solid composite	< 1.02	< 1.02	< 1.02
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.18		< 0.18[QC:f]
2249	43: 1	Drainable liquid	0.0703		0.070[QC:f]
2248	44: 1	Drainable liquid	0.0703		0.070[QC:f]

Table B2-35. Tank 241-S-104 Analytical Results: Silver (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 0.81	< 1	< 0.90
2006		Water dilution	< 1.01	< 1.01	< 1.01
2007		Water dilution	< 1.01	< 1	< 1.00[QC:f]
2008		Water dilution	< 0.95	< 0.95	< 0.95
2010		Water dilution	< 0.88	< 0.89	< 0.88[QC:f]

Table B2-36. Tank 241-S-104 Analytical Results: Sodium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	1.22E+05	1.18E+05	1.20E+05[QC:e]
2089		Homogenized Test 2	1.19E+05	1.17E+05	1.18E+05[QC:e]
2092	43: 4	Homogenized Test 1	1.16E+05	1.18E+05	1.17E+05[QC:e]
2093		Homogenized Test 2	1.11E+05	1.06E+05	1.08E+05[QC:e]
2096	43: 6	Homogenized Test 1	1.41E+05	1.29E+05	1.35E+05[QC:d]
2097		Homogenized Test 2	1.29E+05	1.45E+05	1.37E+05[QC:d]
2171	Core 42	Solid composite	1.32E+05	1.30E+05	1.31E+05[QC:e]
2172		Solid composite	1.17E+05	1.21E+05	1.19E+05[QC:e]
2175	Core 43	Solid composite	1.18E+05	1.16E+05	1.17E+05
2176		Solid composite	1.15E+05	1.20E+05	1.17E+05
2177	Core 44	Solid composite	1.14E+05	1.22E+05	1.18E+05
2178		Solid composite	1.20E+05	1.23E+05	1.21E+05[QC:d]
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	1.24E+05	1.25E+05	1.24E+05[QC:e]
2172		Solid composite	1.16E+05	1.19E+05	1.17E+05[QC:e]
2175	Core 43	Solid composite	1.19E+05	1.20E+05	1.19E+05
2176		Solid composite	1.16E+05	1.19E+05	1.17E+05
2177	Core 44	Solid composite	1.14E+05	1.13E+05	1.13E+05
2178		Solid composite	1.15E+05	1.19E+05	1.17E+05

Table B2-36. Tank 241-S-104 Analytical Results: Sodium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	1.16E+05	1.20E+05	1.18E+05
2172		Solid composite	1.18E+05	1.24E+05	1.21E+05
2175	Core 43	Solid composite	1.18E+05	1.20E+05	1.19E+05
2176		Solid composite	1.21E+05	1.17E+05	1.19E+05
2177	Core 44	Solid composite	28,000	45,500	36,750
2178		Solid composite	44,300	33,300	38,800
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	1.61E+05		1.61E+05
2249	43: 1	Drainable liquid	1.51E+05		1.51E+05
2248	44: 1	Drainable liquid	1.52E+05		1.52E+05
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	1.150E+05	1.280E+05	1.22E+05
2006		Water dilution	1.160E+05	1.140E+05	1.150E+05
2007		Water dilution	1.380E+05	1.370E+05	1.38E+05
2010		Water dilution	78,400	61,000	69,700[QC:c]

Table B2-37. Tank 241-S-104 Analytical Results: Strontium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	173	183	178
2089		Homogenized Test 2	183	185	184
2092	43: 4	Homogenized Test 1	405	423	414
2093		Homogenized Test 2	434	391	412.5
2096	43: 6	Homogenized Test 1	359	386	372.5
2097		Homogenized Test 2	455	406	430.5
2171	Core 42	Solid composite	338	296	317
2172		Solid composite	368	358	363

Table B2-37. Tank 241-S-104 Analytical Results: Strontium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2175	Core 43	Solid composite	327	328	327.5
2176		Solid composite	345	350	347.5
2177	Core 44	Solid composite	321	329	325
2178		Solid composite	283	264	273.5
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	416	401	408.5
2172		Solid composite	434	399	416.5
2175	Core 43	Solid composite	415	440	427.5
2176		Solid composite	503	474	488.5
2177	Core 44	Solid composite	371	488	429.5
2178		Solid composite	372	373	372.5
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 0.406	1.08	< 0.743
2172		Solid composite	< 0.406	< 0.408	< 0.407
2175	Core 43	Solid composite	0.777	0.927	0.852
2176		Solid composite	0.695	0.833	0.764
2177	Core 44	Solid composite	0.688	< 0.612	< 0.65
2178		Solid composite	0.824	< 0.611	< 0.7175
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.059		< 0.059
2249	43: 1	Drainable liquid	0.023		0.023[QC:f]
2248	44: 1	Drainable liquid	0.037		0.037[QC:f]
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 0.32	< 0.4	< 0.362
2006		Water dilution	2.11	0.53	1.32
2007		Water dilution	4.47	0.68	2.58
2008		Water dilution	< 0.38	0.61	< 0.50
2010		Water dilution	0.73	0.74	0.74[QC:f]

Table B2-38. Tank 241-S-104 Analytical Results: Sulfur (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	324	347	335.5
2089		Homogenized Test 2	347	338	342.5
2092	43: 4	Homogenized Test 1	366	366	366
2093		Homogenized Test 2	382	394	388
2096	43: 6	Homogenized Test 1	400	437	418.5
2097		Homogenized Test 2	476	380	428
2171	Core 42	Solid composite	418	445	431.5
2172		Solid composite	415	404	409.5
2175	Core 43	Solid composite	435	389	412
2176		Solid composite	414	388	401
2177	Core 44	Solid composite	350	347	348.5
2178		Solid composite	367	359	363
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	464	467	465.5
2172		Solid composite	473	462	467.5
2175	Core 43	Solid composite	463	482	472.5
2176		Solid composite	449	430	439.5
2177	Core 44	Solid composite	439	459	449[QC:c]
2178		Solid composite	615	461	538[QC:c]
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	478	470	474
2172		Solid composite	467	431	449
2175	Core 43	Solid composite	445	455	450[QC:c]
2176		Solid composite	459	480	469.5[QC:c]
2177	Core 44	Solid composite	74.9	123	98.95
2178		Solid composite	121	77.1	99.05
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	424		424
2249	43: 1	Drainable liquid	383		383
2248	44: 1	Drainable liquid	423		423

Table B2-38. Tank 241-S-104 Analytical Results: Sulfur (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	487	462	474.5
2006		Water dilution	494	525	509.5
2007		Water dilution	469	480	474.5
2008		Water dilution	488	471	479.5
2010		Water dilution	191	199	195

Table B2-39. Tank 241-S-104 Analytical Results: Tin (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	4.95	2.65	3.8
2089		Homogenized Test 2	4.18	3.68	3.93
2092	43: 4	Homogenized Test 1	< 1.47	< 1.55	< 1.51
2093		Homogenized Test 2	< 1.57	< 1.6	< 1.585
2096	43: 6	Homogenized Test 1	< 2.28	< 2.17	< 2.225
2097		Homogenized Test 2	< 2.38	< 2.06	< 2.22
2171	Core 42	Solid composite	< 2.2	< 2.22	< 2.21
2172		Solid composite	< 2.28	< 2.2	< 2.24
2175	Core 43	Solid composite	< 1.54	< 1.53	< 1.535
2176		Solid composite	< 1.57	1.84	< 1.705
2177	Core 44	Solid composite	< 1.57	< 1.54	< 1.555
2178		Solid composite	1.77	< 1.52	< 1.645
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 11.5	< 11.5	< 11.5
2172		Solid composite	< 11.3	< 11.4	< 11.35
2175	Core 43	Solid composite	< 8.95	< 8.89	< 8.92
2176		Solid composite	< 8.82	< 8.79	< 8.805
2177	Core 44	Solid composite	< 7.89	< 8	< 7.945
2178		Solid composite	< 7.92	< 7.94	< 7.93

Table B2-39. Tank 241-S-104 Analytical Results: Tin (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	2.51	< 2.32	< 2.415
2172		Solid composite	< 2.34	< 2.35	< 2.345
2175	Core 43	Solid composite	3.98	2.27	3.125
2176		Solid composite	2.52	3.17	2.845
2177	Core 44	Solid composite	< 1.63	< 1.63	< 1.63
2178		Solid composite	< 1.63	< 1.63	< 1.63
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	2.57		2.57
2249	43: 1	Drainable liquid	< 2.23		< 2.23
2248	44: 1	Drainable liquid	2.63		2.63
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 1.86	< 2.3	< 2.08
2006		Water dilution	< 2.33	< 2.33	< 2.33
2007		Water dilution	2.6	< 2.3	< 2.45
2008		Water dilution	< 2.18	< 2.19	< 2.19
2010		Water dilution	< 1.76	< 1.78	< 1.77

Table B2-40. Tank 241-S-104 Analytical Results: Titanium (ICP). (3 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	3.89	4.46	4.175
2089		Homogenized Test 2	3.86	4.04	3.95
2092	43: 4	Homogenized Test 1	6.44	7.23	6.835
2093		Homogenized Test 2	7.69	6.43	7.06
2096	43: 6	Homogenized Test 1	3.39	3.9	3.645
2097		Homogenized Test 2	4.4	4.32	4.36
2171	Core 42	Solid composite	4.84	5.16	5
2172		Solid composite	6.42	5.79	6.105

Table B2-40. Tank 241-S-104 Analytical Results: Titanium (ICP). (3 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2175	Core 43	Solid composite	4.04	3.56	3.8
2176		Solid composite	4.09	3.93	4.01
2177	Core 44	Solid composite	9.02	8.63	8.825
2178		Solid composite	10.7	9.97	10.335
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	3.5	< 2	< 2.75
2172		Solid composite	4.45	3.46	3.955
2175	Core 43	Solid composite	11.5	8.68	10.09
2176		Solid composite	6.98	6.6	6.79
2177	Core 44	Solid composite	10.1	7.18	8.64
2178		Solid composite	11.7	13.9	12.8
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 0.41	3.48	< 1.94
2172		Solid composite	< 0.41	< 0.41	< 0.41
2175	Core 43	Solid composite	0.784	< 0.5	< 0.64
2176		Solid composite	< 0.51	< 0.51	< 0.51
2177	Core 44	Solid composite	< 0.51	< 0.51	< 0.51
2178		Solid composite	< 0.51	< 0.51	< 0.51
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.14		< 0.14
2249	43: 1	Drainable liquid	< 0.055		< 0.055
2248	44: 1	Drainable liquid	< 0.059		< 0.059
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 0.32	< 0.4	< 0.362
2006		Water dilution	< 0.41	< 0.41	< 0.41
2007		Water dilution	< 0.40	< 0.40	< 0.40
2008		Water dilution	< 0.38	< 0.38	< 0.38
2010		Water dilution	< 0.68	< 0.69	< 0.69[QC:f]

Table B2-40. Tank 241-S-104 Analytical Results: Titanium (ICP). (3 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	7,100	6,510	6,805
2172		Solid composite	6,900	7,270	7,085
2175	Core 43	Solid composite	7,060	6,520	6,790
2176		Solid composite	7,530	7,510	7,520
2177	Core 44	Solid composite	6,140	6,210	6,175
2178		Solid composite	5,150	6,320	5,735

Table B2-41. Tank 241-S-104 Analytical Results: Zinc (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	6.09	7.11	6.6
2089		Homogenized Test 2	5.38	4.64	5.01
2092	43: 4	Homogenized Test 1	16.3	9.92	13.11
2093		Homogenized Test 2	11.4	11.8	11.6
2096	43: 6	Homogenized Test 1	< 2.48	< 2.35	< 2.415
2097		Homogenized Test 2	21.7	19	20.35
2171	Core 42	Solid composite	26.2	32.6	29.4
2172		Solid composite	21.5	18.6	20.05
2175	Core 43	Solid composite	26.5	23.6	25.05
2176		Solid composite	26	17	21.5
2177	Core 44	Solid composite	13.5	11.7	12.6
2178		Solid composite	12	12.2	12.1
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	77.9	69.3	73.6
2172		Solid composite	55.4	95.4	75.4
2175	Core 43	Solid composite	96.9	45.2	71.05
2176		Solid composite	117	59.9	88.45

Table B2-41. Tank 241-S-104 Analytical Results: Zinc (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
2177	Core 44	Solid composite	234	206	220
2178		Solid composite	1,370	263	816.5
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	19.5	44.6	32.05
2172		Solid composite	19.4	18.2	18.8
2175	Core 43	Solid composite	13.9	13.9	13.9
2176		Solid composite	11.9	11.9	11.9
2177	Core 44	Solid composite	< 2.54	< 2.55	< 2.545
2178		Solid composite	7.12	< 2.55	< 4.835
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	7		7[QC:f]
2249	43: 1	Drainable liquid	< 6.66406		< 6.66406
2248	44: 1	Drainable liquid	< 3.64844		< 3.64844
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 2.02	< 2.5	< 2.26
2006		Water dilution	11.4	< 2.53	< 6.965
2007		Water dilution	< 2.52	< 2.5	< 2.51
2008		Water dilution	5.4	4.82	5.11
2010		Water dilution	4.45	1.43	2.94[QC:f]

Table B2-42. Tank 241-S-104 Analytical Results: Zirconium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
2088	43: 2	Homogenized Test 1	24.2	25.8	25
2089		Homogenized Test 2	25.6	26	25.8
2092	43: 4	Homogenized Test 1	47	46.4	46.7
2093		Homogenized Test 2	46.8	44.8	45.8
2096	43: 6	Homogenized Test 1	33.1	34.2	33.65
2097		Homogenized Test 2	42	35.8	38.9
2171	Core 42	Solid composite	32.3	30.9	31.6
2172		Solid composite	37	34.5	35.75
2175	Core 43	Solid composite	34.8	33.6	34.2
2176		Solid composite	34.3	35.5	34.9
2177	Core 44	Solid composite	34.5	35.5	35
2178		Solid composite	31.5	29.3	30.4
Solids: fusion			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	13.1	8.63	10.865
2172		Solid composite	4.85	12.5	8.675
2175	Core 43	Solid composite	26	28.3	27.15
2176		Solid composite	29.7	37.9	33.8
2177	Core 44	Solid composite	22.9	20.3	21.6
2178		Solid composite	20.9	29.4	25.15
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 0.813	< 0.808	< 0.8105
2172		Solid composite	< 0.813	< 0.816	< 0.8145
2175	Core 43	Solid composite	< 1.1	< 1.1	< 1.1
2176		Solid composite	< 1.11	< 1.11	< 1.11
2177	Core 44	Solid composite	< 1.12	< 1.12	< 1.12
2178		Solid composite	1.2	< 1.12	< 1.16

Table B2-42. Tank 241-S-104 Analytical Results: Zirconium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid: acid digest			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.234375		< 0.234375
2249	43: 1	Drainable liquid	0.094		0.094[QC:f]
2248	44: 1	Drainable liquid	0.094		0.094[QC:f]
Water dilution			µg/g	µg/g	µg/g
2005	44: 6	Water dilution	< 0.648	< 0.8	< 0.724
2006		Water dilution	< 0.809	< 0.811	< 0.81
2007		Water dilution	< 0.806	< 0.802	< 0.804
2008		Water dilution	< 0.76	< 0.76	< 0.76
2010		Water dilution	< 1.17	< 1.19	< 1.18

Table B2-43. Tank 241-S-104 Analytical Results: Ammonium (Distillation (NH3).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µg/g	µg/g	µg/g
2245	42: 1	Drainable liquid	31.25		31.25
2245	43: 1	Drainable liquid	< 31.25		< 31.25
2245	44: 1	Drainable liquid	< 31.25		< 31.25

Table B2-44. Tank 241-S-104 Analytical Results: Ammonium (Distillation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	< 4,500	< 4,500	< 4,500
2172		Solid composite	< 4,500	< 4,500	< 4,500
2175	Core 43	Solid composite	< 4,500	< 4,500	< 4,500
2176		Solid composite	< 4,500	< 4,500	< 4,500
2177	Core 44	Solid composite	< 9,000	< 9,000	< 9,000
2178		Solid composite	< 9,000	< 9,000	< 9,000

Table B2-45. Tank 241-S-104 Analytical Results: Carbonate (TIC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	2,490	3,020	2,755
2172		Solid composite	4,980	4,150	4,565
2175	Core 43	Solid composite	3,330	3,180	3,255
2176		Solid composite	3,280	4,650	3,965
2177	Core 44	Solid composite	3,540	2,390	2,965
2178		Solid composite	7,550	7,140	7,345
Drainable liquid			µg/mL	µg/mL	µg/mL
2247	42: 1	Drainable liquid	1,370		1,370[QC:f]
2249	43: 1	Drainable liquid	1,030		1,030[QC:f]
2248	44: 1	Drainable liquid	922		922[QC:f]

Table B2-46. Tank 241-S-104 Analytical Results: Chloride (IC). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	4,625		4,625
2249	43: 1	Drainable liquid	4,476		4,476
2248	44: 1	Drainable liquid	5,875		5,875
Drainable liquid: water digest			µg/g	µg/g	µg/g
2012	44: 1	Drainable liquid	2,730	2,540	2,635
2035		Drainable liquid	172	158	165
2181		Drainable liquid	2,610	2,630	2,620
2212		Drainable liquid	3,210	3,100	3,155
2235		Drainable liquid	2,160	2,230	2,195
2237		Drainable liquid	3,620	4,340	3,980

Table B2-46. Tank 241-S-104 Analytical Results: Chloride (IC). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
2009	44: 6	Final 15 cm (6 in.)	2,160	2,230	2,195
2171	Core 42	Solid composite	3,220	3,080	3,150
2172		Solid composite	3,130	3,100	3,115
2175	Core 43	Solid composite	3,140	3,000	3,070
2176		Solid composite	2,950	3,220	3,085
2177	Core 44	Solid composite	3,340	3,420	3,380
2178		Solid composite	3,260	3,520	3,390

Note:

IC = ion chromatography

Table B2-47. Tank 241-S-104 Analytical Results: Cyanide.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	3.96	4.12	4.04
2172		Solid composite	2.98	2.72	2.85
2175	Core 43	Solid composite	4.15	3.84	3.995
2176		Solid composite	4.08	3.74	3.91
2177	Core 44	Solid composite	4.3	3.94	4.12
2178		Solid composite	3.21	3.4	3.305
Drainable liquid			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	2.14		2.14
2249	43: 1	Drainable liquid	2.09		2.09
2248	44: 1	Drainable liquid	2.06		2.06

Table B2-48. Tank 241-S-104 Analytical Results: Fluoride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	1,453		1,453
2249	43: 1	Drainable liquid	2,125		2,125
2248	44: 1	Drainable liquid	3,336		3,336
Drainable liquid: water digest			µg/g	µg/g	µg/g
2012	44: 1	Drainable liquid	< 7.94	< 9.79	< 8.865
2035		Drainable liquid	< 109	< 109	< 109
2181		Drainable liquid	< 9.87	< 9.82	< 9.845
2212		Drainable liquid	< 9.29	< 9.34	< 9.315
2235		Drainable liquid	< 9.97	< 9.99	< 9.98
Solids: water digest			µg/g	µg/g	µg/g
2009	44: 6	Final 15 cm (6 in.)	< 9.97	< 9.99	< 9.98
2171	Core 42	Solid composite	< 110	< 109	< 109.5
2172		Solid composite	< 110	< 110	< 110
2175	Core 43	Solid composite	< 108	< 108	< 108
2176		Solid composite	< 109	< 109	< 109
2177	Core 44	Solid composite	< 216	< 219	< 217.5
2178		Solid composite	< 219	< 218	< 218.5

Table B2-49. Tank 241-S-104 Analytical Results: Hydroxide (OH Automatic).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µg/mL	µg/mL	µg/mL
2247	42: 1	Drainable liquid	51,200		51,200
2249	43: 1	Drainable liquid	40,500		40,500
2248	44: 1	Drainable liquid	41,100		41,100

Table B2-50. Tank 241-S-104 Analytical Results: Nitrate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	1.930E+05		1.930E+05
2249	43: 1	Drainable liquid	2.070E+05		2.070E+05
2248	44: 1	Drainable liquid	2.297E+05		2.297E+05
Drainable liquid: water digest			µg/g	µg/g	µg/g
2012	44: 1	Drainable liquid	2.200E+05	2.740E+05	2.470E+05
2035		Drainable liquid	2.280E+05	2.220E+05	2.250E+05
2181		Drainable liquid	2.600E+05	2.540E+05	2.570E+05
2212		Drainable liquid	1.730E+05	1.540E+05	1.635E+05
2235		Drainable liquid	2.580E+05	2.870E+05	2.725E+05
2237		Drainable liquid	2.610E+05	1.770E+05	2.190E+05
Solids: water digest			µg/g	µg/g	µg/g
2009	44: 6	Final 15 cm (6 in.)	20,400	2.870E+05	1.537E+05
2171	Core 42	Solid composite	1.700E+05	1.970E+05	1.835E+05
2172		Solid composite	1.970E+05	2.110E+05	2.040E+05
2175	Core 43	Solid composite	1.950E+05	1.890E+05	1.920E+05
2176		Solid composite	1.570E+05	1.770E+05	1.670E+05
2177	Core 44	Solid composite	2.090E+05	2.070E+05	2.080E+05
2178		Solid composite	1.860E+05	1.950E+05	1.905E+05

Table B2-51. Tank 241-S-104 Analytical Results: Nitrite (IC). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	34,375		34,375
2249	43: 1	Drainable liquid	< 27,578.1		< 27,578.1
2248	44: 1	Drainable liquid	27,656.2		27,656.2

Table B2-51. Tank 241-S-104 Analytical Results: Nitrite (IC). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid: water digest			µg/g	µg/g	µg/g
2012	44: 1	Drainable liquid	10,400	10,500	10,450
2035		Drainable liquid	20,000	20,800	20,400
2181		Drainable liquid	23,000	23,400	23,200
2212		Drainable liquid	23,800	23,500	23,650
2235		Drainable liquid	20,400	20,800	20,600
2237		Drainable liquid	37,400	41,800	39,600
Solids: water digest			µg/g	µg/g	µg/g
2009	44: 6	Final 15 cm (6 in.)	2,580	20,800	11,690
2171	Core 42	Solid composite	22,100	20,600	21,350
2172		Solid composite	19,800	19,900	19,850
2175	Core 43	Solid composite	19,200	16,600	17,900
2176		Solid composite	17,700	19,300	18,500
2177	Core 44	Solid composite	22,800	22,700	22,750
2178		Solid composite	23,300	25,700	24,500

Table B2-52. Tank 241-S-104 Analytical Results: Nitrite (Spectrophotometric). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	28,400	25,800	27,100
2172		Solid composite	26,100	24,800	25,450
2175	Core 43	Solid composite	29,800	26,600	28,200
2176		Solid composite	20,400	21,200	20,800
2177	Core 44	Solid composite	26,500	26,700	26,600
2178		Solid composite	24,800	29,400	27,100

Table B2-52. Tank 241-S-104 Analytical Results: Nitrite (Spectrophotometric). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid: water digest			µg/g	µg/g	µg/g
2012	44: 1	Drainable liquid	24,000	22,100	23,050
2035		Drainable liquid	28,000	25,500	26,750
2181		Drainable liquid	23,700	23,300	23,500
2212		Drainable liquid	26,500	26,600	26,550
2235		Drainable liquid	21,000	21,500	21,250
2237		Drainable liquid	31,400	38,900	35,150

Table B2-53. Tank 241-S-104 Analytical Results: Phosphate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	< 0.78		< 0.78
2249	43: 1	Drainable liquid	0.78		0.78
2248	44: 1	Drainable liquid	< 0.78		< 0.78
Drainable liquid: water digest			µg/g	µg/g	µg/g
2012	44: 1	Drainable liquid	< 79.4	< 97.9	< 88.65
2035		Drainable liquid	< 1,090	< 1,090	< 1,090
2181		Drainable liquid	< 98.9	< 98.2	< 98.55
2212		Drainable liquid	< 92.9	< 93.4	< 93.15
2235		Drainable liquid	< 99.7	< 99.9	< 99.8
2237		Drainable liquid	< 95.5	< 96.9	< 96.2
Solids: water digest			µg/g	µg/g	µg/g
2009	44: 6	Final 15 cm (6 in.)	< 99.7	< 99.9	< 99.8
2171	Core 42	Solid composite	< 1,100	< 1,090	< 1,095
2172		Solid composite	< 1,100	< 1,100	< 1,100
2175	Core 43	Solid composite	< 1,080	< 1,080	< 1,080
2176		Solid composite	< 1,090	< 1,090	< 1,090
2177	Core 44	Solid composite	< 2,160	< 2,190	< 2,175
2178		Solid composite	< 2,190	< 2,180	< 2,185

Table B2-54. Tank 241-S-104 Analytical Results: Sulfate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	4,940		4,940
2249	43: 1	Drainable liquid	10,000		10,000
2248	44: 1	Drainable liquid	41,560		41,560
Drainable liquid: water dilution			µg/g	µg/g	µg/g
2012	44: 1	Drainable liquid	1,640	1,420	1,530
2035		Drainable liquid	1,790	1,830	1,810
2181		Drainable liquid	1,500	1,510	1,505
2212		Drainable liquid	1,860	1,800	1,830
2235		Drainable liquid	1,670	1,680	1,675
2237		Drainable liquid	3,000	3,180	3,090
Solids: water digest			µg/g	µg/g	µg/g
2009	44: 6	Final 15 cm (6 in.)	1,670	1,630	1,650
2171	Core 42	Solid composite	2,520	2,250	2,385
2172		Solid composite	2,520	2,270	2,395
2175	Core 43	Solid composite	2,410	2,010	2,210
2176		Solid composite	2,370	2,240	2,305
2177	Core 44	Solid composite	2,200	2,170	2,185
2178		Solid composite	2,170	2,160	2,165

Table B2-55. Tank 241-S-104 Analytical Results: Americium-241 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
2088	43: 2	Homogenized Test 1	< 0.703	< 0.717	< 0.71
2089		Homogenized Test 2	< 0.732	< 0.722	< 0.727
2092	43: 4	Homogenized Test 1	< 0.269	< 0.262	< 0.2655
2093		Homogenized Test 2	< 0.125	< 0.124	< 0.1245
2096	43: 6	Homogenized Test 1	< 0.163	< 0.169	< 0.166
2097		Homogenized Test 2	< 0.171	< 0.179	< 0.175
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	< 0.699	< 0.679	< 0.689
2172		Solid composite	< 0.695	< 0.69	< 0.6925
2175	Core 43	Solid composite	< 0.434	< 0.432	< 0.433
2176		Solid composite	< 0.439	< 0.424	< 0.4315
2177	Core 44	Solid composite	< 0.267	< 0.266	< 0.2665
2178		Solid composite	< 0.258	< 0.262	< 0.26
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2247	42: 1	Drainable liquid	< 0.105		< 0.105
2249	43: 1	Drainable liquid	< 0.105		< 0.105
2248	44: 1	Drainable liquid	< 0.11		< 0.11

Table B2-56. Tank 241-S-104 Analytical Results: Americium-241 (Alpha Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	0.111	0.111	0.111
2172		Solid composite	0.118	0.116	0.117
2175	Core 43	Solid composite	0.12	0.12	0.12
2176		Solid composite	0.14	0.12	0.13
2177	Core 44	Solid composite	0.117	0.129	0.123
2178		Solid composite	0.109	0.113	0.111
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2247	42: 1	Drainable liquid	< 8.150E-05		< 8.150E-05
2249	43: 1	Drainable liquid	< 7.490E-05		< 7.490E-05
2248	44: 1	Drainable liquid	< 6.720E-05		< 6.720E-05

Table B2-57. Tank 241-S-104 Analytical Results: Carbon-14.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	0.001	6.900E-05	5.345E-04
2172		Solid composite	9.070E-04	0.00112	0.0010135
2175	Core 43	Solid composite	5.080E-04	6.150E-04	5.615E-04
2176		Solid composite	0.00108	9.580E-04	0.001019
2177	Core 44	Solid composite	0.00102	0.00118	0.0011
2178		Solid composite	0.00114	0.00122	0.00118

Table B2-58. Tank 241-S-104 Analytical Results: Cesium-137 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
2088	43: 2	Homogenized Test 1	52.9	53.7	53.3
2089		Homogenized Test 2	52.9	54.2	53.55
2092	43: 4	Homogenized Test 1	63.5	61.1	62.3
2093		Homogenized Test 2	51.5	49.6	50.55
2096	43: 6	Homogenized Test 1	47.1	53.6	50.35
2097		Homogenized Test 2	53.9	59	56.45
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	67.5	62	64.75
2172		Solid composite	66.1	62.6	64.35
2175	Core 43	Solid composite	60.2	60.3	60.25
2176		Solid composite	58.3	55.7	57
2177	Core 44	Solid composite	63.1	64	63.55
2178		Solid composite	63.9	64	63.95
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2247	42: 1	Drainable liquid	78		78
2249	43: 1	Drainable liquid	78.1		< 78.1
2248	44: 1	Drainable liquid	86.5		86.5

Table B2-59. Tank 241-S-104 Analytical Results: Cobalt-60 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
2088	43: 2	Homogenized Test 1	< 0.0446	< 0.0383	< 0.04145
2089		Homogenized Test 2	< 0.0478	< 0.0442	< 0.046
2092	43: 4	Homogenized Test 1	< 0.0143	< 0.013	< 0.01365
2093		Homogenized Test 2	< 0.00394	< 0.0455	< 0.02472
2096	43: 6	Homogenized Test 1	< 0.00689	< 0.0069	< 0.006895
2097		Homogenized Test 2	< 0.0059	< 0.00594	< 0.00592
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	< 0.063	< 0.084	< 0.0735
2172		Solid composite	< 0.062	< 0.07	< 0.06605
2175	Core 43	Solid composite	< 0.0325	< 0.0333	< 0.0329
2176		Solid composite	< 0.032	< 0.034	< 0.033
2177	Core 44	Solid composite	< 0.0135	< 0.0137	< 0.0136
2178		Solid composite	< 0.0143	< 0.0138	< 0.01405
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2247	42: 1	Drainable liquid	< 0.0025		< 0.0025
2249	43: 1	Drainable liquid	0.00257		0.00257
2248	44: 1	Drainable liquid	< 0.00246		< 0.00246

Table B2-60. Tank 241-S-104 Analytical Results: Europium-154 (GEA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
2088	43: 2	Homogenized Test 1	< 0.174	< 0.15	< 0.162
2089		Homogenized Test 2	< 0.122	< 0.132	< 0.127
2092	43: 4	Homogenized Test 1	< 0.03	< 0.0353	< 0.03265
2093		Homogenized Test 2	< 0.15	< 0.169	< 0.1595
2096	43: 6	Homogenized Test 1	0.095	0.121	0.108
2097		Homogenized Test 2	0.12	0.107	0.1135

Table B2-60. Tank 241-S-104 Analytical Results: Europium-154 (GEA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	< 0.237	< 0.317	< 0.277
2172		Solid composite	< 0.269	< 0.235	< 0.252
2175	Core 43	Solid composite	< 0.0821	< 0.0984	< 0.09025
2176		Solid composite	< 0.085	< 0.093	< 0.089
2177	Core 44	Solid composite	< 0.0379	< 0.0411	< 0.0395
2178		Solid composite	< 0.0372	< 0.0433	< 0.04025
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2247	42: 1	Drainable liquid	< 0.00967		< 0.00967
2249	43: 1	Drainable liquid	< 0.00834		< 0.00834
2248	44: 1	Drainable liquid	< 0.00948		< 0.00948

Table B2-61. Tank 241-S-104 Analytical Results: Europium-155 (GEA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
2088	43: 2	Homogenized Test 1	< 0.332	< 0.33	< 0.331
2089		Homogenized Test 2	< 0.328	< 0.322	< 0.325
2092	43: 4	Homogenized Test 1	< 0.116	< 0.114	< 0.115
2093		Homogenized Test 2	< 0.2	< 0.2	< 0.2
2096	43: 6	Homogenized Test 1	< 0.0712	< 0.0736	< 0.0724
2097		Homogenized Test 2	< 0.0745	< 0.0782	< 0.07635
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	< 0.461	< 0.447	< 0.454
2172		Solid composite	< 0.463	< 0.454	< 0.4585
2175	Core 43	Solid composite	< 0.186	< 0.188	< 0.187
2176		Solid composite	< 0.188	< 0.184	< 0.186
2177	Core 44	Solid composite	< 0.115	< 0.116	< 0.1155
2178		Solid composite	< 0.113	< 0.115	< 0.114

Table B2-61. Tank 241-S-104 Analytical Results: Europium-155 (GEA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2247	42: 1	Drainable liquid	< 0.0449		< 0.0449
2249	43: 1	Drainable liquid	< 0.0449		< 0.0449
2248	44: 1	Drainable liquid	< 0.047		< 0.047

Table B2-62. Tank 241-S-104 Analytical Results: Iodine-129.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	< 0.0196	< 0.0196	< 0.0196
2172		Solid composite	< 0.0125	< 0.0244	< 0.01845
2175	Core 43	Solid composite	< 0.0172	< 0.0132	< 0.0152
2176		Solid composite	< 0.0143	< 0.0136	< 0.01395
2177	Core 44	Solid composite	< 0.0162	< 0.0214	< 0.0188
2178		Solid composite	< 0.0334	< 0.0154	< 0.0244

Table B2-63. Tank 241-S-104 Analytical Results: Neptunium-237.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	< 0.0216	< 0.0216	< 0.0216
2172		Solid composite	< 0.021	< 0.0080	< 0.015
2175	Core 43	Solid composite	< 0.0215	< 0.0214	< 0.02145
2176		Solid composite	< 0.021	< 0.021	< 0.0212
2177	Core 44	Solid composite	< 0.021	< 0.022	< 0.021
2178		Solid composite	< 0.0107	< 0.0107	< 0.0107

Table B2-64. Tank 241-S-104 Analytical Results: Plutonium-238 (Alpha Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µCi/g	µCi/g	µCi/g
2168	42: 6	Final 15 cm (6 in.)	< 0.009	< 0.00898	< 0.00899
2166	43: 6	Final 15 cm (6 in.)	< 0.0045	< 0.0045	< 0.00445
2162	44: 6	Final 15 cm (6 in.)	< 0.00893	< 0.00892	< 0.00893
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	< 0.00901	< 0.00901	< 0.00901
2172		Solid composite	< 0.0089	< 0.0090	< 0.0089
2175	Core 43	Solid composite	< 0.018	< 0.018	< 0.018
2176		Solid composite	< 0.018	< 0.018	< 0.018
2177	Core 44	Solid composite	< 0.018	< 0.018	< 0.0179
2178		Solid composite	< 0.018	< 0.018	< 0.018

Table B2-65. Tank 241-S-104 Analytical Results: Plutonium-238 to Plutonium Ratio (Mass Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
93-1075-H1	42: 6	Partial	0.012	0.01	0.011
93-1755-H1	43: 6	Whole	0.01	0.01	0.01
93-1754-H1	44: 6	Partial	0.011	0.014	0.0125
93-1076-H1	Core 42	Solid composite	0.009	0.01	0.0095
93-1756-H1		Solid composite	0.011	0.008	0.0095
93-1758-H1	Core 43	Solid composite	0.009	0.009	0.009
93-1757-H1		Solid composite	0.008	0.009	0.0085
93-1759-H1	Core 44	Solid composite	0.009	0.009	0.009
93-1760-H1		Solid composite	0.009	0.009	0.009

Table B2-66. Tank 241-S-104 Analytical Results: Plutonium-239/40 (Alpha Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µCi/g	µCi/g	µCi/g
2168	42: 6	Final 15 cm (6 in.)	0.354	0.295	0.3245
2166	43: 6	Final 15 cm (6 in.)	0.129	0.142	0.1355
2162	44: 6	Final 15 cm (6 in.)	0.185	0.209	0.197
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	0.137	0.136	0.1365
2172		Solid composite	0.157	0.154	0.1555
2175	Core 43	Solid composite	0.296	0.314	0.305
2176		Solid composite	0.385	0.361	0.373
2177	Core 44	Solid composite	0.365	0.404	0.3845
2178		Solid composite	0.366	0.31	0.338
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2247	42: 1	Drainable liquid	< 1.370E-04		< 1.370E-04
2249	43: 1	Drainable liquid	< 6.410E-05		< 6.410E-05
2248	44: 1	Drainable liquid	< 6.880E-05		< 6.880E-05

Table B2-67. Tank 241-S-104 Analytical Results: Plutonium-239 to Plutonium Ratio (Mass Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
93-1075-H1	42: 6	Partial	95	95	95
93-1755-H1	43: 6	Whole	95	95	95
93-1754-H1	44: 6	Partial	95	95	95
93-1076-H1	Core 42	Solid composite	95	95	95
93-1756-H1		Solid composite	95	95	95
93-1758-H1	Core 43	Solid composite	95	95	95
93-1757-H1		Solid composite	95	95	95
93-1759-H1	Core 44	Solid composite	95	95	95
93-1760-H1		Solid composite	95	95	95

Table B2-68. Tank 241-S-104 Analytical Results: Plutonium-240 to Plutonium Ratio (Mass Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
93-1075-H1	42: 6	Partial	4.96	4.91	4.93
93-1755-H1	43: 6	Whole	4.92	4.91	4.92
93-1754-H1	44: 6	Partial	4.95	5.02	4.99
93-1076-H1	Core 42	Solid composite	4.83	5.15	5.0
93-1756-H1		Solid composite	5.06	5.03	5.05
93-1758-H1	Core 43	Solid composite	5.01	4.93	4.97
93-1757-H1		Solid composite	5.00	5.01	5.01
93-1759-H1	Core 44	Solid composite	5.03	5.07	5.05
93-1760-H1		Solid composite	5.0	4.97	4.98

Table B2-69. Tank 241-S-104 Analytical Results: Plutonium-241 to Plutonium Ratio (Mass Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
93-1075-H1	42: 6	Partial	0.054	0.077	0.065
93-1755-H1	43: 6	Whole	0.054	0.053	0.054
93-1754-H1	44: 6	Partial	0.052	0.070	0.061
93-1076-H1	Core 42	Solid composite	0.069	0.11	0.090
93-1756-H1		Solid composite	0.053	0.060	0.056
93-1758-H1	Core 43	Solid composite	0.055	0.054	0.055
93-1757-h1		Solid composite	0.080	0.053	0.066
93-1759-H1	Core 44	Solid composite	0.073	0.055	0.064
93-1760-H1		Solid composite	0.058	0.061	0.060

Table B2-70. Tank 241-S-104 Analytical Results: Plutonium-242 to Plutonium Ratio (Mass Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
93-1075-H1	42: 6	Partial	0.0129	0.0122	0.013
93-1755-H1	43: 6	Whole	0.013	0.011	0.012
93-1754-H1	44: 6	Partial	0.0105	0.0241	0.0173
93-1076-H1	Core 42	Solid composite	0.0256	0.0527	0.039
93-1756-H1		Solid composite	0.0405	0.0151	0.0278
93-1758-H1	Core 43	Solid composite	0.0179	0.0122	0.015
93-1757-H1		Solid composite	0.0263	0.0151	0.021
93-1759-H1	Core 44	Solid composite	0.0241	0.0178	0.021
93-1760-H1		Solid composite	0.0075	0.0288	0.018

Table B2-71. Tank 241-S-104 Analytical Results: Selenium-79.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	< 1.240E-04	< 1.270E-04	< 1.255E-04
2172		Solid composite	0.0013	< 1.260E-04	< 7.130E-04
2175	Core 43	Solid composite	< 1.210E-04	< 1.220E-04	< 1.215E-04
2176		Solid composite	< 1.230E-04	< 1.230E-04	< 1.230E-04
2177	Core 44	Solid composite	< 1.440E-04	< 1.480E-04	< 1.460E-04
2178		Solid composite	< 1.420E-04	< 1.470E-04	< 1.445E-04

Table B2-72. Tank 241-S-104 Analytical Results: Strontium-90.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	295	281	288
2172		Solid composite	339	310	324.5
2175	Core 43	Solid composite	305	300	302.5
2176		Solid composite	310	345	327.5
2177	Core 44	Solid composite	299	356	327.5
2178		Solid composite	272	303	287.5
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2247	42: 1	Drainable liquid	0.0030		0.0030[QC:f]
2249	43: 1	Drainable liquid	0.010		0.010[QC:f]
2248	44: 1	Drainable liquid	0.0024		0.0024[QC:f]

Table B2-73. Tank 241-S-104 Analytical Results: Technetium-99.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	0.0271	0.0235	0.0253
2172		Solid composite	0.0261	0.026	0.026
2175	Core 43	Solid composite	0.023	0.021	0.022
2176		Solid composite	0.0213	0.0209	0.0211
2177	Core 44	Solid composite	0.0281	0.0283	0.0282
2178		Solid composite	0.022	0.023	0.022

Table B2-74. Tank 241-S-104 Analytical Results: Tritium (Liquid Scintillation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	0.0019	0.002	0.00195
2172		Solid composite	0.00334	0.00583	0.0046
2175	Core 43	Solid composite	0.00316	0.00314	0.00315
2176		Solid composite	0.00277	0.00313	0.00295
2177	Core 44	Solid composite	0.00319	0.00328	0.0032
2178		Solid composite	0.00321	0.00556	0.0044

Table B2-75. Tank 241-S-104 Analytical Results: Uranium-234 to Uranium Ratio (Mass Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
93-1075-H1	42: 6	Partial	0.0056	0.0063	0.00595
93-1755-H1	43: 6	Whole	0.0057	0.0056	0.00565
93-1754-H1	44: 6	Partial	0.0053	0.0047	0.005
93-1076-H1	Core 42	Solid composite	0.0027	0.0064	0.00455
93-1756-H1		Solid composite	0.0069	0.0047	0.0058
93-1758-H1	Core 43	Solid composite	0.009	0.0053	0.00715
03-1757-H1		Solid composite	0.0032	0.0061	0.00465
93-1759-H1	Core 44	Solid composite	0.006	0.0053	0.00565
93-1760-H1		Solid composite	0.0071	0.005	0.00605

Table B2-76. Tank 241-S-104 Analytical Results: Uranium-235 to Uranium Ratio (Mass Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
93-1075-H1	42: 6	Partial	0.65	0.65	0.65
93-1755-H1	43: 6	Whole	0.64	0.64	0.64
93-1754-H1	44: 6	Partial	0.65	0.65	0.65
93-1076-H1	Core 42	Solid composite	0.65	0.65	0.65
93-1756-H1		Solid composite	0.64	0.65	0.65
93-1758-H1	Core 43	Solid composite	0.65	0.65	0.65
93-1757-H1		Solid composite	0.65	0.65	0.65
93-1759-H1	Core 44	Solid composite	0.65	0.65	0.65
93-1760-H1		Solid composite	0.65	0.64	0.65

Table B2-77. Tank 241-S-104 Analytical Results: Uranium-236 to Uranium Ratio (Mass Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
93-1075-H1	42: 6	Partial	0.0112	0.0109	0.011
93-1755-H1	43: 6	Whole	0.0098	0.0103	0.010
93-1754-H1	44: 6	Partial	0.0123	0.011	0.012
93-1076-H1	Core 42	Solid composite	0.0065	0.0082	0.0074
93-1756-H1		Solid composite	0.0109	0.0124	0.0117
93-1758-H1	Core 43	Solid composite	0.0105	0.0104	0.0105
93-1757-H1		Solid composite	0.0037	0.011	0.00735
93-1759-H1	Core 44	Solid composite	0.0102	0.0096	0.0099
93-1760-H1		Solid composite	0.0097	0.0111	0.0104

Table B2-78. Tank 241-S-104 Analytical Results: Uranium-238 to Uranium Ratio (Mass Spectrometry).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			%	%	%
93-1075-H1	42: 6	Partial	99	99	99
93-1755-H1	43: 6	Whole	99	99	99
93-1754-H1	44: 6	Partial	99	99	99
93-1076-H1	Core 42	Solid composite	99	99	99
93-1756-H1		Solid composite	99	99	99
93-1758-H1	Core 43	Solid composite	99	99	99
93-1757-H1		Solid composite	99	99	99
93-1759-H1	Core 44	Solid composite	99	99	99
93-1760-H1		Solid composite	99	99	99

Table B2-79. Tank 241-S-104 Analytical Results: Total Alpha.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µCi/g	µCi/g	µCi/g
2088	43: 2	Homogenized Test 1	0.34	0.363	0.352
2089		Homogenized Test 2	0.291	< 0.302	< 0.30
2092	43: 4	Homogenized Test 1	0.778	0.823	0.80
2093		Homogenized Test 2	0.503	0.457	0.48
2096	43: 6	Homogenized Test 1	0.428	0.393	0.41
2097		Homogenized Test 2	0.455	0.441	0.448
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2245	43: 1	Drainable liquid	0.188		0.188
2245	44: 1	Drainable liquid	0.228		0.228
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	0.701	< 0.352	< 0.5265
2172		Solid composite	0.578	< 0.72	< 0.649
2175	Core 43	Solid composite	0.807	0.779	0.793
2176		Solid composite	0.998	0.916	0.957
2177	Core 44	Solid composite	0.432	0.489	0.461
2178		Solid composite	0.39	0.239	0.315

Table B2-80. Tank 241-S-104 Analytical Results: Total Alpha Plutonium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
93-1075-H1	42: 6	Partial	0.259	0.335	0.297[QC:f]
93-1755-H1	43: 6	Whole	0.334	0.305	0.32[QC:f]
93-1754-H1	44: 6	Partial	0.35	0.376	0.36[QC:f]
93-1076-H1	Core 42	Solid composite	0.401	0.373	0.387[QC:f]
93-1756-H1		Solid composite	0.335	0.328	0.332
93-1758-H1	Core 43	Solid composite	0.428	0.431	0.43[QC:f]
93-1757-H1		Solid composite	0.454	0.487	0.47[QC:f]
93-1759-H1	Core 44	Solid composite	0.405	0.424	0.415[QC:f]
93-1760-H1		Solid composite	0.407	0.401	0.404[QC:f]

Table B2-81. Tank 241-S-104 Analytical Results: Ratio of Total Alpha to Plutonium + Americium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			unitless	unitless	unitless
2171	Core 42	Solid composite	2.84	---	1.42
2172		Solid composite	2.1	---	2.1
2175	Core 43	Solid composite	1.95	1.79	1.87
2176		Solid composite	1.92	1.92	1.92
2177	Core 44	Solid composite	0.896	0.917	0.907
2178		Solid composite	0.821	0.565	0.693

Table B2-82. Tank 241-S-104 Analytical Results: Total Beta (Alpha Radiation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µCi/mL	µCi/mL	µCi/mL
2247	42: 1	Drainable liquid	116		116
2249	43: 1	Drainable liquid	127		127
2248	44: 1	Drainable liquid	138		138

Table B2-83. Tank 241-S-104 Analytical Results: Total Beta.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
2171	Core 42	Solid composite	80.3	89.7	85
2172		Solid composite	94.8	102	98.4
2175	Core 43	Solid composite	930	914	922
2176		Solid composite	985	986	985.5
2177	Core 44	Solid composite	865	1,010	937.5
2178		Solid composite	795	846	820.5

Table B2-84. Tank 241-S-104 Analytical Results: Ratio of Total Beta to Cesium + Strontium.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			unitless	unitless	unitless
2171	Core 42	Solid composite	0.086	0.101	0.093
2172		Solid composite	0.089	0.105	0.0971
2175	Core 43	Solid composite	0.97	0.969	0.9705
2176		Solid composite	1.02	0.927	0.974
2177	Core 44	Solid composite	0.916	0.912	0.914
2178		Solid composite	0.915	0.884	0.90

Table B2-85. Tank 241-S-104 Analytical Results: Percent Water (TGA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
2067	42: 1	Whole	39.3	40.6	39.95
2071	42: 2	Whole	35.2	38.5	36.85
2074	42: 3	Whole	42	42.3	42.15
2060	42: 4	Whole	23.8	21.6	22.7
2077	42: 5	Whole	29.4	29.5	29.45
2083	42: 6	Whole	30.32	20.9	25.61
2038	43: 1	Whole	31.1	32	31.55
		Whole	43.4	42.9	43.15
2046	43: 2	Whole	33.9	29.3	31.6
2051	43: 3	Whole	53.8	52.4	53.1
2053	43: 4	Whole	30.8		30.8
		Whole		30.3	30.3
2056	43: 5	Whole	26.4	26.3	26.35
2059	43: 6	Whole	22.9	17.99	20.445
2030	44: 1	Whole	29.7	36.2	32.95
2033		Whole	9.1	7.66	8.38
2029	44: 2	Whole	38.3	37.8	38.05
2022	44: 3	Whole	23.7	25.2	24.45
2026		Whole	30.4	37.7	34.05
2023	44: 4	Whole	35.2	36.2	35.7
2015	44: 5	Whole	25.3	31.6	28.45
2017		Whole	20.5	25.7	23.1
2001	44: 6	Partial	23.7	24.9	24.3
2171	Core 42	Solid composite	23.9	25.5	24.7
2172		Solid composite	36	33.9	34.95
2175	Core 43	Solid composite	29.4	28.6	29
2176		Solid composite	29.7	33.5	31.6
2177	Core 44	Solid composite	95.24	94.93	95.085
2178		Solid composite	93.84	94.68	94.26

Table B2-85. Tank 241-S-104 Analytical Results: Percent Water (TGA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			%	%	%
2247	42: 1	Drainable liquid	55.71	55.4	55.555
2249	43: 1	Drainable liquid	54.29		54.29
2248	44: 1	Drainable liquid	55.13		55.13

Table B2-86. Tank 241-S-104 Analytical Results: Percent Water (Percent Solids). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
2116	42: 1	Whole	43.5	43.4	43.45
2118	42: 2	Whole	45	50.1	47.55
2120	42: 3	Whole	42.8	43.3	43.05
2122	42: 4	Whole	43.3	34.5	38.9
2125	42: 5	Whole	31.6	29.6	30.6
2127	42: 6	Whole	27.1	30.6	28.85
2129	43: 1	Whole	44.8	44.2	44.5
2131	43: 2	Whole	41.3	41.6	41.45
2134	43: 3	Whole	42.3	41.6	41.95
2136	43: 4	Whole	34.9	36.3	35.6
2138	43: 5	Whole	34.6	30.8	32.7
2140	43: 6	Whole	26.3	25.6	25.95
2143	44: 1	Whole	67	63.3	65.15
2131	44: 2	Whole	41.3	43.9	42.6
2147	44: 3	Whole	80.3	64.6	72.45
2149	44: 4	Whole	58.1	53.1	55.6
2152	44: 5	Whole	34.9	31.9	33.4
2003	44: 6	Partial	24.2	24.9	24.55
2199	Core 42	Solid composite	36.2	34.9	35.55
2201		Solid composite	36.2	33.4	34.8

Table B2-86. Tank 241-S-104 Analytical Results: Percent Water (Percent Solids). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
2203	Core 43	Solid composite	28.5	30	29.25
2205		Solid composite	34.7	32.8	33.75
2208	Core 44	Solid composite	37.1	35.5	36.3
2210		Solid composite	38.3	37.2	37.75
Drainable liquid			%	%	%
2247	42: 1	Drainable liquid	56.94		56.94
2248	43: 1	Drainable liquid	56.24		56.24
2249	44: 1	Drainable liquid	56.85		56.85

Table B2-87. Differential Scanning Calorimetry (DSC). (2 sheets)

Sample	Sample Location	Sample Results	Duplicate	Mean
F2063	42: 1	0	---	
F2060	42. 4	0	---	
F2067	42: 1	0	---	
F2071	42: 2	0	---	
F2074	42. 3	0	---	
F2085	42: 5	0	---	
F2077	42: 5	0	---	
F2083	42: 5	0	---	
F2169	42: Composite 1	0	---	
F2171	42: Composite 1	0	---	
F2172	42: Composite 2	0	---	
F2064	43: 5	0	---	
F2051	43: 3	0	---	
F2053	43: 4	0	---	
F2056	43: 5	0	---	
F2059	43: 6	0	---	
F2062	43: 5	0	---	

Table B2-87. Differential Scanning Calorimetry (DSC). (2 sheets)

Sample	Sample Location	Sample Results	Duplicate	Mean
F2038	43: 1	0	---	
F2039	43: 1	0	---	
F2046	43: 2	0	---	
F2047	43: 5	0	---	
F2173	42: Composite 1	0	---	
F2175	42: Composite 1	4.5	0	
F2176	43: Composite 2	0	0	
F2023	C44S4	0	0	0
F2029	C44S2	0	0	
F2030	C44S1	0	---	
F2033	C44S1	0	---	
F2015	C44S5	0	0	0
F2017	C44S5	0	---	
F2022	C44S3	0	---	
F2026	C44S3	0	0	0
F2177	C44 Composite 1	74.3	55.4	
F2178	C44 Composite 1	32.5	27.5	

Table B2-88. Tank 241-S-104 Analytical Results: pH Measurement.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			unitless	unitless	unitless
2247	42: 1	Drainable liquid	13.65		13.65
2248	43: 1	Drainable liquid	13.62		13.62
2249	44: 1	Drainable liquid	13.1		13.1
Solids: water digest			unitless	unitless	unitless
2171	Core 42	Solid composite	10.17	13.29	11.73
2172		Solid composite	13.32	13.38	13.35
2175	Core 43	Solid composite	12.91	12.63	12.77
2176		Solid composite	13.08	13.09	13.085
2177	Core 44	Solid composite	13.13	13.15	13.14
2178		Solid composite	13.07	13.09	13.08

Table B2-89. Tank 241-S-104 Analytical Results: Total Organic Carbon (Furnace Oxidation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			µg/g	µg/g	µg/g
2247	42: 1	Drainable liquid	529		529[QC:f]
2249	43: 1	Drainable liquid	469	73.4	271[QC:f]
2248	44: 1	Drainable liquid	404	73.4	239[QC:f]

Table B2-90. Tank 241-S-104 Analytical Results: Total Organic Carbon (Furnace Oxidation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
2171	Core 42	Solid composite	2,190	2,380	2,285
2172		Solid composite	1,300	1,300	1,300
2175	Core 43	Solid composite	2,350	2,060	2,205
2176		Solid composite	1,190	1,090	1,140
2177	Core 44	Solid composite	< 1,100	< 1,100	< 1,100
2178		Solid composite	< 1,100	< 1,100	< 1,100

Table B2-91. Tank 241-S-104 Analytical Results: Specific Gravity.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Drainable liquid			unitless	unitless	unitless
2247	42: 1	Drainable liquid	1.36		1.36[QC:f]
2249	43: 1	Drainable liquid	1.39		1.39[QC:f]
2248	44: 1	Drainable liquid	1.36		1.36[QC:f]

Table B2-92. Tank 241-S-104 Analytical Results: Centrifuged Solids Density.

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			g/mL	g/mL
93-01072	42: 2	Whole	1.71	1.71

Table B2-93. Tank 241-S-104 Analytical Results: Centrifuged Supernatant Density.

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			g/mL	g/mL
93-01072	42: 2	Whole	1.28	1.28

Table B2-94. Tank 241-S-104 Analytical Results: Density.

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			g/mL	g/mL
93-01072	42: 2	Whole	1.64	1.64

Table B2-95. Tank 241-S-104 Analytical Results: Settled Solids.

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			%	%
93-01072	42: 2	Whole	100	100
93-01753	42: 4	Whole	100	100

Table B2-96. Tank 241-S-104 Analytical Results: Volume Percent Centrifuged Solids.

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			%	%
93-01072	42: 2	Whole	82.5	82.5
93-01753	42: 4	Whole	100	100

Table B2-97. Tank 241-S-104 Analytical Results: Weight Percent Centrifuged Solids.

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			%	%
93-01072	42: 2	Whole	86.1	86.1
93-01753	42: 4	Whole	100	100

Table B2-98. Tank 241-S-104 Analytical Results: Weight Percent Solids.

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			%	%
93-01072	42: 2	Whole	62.3	62.3
93-01753	42: 4	Whole	67.7	67.7

Table B2-99. Tank 241-S-104 Analytical Results: Weight Percent Undissolved Solids.

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			%	%
93-01072	42: 2	Whole	55.4	55.4

Table B2-100. Tank 241-S-104 Analytical Results: Extractible Organic Halides.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
93-01076-F1	Core 42	Solid composite	< 10	< 10	< 10
93-01756-F1		Solid composite	< 10	< 10	< 10
93-01757-F1	Core 43	Solid composite	< 10	< 10	< 10[QC:f]
93-01758-F1		Solid composite	11	< 10	< 10.5
93-01759-F1	Core 44	Solid composite	30	30	30[QC:f]
93-01760-F1		Solid composite	< 10	< 10	< 10

Table B2-101. Tank 241-S-104 Analytical Data: Volatile Organic Analyses.

Volatile Organic Compound	Result µg/L	Volatile Organic Compound	Result µg/L
Chloromethane	n/d	1,2-Dichloropropane	n/d
Bromomethane	n/d	cis-1,3-Dichloropropene	n/d
Vinyl chloride	n/d	Trichloroethene	n/d
Chloroethane	n/d	Dibromochloromethane	n/d
Methylene chloride	n/d	1,1,2-Trichloroethane	n/d
Acetone	n/d	Benzene	n/d
Carbon disulfide	n/d	trans-1,3-Dichloropropene	n/d
1,1-Dichloroethene	n/d	Bromoform	n/d
1,1-Dichloroethane	n/d	4-Methyl-2-Pentanone	n/d
1,2-Dichloroethene (total)	n/d	2-Hexanone	n/d
Chloroform	n/d	Tetrachloroethene	n/d
1,2-Dichloroethane	n/d	1,1,2,2-Tetrachloroethane	n/d
2-Butanone	n/d	Toluene	n/d
1,1,1-Trichloroethane	n/d	Chlorobenzene	n/d
Carbon tetrachloride	n/d	Ethylbenzene	n/d
Vinyl acetate	n/d	Styrene	n/d
Bromodichloromethane	n/d	Xylene (total)	n/d

Note:
n/d = not detected

Table B2-102. Tank 241-S-104 Analytical Results: Dodecane (VOA).

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			µg/g	µg/g
93-01070-M1	43: 6	Whole	2.8	2.8

Note:
VOA = volatile organic analysis

Table B2-103. Tank 241-S-104 Analytical Results: Hexamethyl Disiloxane (VOA).

Sample Number	Sample Location	Sample Portion	Result	Mean
Solids			µg/g	µg/g
93-01071-M1	42: 1	Whole	1,200	1,200
93-01073-M1	42: 3	Whole	2,900	2,900
93-01074-M1	42: 5	Whole	190	190
93-01750-M1	43: 1	Whole	450	450
93-01751-M1	43: 2	Whole	420	420
93-01068-M1	43: 3	Whole	440	440
93-01752-M1	43: 4	Whole	530	530
93-01069-M1	43: 5	Whole	560	560
93-01070-M1	43: 6	Whole	400	400
93-01067-M1	44: 1	Whole	540	540
93-01066-M1	44: 2	Whole	220	220
93-01065-M1	44: 3	Whole	74	74
93-01064-M1	44: 5	Whole	110	110
93-01815-M1	44: 6	Partial	540	540

Table B2-104. Tank 241-S-104 Analytical Results: Methoxytrimethyl Silane (VOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
93-01071-M1	42: 1	Whole	1,900		1,900
93-01073-M1	42: 3	Whole	1,400		1,400
93-01074-M1	42: 5	Whole	650		650
93-01750-M1	43: 1	Whole	600		600
93-01751-M1	43: 2	Whole	320		320
93-01068-M1	43: 3	Whole	370		370
93-01752-M1	43: 4	Whole	720		720
93-01069-M1	43: 5	Whole	380		380
93-01070-M1	43: 6	Whole	540		540
93-01067-M1	44: 1	Whole	88		88
93-01066-M1	44: 2	Whole	65		65
93-01065-M1	44: 3	Whole	31		31
93-01064-M1	44: 5	Whole	92		92
93-01815-M1	44: 6	Partial	88		88

Table B2-105. Tank 241-S-104 Analytical Results: Trimethyl Silanol (VOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
93-01071-M1	42: 1	Whole	1,600		1,600
93-01073-M1	42: 3	Whole	2,400		2,400
93-01074-M1	42: 5	Whole	110		110
93-01750-M1	43: 1	Whole	900		900
93-01751-M1	43: 2	Whole	1,000		1,000
93-01068-M1	43: 3	Whole	1,000		1,000
93-01752-M1	43: 4	Whole	810		810
93-01069-M1	43: 5	Whole	400		400
93-01070-M1	43: 6	Whole	550		550
93-01067-M1	44: 1	Whole	290		290
93-01066-M1	44: 2	Whole	200		200
93-01065-M1	44: 3	Whole	92		92
93-01064-M1	44: 5	Whole	120		120
93-01815-M1	44: 6	Partial	290		290

Table B2-106. Tank 241-S-104 Analytical Data: Semivolatile Organic Analyses (SVOA).

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

Table B2-107. Tank 241-S-104 Analytical Results: Dodecane (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
93-01076-E1	Core 42	Solid composite	170		170
93-01756-E1		Solid composite	170		170
93-01757-E1	Core 43	Solid composite	230		230
93-01758-E1		Solid composite	33		33
93-01759-E1	Core 44	Solid composite	14		14
93-01760-E1		Solid composite	12		12

Note:
SVOA = semivolatile organic analysis

Table B2-108. Tank 241-S-104 Analytical Results: Pentadecane (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
93-01076-E1	Core 42	Solid composite	15		15
93-01756-E1		Solid composite	14		14
93-01757-E1	Core 43	Solid composite	24		24

Table B2-109. Tank 241-S-104 Analytical Results: Tetradecane (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
93-01076-E1	Core 42	Solid composite	410		410
93-01756-E1		Solid composite	390		390
93-01757-E1	Core 43	Solid composite	670		670
93-01758-E1		Solid composite	110		110
93-01759-E1	Core 44	Solid composite	49		49
93-01760-E1		Solid composite	42		42

Table B2-110. Tank 241-S-104 Analytical Results: Tridecane (SVOA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
93-01076-E1	Core 42	Solid composite	510		510
93-01756-E1		Solid composite	500		500
93-01757-E1	Core 43	Solid composite	810		810
93-01758-E1		Solid composite	130		130
93-01759-E1	Core 44	Solid composite	58		58
93-01760-E1		Solid composite	49		49

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS

The purpose of this chapter is to discuss the overall quality and consistency of the current sampling results for tank 241-S-104, and to present the results of the calculation of an analytical-based inventory.

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 limitations in the use of the data.

B3.1 FIELD OBSERVATIONS

The samples obtained from core sampling activities in tank 241-S-104 were a mixture of air, liquids, and solids. After the sample was extruded from the sampler, photographs were taken of the sample with appropriate jar numbers and a color comparator chart shown in the same photograph. Visual characteristics of extruded samples were recorded in the appropriate log book, and careful attention was paid to sample volume, liquid/solid ratio, color, consistency, and homogeneity.

No problems were noted during the sampling event that would impact the analytical results. Recoveries were good for all segments, although segment 6R of core 42, segment 6 of core 43, and segment 5 of core 44 had 10 percent, 33 percent, and 33 percent recoveries, respectively.

B3.2 QUALITY CONTROL ASSESSMENT

Systematic error estimates are determined from the analysis of reference standards or spike recoveries. Laboratory control standards are used to estimate the accuracy of the analytical method, and are analyzed in conjunction with the duplicate samples. The laboratory measurement control system has set a quality control criterion under which no laboratory control standard may be run in conjunction with an analytical sample larger than three times the historical results. Matrix spikes are used to estimate the bias of the analytical method caused by matrix interferences. Spike samples are prepared by splitting a sample into two aliquots and adding a known amount of a particular analyte to one aliquot to calculate a percent recovery. The quality control criterion for spikes is 100 + 25 percent recovery (Winters et al. 1990). Matrix spikes are not always applicable to analytes at high concentrations (> 1,000 μg/g)

About half of the analytes analyzed had one or more spikes that were outside the 100 + 25 percent recovery limits. Aluminum, sodium, and technetium-299 had all three spikes outside the prescribed limits, while most of the others had just one of three outside the limits. Several of these elements were metals found in relatively high concentrations in the tank. Spike failures for major elements in general are frequently caused by a high element concentration in the sample. When the added spike concentration is insignificant compared to the concentration present in the sample, a failure usually occurs. Also, the standard results for potassium, sodium, and uranium exceeded the criteria of three times the historical results.

B3.3 DATA VALIDATION FINDINGS

The primary objective of data validation is to ensure the usability and defensibility of the data produced for the tank. This was accomplished through a detailed examination of the data package that attempted to verify that proper and acceptable analytical techniques had been applied. Evaluations such as instrument calibration checks, matrix spikes, duplicates, and blank analyses were reviewed, and the corresponding results were compared to relevant quality control criteria. Additionally, the data package was checked for the correct submission of required deliverables, correct transcription of raw data to the summary forms, and proper calculation of a number of parameters. Data that failed to satisfy the established quality objectives were qualified as reported in WHC (1993).

B3.4 DATA CONSISTENCY CHECKS

Comparisons of different analytical methods can help to assess the consistency and quality of the data. Several comparisons were possible with the data set provided by the three core samples, including a comparison of sulfur as analyzed by ICP with sulfate as analyzed by IC,

and a comparison of total alpha activity and total beta activity with the sum of their individual emitters. In addition, mass and charge balances were calculated to help assess the overall data consistency.

B3.4.1 Comparison of Results from Different Analytical Methods

The following data consistency checks compare the results from two different analytical methods. Close comparison between the two methods strengthens the credibility of both results, whereas a poor correlation brings the reliability of the data into question. All analytical mean results were taken from tables in Section B2.0.

The analytical sulfur mean result as determined by ICP was 472 μg/g, which converts to 1,420 μg/g of sulfate. The IC sulfate mean result was 2,270 μg/g. The relative percent difference between these two sulfate results was 46 percent. This difference may be caused by the sulfur being low and near detection limits.

A comparison was made between the sums of the gross beta and gross alpha activities with the sums of the activities of the individual beta and alpha emitters. The activities of the individual beta emitters were summed according to the following equation:

$$\text{Total beta} = 1.42(2 * {}^{90}\text{Sr}) + 1.51({}^{137}\text{Cs}).$$

(The coefficients 1.42 and 1.51 account for the detector efficiencies calibrated to ^{60}Co.)

The activities of the individual alpha emitters were summed according to:

$$\text{Total alpha} = {}^{239/240}\text{Pu} + {}^{241}\text{Am}.$$

The comparisons are given in Tables B3-1 and B3-2. The values for the individual cores in Table B3-1 are the means of the solid sample and duplicate solid sample results. The values for the liquid column in Table B3-2 are the means of all liquid sample results. As can be seen in Table B3-1, the individual beta and gross beta activities agree closely with the exception of those for the core 42 solid samples.

A comparison was made between the individual alpha emitters and the total alpha activity to determine the level of data consistency (Table B3-2). The sum of the individual alpha activity was 0.40 μCi/g and the gross alpha sample result was 0.62 μCi/g. The individual alpha activity results are less than the total alpha results. This difference may have been the result of the total alpha counting instrumentation problem that caused high total alpha results when high beta activities were present. This problem has been corrected.

Table B3-1. Tank 241-S-104 Comparison of Gross Beta Activities with the Total of the Individual Activities.

Analyte	Core 42 (μCi/g)	Core 43 (μCi/g)	Core 44 (μCi/g)	Liquid (μCi/g)
^{90}Sr	306	316	308	0.0052
^{137}Cs	64.5	58.7	63.7	80.9
Sum of individual beta	966	985	970	122
Total beta	91.7	954	880	127
Relative percent difference[1]	165%	3.2%	9.7%	3.8%

Note:

[1]Relative percent difference = Absolute value of difference between total activities and gross activities divided by their average.

Table B3-2. Tank 241-S-104 Comparison of Gross Alpha Activities with the Total of the Individual Activities.

Analyte	Solid (μCi/g)	Relative Percent Difference[1]
$^{239/240}Pu$	0.282	
^{241}Am	0.118	
Sum of individual alpha	0.400	42.7%
Total alpha	0.617	

Note:

[1]Relative Percent Difference = Absolute value of difference between total activities and gross activities divided by their average.

B3.4.2 Mass and Charge Balance

The principle objective in performing mass and charge balances is to determine if the measurements are self-consistent. In calculating the balances, only analytes listed in Section B2.0 detected at a concentration of 1,000 μg/g or greater were considered.

Except sodium, all cations listed in Table B3-3 were assumed to be in their most common hydroxide or oxide form, and the concentrations of the assumed species were calculated stoichiometrically. Because precipitates are neutral species, all positive charge was attributed to the sodium cation. The anions listed in Table B3-4 were assumed to be present as sodium salts and were expected to balance the positive charge exhibited by the cations. The concentrations of cationic species in Table B3-3, the anionic species in Table B3-4, and the percent water were ultimately used to calculate the mass balance.

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

<u>Total cations</u> (μeq/g) = $[Na^+]/23.0 = 5{,}260\ \mu eq/g$

<u>Total anions</u> (μeq/g) = $[Cl^-]/35.5 + [NO_3^-]/62.0 + [NO_2^-]/46.0 + [SO_4^{-2}]/48.0 + [CO_3^{-2}]/30.0 + [C_2H_3O^-]/59.0 = 3{,}830\ \mu eq/g$

The charge balance obtained by dividing the sum of the positive charge by the sum of the negative charge was 1.37. The large unbalanced positive charge indicated from the charge balance and the process history of this tank suggests a substantial amount of unquantifiable hydroxide ion is present.

The following equation illustrates that the sum of the total concentration of the assumed species in Table B3-3, the total concentration of anionic analytes in Table B3-4, and the laboratory-derived value for percent water should equal 1,000,000 μg/g.

$$1{,}000{,}000\ \mu g/g = Al(OH)_3 + CaO + CrO_3 + Fe(O)(OH) + MnO_2 + SiO_2 + Na^+ + UO_2(OH)_2 + CO_3^{2-} + C_2H_3O^- + Cl^- + NO_3^- + NO_2^- + SO_4^{2-} + H_2O$$

Table B3-5 demonstrates that the calculated mass balance differs by 3 percent. The difference in charge balance between cations and anions is probably attribute hydroxide associated with metals.

Table B3-3. Cation Mass and Charge Data.

	Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge (μeq/g)
Aluminum	117,000	$Al(OH)_3$	338,000	0
Calcium	4,230	CaO	5,920	0
Chromium	2,350	CrO_3	4,520	0
Iron	1,720	Fe(O)(OH)	2,740	0
Manganese	1,150	MnO_2	1,820	0
Silicon	1,330	SiO_2	2,850	0
Sodium	121,000	Na^+	121,000	5,260
Uranium	6,690	$UO_2(OH)_2$	8,550	0
Totals			485,000	5,260

Table B3-4. Anion Mass and Charge Data.

	Concentration (μg/g)	Charge (μeq/g)
Carbonate (TIC)	4,140	138
Acetate (TOC)	1,520	25.7
Chloride	3,200	90.1
Nitrate	191,000	3,080
Nitrite	20,800	452
Sulfate	2,270	47.3
Totals	223,000	3,830

Table B3-5. Mass Balance Totals.

	Concentration (μg/g)
Total From Table B3-3	485,000
Total From Table B3-4	223,000
Water	316,000
Grand total	1,030,000

B3.5 MEAN CONCENTRATIONS AND CONFIDENCE INTERVALS

The following evaluation was performed on the analytical data from the samples from tank 241-S-104.

Because an inventory estimate is needed without comparing it to a threshold value, two-sided 95 percent confidence intervals on the mean inventory are computed. This was done with composite-level data.

The upper and lower limits (UL and LL) to a two-sided 95 percent confidence interval for the mean are

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

In these equations, $\hat{\mu}$ is the estimate of the mean concentration, $\hat{\sigma}^2_{\hat{\mu}}$ is the estimate of the variance of the mean concentration, and $t_{(df,0.025)}$ is the quantile from Student's t distribution with df degrees of freedom for a two-sided 95 percent confidence interval.

The mean, $\hat{\mu}$, and the variance, $\hat{\sigma}^2_{\hat{\mu}}$, were estimated using restricted maximum likelihood estimation methods. The degrees of freedom (df), for tank 241-S-104, is the number of cores sampled minus one.

B3.5.1 Composite Means

The statistics in this section were based on analytical data from the most recent sampling event of tank 241-S-104. Analysis of variance (ANOVA) techniques were used to estimate the mean, and calculate confidence limits on the mean for all analytes.

The results given below are ANOVA estimates based on the core composite data from core 42, core 43, and core 44 for tank S-104. Estimates of the mean concentration and confidence interval on the mean concentration are given in Table B3-6. The lower limit, LL, to a 95 percent confidence interval can be negative. Because an actual concentration of less than zero is not possible, the lower limit is reported as zero, whenever this occurred.

Table B3-6. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Composite Sample Data (Units μg/g Except Radionuclides μCi/g). (3 sheets)

Analyte	$\hat{\mu}$	$\hat{\sigma}^2(\mu)$	df	95% LL	95% UL
ICP.a.Al	3.89E+04	5.05E+07	2	8.31E+03	6.94E+04
ICP.a.B[2]	1.44E+01	1.22E+01	2	0.00E+00	2.94E+01
ICP.a.Ba	2.16E+01	1.01E+00	2	1.72E+01	2.59E+01
ICP.a.Ca[2]	2.47E+02	6.50E+02	2	1.37E+02	3.56E+02
ICP.a.Ce[1]	2.21E+01	1.99E+00	2	1.60E+01	2.82E+01
ICP.a.Co[1]	2.52E+00	2.73E-02	2	1.81E+00	3.23E+00
ICP.a.Cr	2.35E+03	4.01E+03	2	2.08E+03	2.62E+03
ICP.a.Cu	1.94E+01	4.21E+01	2	0.00E+00	4.73E+01
ICP.a.Fe	7.71E+02	5.40E+03	2	4.55E+02	1.09E+03
ICP.a.K	3.00E+02	8.07E+02	2	1.78E+02	4.22E+02
ICP.a.Mg	4.28E+01	2.67E+01	2	2.06E+01	6.50E+01
ICP.a.Mn	9.27E+02	1.86E+04	2	3.40E+02	1.51E+03
ICP.a.Na	1.21E+05	5.22E+06	2	1.11E+05	1.30E+05
ICP.a.Ni	5.60E+01	6.36E+00	2	4.52E+01	6.69E+01
ICP.a.P[1]	2.12E+01	2.14E+00	2	1.49E+01	2.75E+01
ICP.a.Pb[1]	2.60E+01	5.02E+00	2	4.40E+00	4.76E+01
ICP.a.S	3.94E+02	3.87E+02	2	3.10E+02	4.79E+02
ICP.a.Si	1.92E+02	3.47E+02	2	1.12E+02	2.72E+02
ICP.a.Sr	3.26E+02	1.74E+02	2	2.69E+02	3.82E+02
ICP.a.Ti[2]	6.35E+00	2.84E+00	2	0.00E+00	1.36E+01
ICP.a.Zn[2]	2.01E+01	1.53E+01	2	3.32E+00	3.69E+01
ICP.a.Zr	3.36E+01	7.62E-01	2	2.99E+01	3.74E+01
ICP.f.Al	1.17E+05	1.69E+06	2	1.11E+05	1.23E+05
ICP.f.B[1]	2.66E+01	1.30E+01	2	0.00E+00	8.25E+01
ICP.f.Ba	3.31E+01	3.32E+00	2	2.53E+01	4.10E+01
ICP.f.Ca[2]	4.23E+03	1.14E+07	2	0.00E+00	1.88E+04
ICP.f.Cr	2.35E+03	7.95E+03	2	1.97E+03	2.74E+03
ICP.f.Cu[2]	5.47E+01	6.08E+01	2	2.12E+01	8.83E+01
ICP.f.Fe	1.72E+03	1.81E+03	2	1.53E+03	1.90E+03
ICP.f.Mg	1.57E+02	5.04E+03	2	0.00E+00	4.62E+02

Table B3-6. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Composite Sample Data (Units μg/g Except Radionuclides μCi/g). (3 sheets)

Analyte	$\hat{\mu}$	$\hat{\sigma}^2(\mu)$	df	95% LL	95% UL
ICP.f.Mn	1.15E+03	4.73E+04	2	2.15E+02	2.09E+03
ICP.f.Na	1.18E+05	2.77E+06	2	1.11E+05	1.25E+05
ICP.f.Ni	5.01E+03	1.84E+05	2	3.16E+03	6.85E+03
ICP.f.P[1]	9.31E+01	5.97E+01	2	5.98E+01	1.26E+02
ICP.f.S	4.72E+02	2.00E+02	2	4.11E+02	5.33E+02
ICP.f.Si	1.33E+03	1.52E+04	2	7.97E+02	1.86E+03
ICP.f.Sr	4.24E+02	3.03E+02	2	3.49E+02	1.86E+03
ICP.f.Ti[1]	7.50E+00	1.09E+00	2	2.83E+00	1.22E+01
ICP.f.Zn[2]	2.24E+02	2.16E+04	2	0.00E+00	8.56E+02
ICP.f.Zr[1]	2.12E+01	3.69E+01	2	0.00E+00	4.73E+01
ICP.w.Al	4.68E+03	2.43E+06	2	0.00E+00	1.14E+04
ICP.w.B[1]	9.08E+00	1.65E+00	2	3.57E+00	1.46E+01
ICP.w.Ca[1]	1.56E+02	3.35E+03	2	0.00E+00	4.04E+02
ICP.w.Cr	1.90E+03	4.39E+05	2	0.00E+00	4.75E+03
ICP.w.Cu[1]	1.47E+00	6.78E-01	2	0.00E+00	4.39E+00
ICP.w.Fe[1]	1.24E+01	8.56E+00	2	0.00E+00	4.92E+01
ICP.w.K	2.53E+02	4.62E+03	2	0.00E+00	5.45E+02
ICP.w.Mg[1]	8.34E+00	1.10E+01	2	0.00E+00	2.26E+01
ICP.w.Na	9.21E+04	7.38E+08	2	0.00E+00	2.09E+05
ICP.w.S	3.40E+02	1.45E+04	2	0.00E+00	8.58E+02
ICP.w.Si[2]	3.98E+01	2.87E+02	2	0.00E+00	1.13E+02
ICP.w.Sr[1]	6.89E-01	6.20E-02	2	4.22E-01	9.56E-01
ICP.w.Zn[1]	1.40E+01	3.33E+00	2	0.00E+00	2.83E+01
IC.w.Cl	3.20E+03	8.96E+03	2	2.79E+03	3.61E+03
IC.w.NO2	2.08E+04	2.46E+06	2	1.41E+04	2.76E+04
IC.w.NO3	1.91E+05	3.64E+07	2	1.65E+05	2.17E+05
IC.w.SO4	2.27E+03	3.92E+03	2	2.00E+03	2.54E+03
CN	3.70E+00	4.34E-02	2	2.81E+00	4.60E+00
Percent.H2O	5.16E+01	4.64E+02	2	0.00E+00	1.44E+02
TOC[1]	1.52E+03	3.42E+02	2	5.15E+01	2.99E+03

Table B3-6. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Composite Sample Data (Units μg/g Except Radionuclides μCi/g). (3 sheets)

Analyte	$\hat{\mu}$	$\hat{\sigma}^2(\hat{\mu})$	df	95% LL	95% UL
Spec.w.NO2	2.59E+04	1.16E+06	2	2.12E+04	3.05E+04
TIC.w.CO3[1]	4.14E+03	4.86E+05	2	1.15E+03	7.14E+03
pH	1.29E+01	6.30E-02	2	1.18E+01	1.39E+01
C-14[1]	9.01E-04	1.42E-08	2	3.88E-04	1.41E-03
GEA.Cs-137	6.23E+01	3.45E+00	2	5.43E+01	7.03E+01
Gross.alpha[1]	6.17E-01	6.92E-02	2	3.19E-01	9.14E-01
Gross.beta	6.41E+02	7.60E+04	2	0.00E+00	1.83E+03
H-3[2]	3.38E-03	1.59E-07	2	1.66E-03	5.09E-03
Pu-239/40	2.82E-01	4.67E-03	2	0.00E+00	5.76E-01
Sr-90	3.10E+02	6.23E+01	2	2.76E+02	3.44E+02
Tc-99[2]	2.42E-02	1.70E-06	2	1.86E-02	2.98E-02
U[2]	6.69E+03	1.37E+05	2	5.09E+03	8.28E+03

B3.5.2 Analysis of Variance Models

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

The statistical model fit to the composite sample data is

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

$$i = 1,\ldots,a,\ j = 1,\ldots,b_i,\ k = 1,\ldots,c_{ij}$$

where

Y_{ijk}	=	laboratory results from the kth duplicate from the jth composite in the ith core in the tank
μ	=	the grand mean
S_i	=	the effect of the ith core
C_{ij}	=	the effect of the jth composite in the ith core
A_{ijk}	=	the effect of the kth analytical result from the jth composite in the ith core
a	=	the number of cores
b_i	=	the number of composites in the ith core
c_{ij}	=	the number of analytical results from the jth composite in the ith core.

The variables S_i and C_{ij} are assumed to be random effects. These variables and A_{ij} are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(S)$, $\sigma^2(C)$, and $\sigma^2(A)$, respectively. Estimates of $\sigma^2(S)$, $\sigma^2(C)$, and $\sigma^2(A)$ were obtained using restricted maximum likelihood estimation techniques. This method, applied to variance component estimation, is described in Harville (1997). The statistical results were obtained using the statistical analysis package S-PLUS[1] (Statistical Sciences, Inc. 1993).

B3.5.3 Inventory

After the sample means are calculated 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) and the estimated tank solids density. The tank volume for solids is 1,113 kL (Hanlon 1996). The density used for this estimate is 1.64 g/mL for composite sample data. The inventory of each of the analytes is presented in Table B3-7 for composite sample data.

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

Table B3-7. Analytical-Based Inventory for Composite Sample Data for Tank 241-S-104. (3 sheets)

Analyte	Inventory (kg or Ci)	LL	UL
ICP.a.Al	7.08E+04	1.51E+04	1.26E+05
ICP.a.B	2.62E+01	0.00E+00	5.36E+01
ICP.a.Ba	3.93E+01	3.14E+01	4.72E+01
ICP.a.Ca	4.50E+02	2.50E+02	6.49E+02
ICP.a.Ce	4.02E+01	2.92E+01	5.13E+01
ICP.a.Co	4.59E+00	3.29E+00	5.88E+00
ICP.a.Cr	4.28E+03	3.78E+03	4.77E+03
ICP.a.Cu	3.53E+01	0.00E+00	8.61E+01
ICP.a.Fe	1.40E+03	8.28E+02	1.98E+03
ICP.a.K	5.46E+02	3.24E+02	7.69E+02
ICP.a.Mg	7.79E+01	3.74E+01	1.18E+02
ICP.a.Mn	1.69E+03	6.19E+02	2.76E+03
ICP.a.Na	2.20E+05	2.02E+05	2.38E+05
ICP.a.Ni	1.02E+02	8.22E+01	1.22E+02
ICP.a.P	3.86E+01	2.71E+01	5.01E+01
ICP.a.Pb	4.73E+01	8.01E+01	8.67E+01
ICP.a.S	7.17E+02	5.63E+02	8.71E+02
ICP.a.Si	3.50E+02	2.04E+02	4.95E+02
ICP.a.Sr	5.93E+02	4.90E+02	6.97E+02
ICP.a.Ti	1.16E+01	0.00E+00	2.48E+01
ICP.a.Zn	3.66E+01	5.95E+00	6.72E+01
ICP.a.Zr	6.12E+01	5.43E+01	6.80E+01
ICP.f.Al	2.13E+05	2.03E+05	2.23E+05
ICP.f.B	4.85E+01	0.00E+00	1.50E+02
ICP.f.Ba	6.03E+01	4.60E+01	7.45E+01
ICP.f.Ca	7.70E+03	0.00E+00	3.41E+04
ICP.f.Cr	4.28E+03	3.58E+03	4.98E+03
ICP.f.Cu	9.96E+01	3.85E+01	1.61E+02
ICP.f.Fe	3.13E+03	2.80E+03	3.46E+03
ICP.f.Mg	2.86E+02	0.00E+00	8.42E+02

Table B3-7. Analytical-Based Inventory for Composite Sample Data for Tank 241-S-104. (3 sheets)

Analyte	Inventory (kg or Ci)	LL	UL
ICP.f.Mn	2.09E+03	3.90E+02	3.80E+03
ICP.f.Na	2.15E+05	2.02E+05	2.28E+05
ICP.f.Ni	9.12E+03	5.76E+03	1.25E+04
ICP.f.P	1.69E+02	1.09E+02	2.30E+02
ICP.f.S	8.59E+02	7.48E+02	9.70E+02
ICP.f.Si	2.42E+03	1.46E+03	3.39E+03
ICP.f.Sr	7.72E+02	6.35E+02	9.08E+02
ICP.f.Ti	1.37E+01	5.15E+00	2.22E+01
ICP.f.Zn	4.08E+02	0.00E+00	1.56E+03
ICP.f.Zr	3.86E+01	0.00E+00	8.62E+01
ICP.w.Al	8.52E+03	0.00E+00	2.07E+04
ICP.w.B	1.65E+01	6.47E+00	2.66E+01
ICP.w.Ca	2.84E+02	0.00E+00	7.37E+02
ICP.w.Cr	3.46E+03	0.00E+00	8.65E+03
ICP.w.Cu	2.68E+00	0.00E+00	7.99E+00
ICP.w.Fe	2.26E+01	0.00E+00	8.96E+01
ICP.w.K	4.61E+02	0.00E+00	9.93E+02
ICP.w.Mg	1.52E+01	0.00E+00	4.12E+01
ICP.w.Na	1.68E+05	0.00E+00	3.80E+05
ICP.w.S	6.19E+02	0.00E+00	1.56E+03
ICP.w.Si	7.25E+01	0.00E+00	2.05E+02
ICP.w.Sr	1.25E+00	7.68E-01	1.74E+00
ICP.w.Zn	2.55E+01	0.00E+00	5.16E+01
IC.w.Cl	5.83E+03	5.08E+03	6.57E+03
IC.w.NO2	3.79E+04	2.56E+04	5.02E+04
IC.w.NO3	3.48E+05	3.00E+05	3.95E+05
IC.w.SO4	4.13E+03	3.64E+03	4.62E+03
CN	6.74E+00	5.10E+00	8.37E+00
Spec.w.NO2	4.71E+04	3.87E+04	5.56E+04
TOC	2.77E+03	9.37E+01	5.45E+03

Table B3-7. Analytical-Based Inventory for Composite Sample Data for Tank 241-S-104. (3 sheets)

Analyte	Inventory (kg or Ci)	LL	UL
TOC.w.CO3	7.54E+03	2.08E+03	1.30E+04
U	1.22E+04	9.28E+03	1.51E+04
Percent water	9.39E+05	0.00E+00	1.82E+06
C-14	1.64E+00	7.07E-01	2.57E+00
GEA.Cs-137	1.13E+05	9.89E+04	1.28E+05
Gross.alpha	1.12E+03	5.81E+02	1.66E+03
Gross.beta	1.17E+06	0.00E+00	3.33E+06
H-3	6.15E+00	3.03E+00	9.28E+00
Pu-239/40	5.13E+02	0.00E+00	1.05E+03
Sr-90	5.64E+05	5.02E+05	6.26E+05
Tc-99	4.41E+01	3.38E+01	5.43E+01

B4.0 APPENDIX B REFERENCES

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

De Lorenzo, D. S., J. H. Rutherford, D. J. Smith, D. B. Hiller, K. W. Johnson, 1994, *Tank Characterization Reference Guide,* LATA-TCR-9491, Los Alamos Technical Associates, Kennewick, Washington.

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

Hanlon, B. L., 1996, *Tank Farm Surveillance and Waste Status Summary Report for Month Ending September 30, 1996*, WHC-EP-0182-102, Westinghouse Hanford Company, Richland, Washington.

Harville, D. A., 1977, "Maximum Likelihood Approaches to Variance Component Estimation and to Related Problems," *Journal of the American Statistical Association*, vol. 72, pp. 320-340.

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

Horton, J. E., 1976, *Characterization and Analysis of Tank 104-S Sludge*, (letter [number unknown] to W. R. Christensen, February 24), Atlantic Richfield Hanford Company, Richland, Washington.

Kocher, K. L., 1993, *Single-Shell Waste Characterization Tank 241-S-104, Data Package*, WHC-SD-WM-DP-031, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Snedecor, G. W., and W. G. Cochran, 1980, *Statistical Methods*, 7th Edition, Iowa State University Press, Ames, Iowa.

Statistical Sciences, Inc., 1993, *S-PLUS Reference Manual, Version 3.2*, Seattle: StatSci, a division of MathSoft, Inc.

WHC, 1993, *Data Package S-104 Validation Summary*, WHC-SD-WM-DP-031, Rev. 0, Addendum 2, Westinghouse Hanford Company, Richland, Washington.

Wheeler, R. E., 1974, *Analysis of Tank Farm Samples, Sample T-4184 104-S*, (internal letter to R. L. Walser, August 12), Atlantic Richfield Company, Richland, Washington.

Winters, W. I., L. Jensen, L. M. Sasaki, R. C. Weiss, J. F. Keller, A. J. Schmidt, and M. G. Woodruff, 1990, *Waste Characterization Plan for the Hanford Site Single-Shell Tanks*, WHC-EP-0210, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

This page left blank intentionally.

APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

This page intentionally left blank.

APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

In Appendix C, the results of the analyses required for the applicable data quality objective (DQO) reports for tank 241-S-104 are reported. Specifically, the results of statistical and other numerical manipulations required in the DQO reports are performed and documented in this appendix. The analyses required for tank 241-S-104 are documented in the following sections:

- **Section C1**: Statistical analysis supporting the safety screening DQO (Dukelow et al. 1995). Specifically, confidence intervals were needed to support the plutonium (criticality) threshold limit.
- **Section C2**: Reference 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. In this appendix, one sided confidence limits supporting the safety screening DQO are calculated for tank 241-S-104. All data considered in this section are taken from the 1992 sampling event.

Confidence intervals were computed for core composites from tank 241-S-104 analytical data. The core composite numbers and confidence intervals are provided in Table C1-1.

The upper limit (UL) of a one-sided 95 percent confidence interval for the mean is

$$\hat{\mu} + t_{(n-1,0.95)} * \sqrt{\frac{\hat{\sigma}^2}{n}}$$

where $\hat{\mu}$ is the arithmetic mean of the data, n is the number of observations, $\hat{\sigma}^2$ is the estimate of the variance of the data, and $t_{(n-1,0.95)}$ is a quantile from Student's t distribution with $n-1$ degrees of freedom and 0.95 confidence.

Table C1-1. 95 Percent Confidence Interval Upper Limits for Total Alpha for Tank 241-S-104.

Core Number	Composite	Result	Mean $\hat{\mu}$ (μCi/g)	Standard Deviation (Mean)	UL (μCi/g)
42	1	0.701			
42	1	0.352	0.5265	0.1745	1.628293
42	2	0.578			
42	2	0.72	0.649	0.071	1.097294
43	1	0.807			
43	1	0.779	0.793	0.014	0.881396
43	2	0.998			
43	2	0.916	0.957	0.041	1.215874
44	1	0.432			
44	1	0.489	0.4605	0.0285	0.640449
44	2	0.39			
44	2	0.239	0.3145	0.0755	0.791207

The upper limit of the 95 percent confidence interval for each sample number based on the total alpha data is listed in Table C1-1. Each confidence interval can be used to make the following statement. If the upper limit is less than 40 μCi/g, then one would reject the null hypothesis that the total alpha is greater than or equal to 40 μCi/g at the 0.05 level of significance.

Confidence intervals were not performed on the DSC data, because all the segment samples had no exotherms.

C2.0 APPENDIX C REFERENCE

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.

APPENDIX D

RESULTS OF THE EVALUATION TO ESTABLISH BEST-BASIS STANDARD INVENTORY FOR TANK 241-S-104

This page intentionally left blank.

APPENDIX D

RESULTS OF THE EVALUATION TO ESTABLISH BEST-BASIS STANDARD INVENTORY FOR TANK 241-S-104

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available waste-related information for single-shell tank 241-S-104 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Available waste (chemical) information for tank 241-S-104 included:

- Data from three push-mode cores samples that were collected in 1992. See Appendix B, Section B2.0 for data.
- Data from pre-1989 analyses, which were used for informational purposes only.
- The inventory estimate for this tank (Agnew et al. 1996) generated from the HDW model. See Section A3.2 for the model estimate.
- Analytical data from TCRs from tanks with the same R sludge waste types (241-S-104 [this TCR], Appendix B), 241-S-107 (Simpson et al. 1996) and 241-S-101 (Kruger et al. 1996). A list of references used in this evaluation is provided in Section D5.0.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

In Tables D2-1 and D2-2, sampling-based inventories (see Appendix B, Section B3.2) derived from the analytical concentration data from the core samples are compared with the HDW model inventories. Table D2-1 compares nonradioactive components on a kilogram (kg) basis, and Table D2-2 compares the radioactive components on a curie basis. See Section D3-1 for details on sample types, volumes and densities.

By comparing Tables D2-1 and D2-2, note the differences between the sample-based values for tank 241-S-104 and the HDW model inventories of this tank, for several of the bulk components.

The ICP metals data for the sampling-based inventory are from fusion with the exception of Ni, K, Na and Zr, for which the acid preparation method was used.

Table D2-1. Sampling-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-S-104. (2 sheets)

Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)	Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)
Al	214,000	95,700	Ni	102	1,760
Ba	60.4	n/r	NO_2	38,000	92,900
Bi	n/r	0.966	NO_3	349,000	204,000
Ca	7,700	5,830	OH	n/r	260,000
Ce	40.3	n/r	oxalate	n/r	1E-06
Cl	5,840	3,120	Pb	n/r	2,240
Co	4.6	n/r	PO_4	518	28.3
Cr	4,290	25,800	Si	2,430	2,390
Cu	99.8	n/r	SO_4	4,140	3,270
F[3]	n/r	5.02	Sr	774	5E-06
Fe	3,140	24,500	TIC as CO_3	7,560	8,930
Hg	n/r	74.5	TOC	2,770	60.5
K	548	750	U_{total}	12,200	11,000
La	n/r	2E-06	Zn	409	n/r
Mg	287	n/r	Zr	61.3	0.204

Table D2-1. Sampling-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-S-104. (2 sheets)

Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)	Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)
Mn	2,100	1.84	H_2O (wt%)	31.6	48.4
Na	221,000	163,000	density (kg/L)	1.64	1.51
NH_4	n/r	1,240			

Notes:

[1]See Appendix B. Based on 1992 core samples

[2]Agnew et al. (1996)

[3]Fluoride based on water soluble portion only.

Table D2-2. Sampling and HDW Model Predicted Inventory Estimates for Radioactive Components in Tank 241-S-104 (Radionuclides degraded to February 1994).

Analyte	Sampling[1] Inventory Estimate (Ci)	HDW[2] Inventory Estimate (Ci)	Analyte	Sampling[1] Inventory Estimate (Ci)	HDW[2] Inventory Estimate (Ci)
^{14}C	1.64	n/r	^{137}Cs	109,000	211,000
^{90}Sr	566,000	587,000	$^{239/240}Pu$	515	326
^{99}Tc	44.2	n/r	Total β	1.17E+06	n/r

Notes:

[1]See Appendix B. Based on 1992 core samples

[2]Agnew et al. (1996)

D3.0 COMPONENT INVENTORY EVALUATION

(Please refer to Appendix A, Section A3.1 for a detailed summary of the waste transfer history.)

The following evaluation of tank contents is performed to identify potential errors and/or missing information that would influence the sample-based and HDW model component inventories.

D3.1 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT

Abbreviations used:

R	=	high-level REDOX waste
CWR	=	REDOX cladding waste
RSltCk	=	REDOX saltcake.

The tank volume used to generate the engineering assessment and sampling-based inventories is 1,113 kL (294 kgal). This volume consists of a 1,109-kL (293-kgal) sludge layer, no saltcake, and 3.8 kL (1 kgal) of supernatant (Hanlon 1996). The HDW inventories were calculated based on a slightly different mix of sludge and saltcake volumes. Agnew et al. (1996) reports 1,109 kL (293 kgal) of total waste, which consists of 90.8 kL (24 kgal) CWR sludge, 408.8 kL (108 kgal) of R sludge and 609.4 kL (161 kgal) of saltcake (RSltCk). The Hanlon estimates are being used in the assessment because these volumes were used in the sampling-based inventory and are essentially the same as the Agnew et al. (1996) volume estimates. Agnew et al. (1996) calls out R, CWR and RSltCk. The RSltCk comes mostly from self evaporation and from a careful study of segment and sub-segment data, and appears to be a more concentrated R waste. This TCR estimates the waste to be a combination of R and CWR with about 90 percent R based on Agnew et al. (1995 and 1996).

The mean sludge density that includes interstitial liquid and is used to calculate the sample-based component inventories is 1.64 g/mL, and the HDW model density for the total solid waste is estimated to be 1.51 g/mL. Sampling-based and engineering assessment inventories were calculated by multiplying the mean analyte concentration value by the current tank volume and by the sampling-based density of the waste.

D3.2 ASSUMPTIONS USED FOR THIS ASSESSMENT

For this evaluation, the following assumptions and observations are made:

- Tank waste mass is calculated using the measured density and the tank volume listed in Hanlon (1996). While this volume may or may not be correct, the analytical-based and the engineering assessment inventories are derived using this volume, and not the slightly different volume reported by Agnew et al. (1996).

- Only the R waste stream and the CWR waste stream contributed to solids formation.

- No radiolysis of NO_3 to NO_2 and no additions of NO_2 to the waste for corrosion purposes are factored into this evaluation.

D3.3 METHODOLOGY USED FOR THIS EVALUATION

The general approach in this evaluation is to identify waste types and their approximate volumes within the tank of interest. The sources of information may include analytical data from samples taken from the tank of interest, analytical data from other tanks believed to contain waste types similar to those believed to be in the tank of interest, data utilizing process flowsheet information combined with tank contents information, and data from models utilizing historical process records. The confidence level assigned to the best-basis inventory values then depends on the level of agreement among the various information sources, and the number of different waste types in the tank. This approach is, of course, best suited for cases where extensive analytical data exist from multiple sampling events from a number of tanks containing similar waste types.

The sludge in this tank appears to be a combination of R and CWR sludge. Evaluation of segment data from the tanks that show similar waste types (241-S-101, 241-S-104, 241-S-107), the RSltCk segments show analyte concentrations that appear to be very similar to R sludge. In trying to pick sampling segments that only contain CWR waste, no segments or sub-segments were identified that showed significant differences from the R waste below or above, where the CWR layers should have been.

Assessment of waste inventories is based on two separate comparison activities. In the first activity, the process flowsheets for R and CWR are compared to those predicted by Agnew et al. (1996). The second activity is a process that compares the R sludge layers from three tanks with the analytical segment data. The average concentrations from these tanks are used to predict the tank inventory. This inventory is later compared to the sampling-based inventory and the HDW model-based inventory.

D3.3.1 Evaluation of Technical Flowsheet Information

Process flowsheet and the HDW model molarity information for the R and CWR waste types is shown in Table D3-1. The R and CWR information was averaged over a period of time that includes the waste activity for this tank.

Table D3-1. Technical Process Flowsheet and Los Alamos National Laboratory Defined Waste Streams.

Analyte	Process Flowsheet[1] REDOX (*M*) (average)	Hanford Defined Waste (HDW) R1/R2[2] (*M*)	Process Flowsheet[1] CWR (average) (*M*)	Hanford Defined Waste (HDW) CWR[2] (*M*)
NO_3	4.53	3.3	0.63	0.885
NO_2	0	0	1.3	0.85
SO_4	0.029	0.025	0	0.0125
Bi	3E-05	0	0	0.003
Fe	0.013	0.050	0	0.0152
Si	0	0.029	0.063	0.015
U	0.0075	0.007	0.006	0.019
Al	1.11	0.89	2.13	1.39
Cr	0.178	0.091	0	0.003
Na	6.98	4.14	4.9	2.87
K	0	0.015	0	0.0028

Notes:

R1 = REDOX waste generated 1952-57
R2 = REDOX waste generated 1958-66

[1]REDOX and CWR Flowsheet average #5 through #8 operated from 1955 to 1965 (Kupfer et al. 1996)

[2]Agnew et al. (1996)

D3.3.2 Evaluation Of Sample Information Sources

The sludge (R) concentrations used in this engineering check comparison were developed with analytical data taken from the following tanks: 241-S-101, 241-S-104, and 241-S-107 (See Section D1.0 for references). While some CWR waste may be intermixed in tank 241-S-104, the same situation applies in the tanks used to predict the R waste concentration.

Thus, the R waste is probably a mixture that includes some CWR and RSltCk waste. Data were selected based on Agnew's predicted sludge location (Agnew et al. 1996). The average concentrations from each tank and the segments used in the calculation are shown in Table D3-2. The mean from each tank was averaged to obtain the projected concentration for each analyte for the R sludge.

The HDW model concentrations for tank 241-S-104 sludge are also listed in Table D3-2 for comparison with the average concentration values for tanks 241-S-101, 241-S-104 and 241-S-107.

The 241-S-104 inventory estimates are also listed in the last column of Table D3-2. The 241-S-104 inventory calculations for Table D3-2 are:

> (average concentration of analyte in μg/g) x (waste in kgal) x 3,785 L/kgal x 1,000 mL/L x (density in g/mL) x kg/(1E+09) μg = total kg for this waste type in the tank.

Table D3-2. Concentrations of Components in REDOX Process Sludges and 241-S-104 Inventory Calculations. (2 sheets)

	Tanks (segments)			Average	HDW Model	S-104
Analyte	241-S-104 μg/g	241-S-107 (Bottom 3)	241-S-101 (Bottom 2)	Concentration μg/g	Concentration μg/g	Sludge[1] Tank Inventory (kg)
Al	117,000	56,400	127,000	100,133	57,000	198,000
Bi	45.7	n/r	n/r	45.7	0.574	90.4
Ca	247	234	322	268	3,480	529
Cl	3,200	1,860	2,050	2,370	1,850	4,690
Cr	2,350	1,180	2,230	1,920	15,400	3,800
F	145	150	n/r	148	2.98	292
Fe	1,720	1,160	1,960	1,613	14,600	3,190
K	300	457	539	432	446	854
Mn	1,150	83	2,750	1,328	1.10	2,630
Na	121,000	60,400	123,000	101,467	97,100	201,000
Ni	56	206	90.7	117.6	1,050	233
NO_2	25,900	34,300	31,100	30,433	55,300	60,200
NO_3	191,000	57,600	102,000	116,867	122,000	231,000
Pb	29.6	33	37	33.2	1,340	65.7

Table D3-2. Concentrations of Components in REDOX Process Sludges and 241-S-104 Inventory Calculations. (2 sheets)

	Tanks (segments)			Average	HDW Model	S-104
Analyte	241-S-104 μg/g	241-S-107 (Bottom 3)	241-S-101 (Bottom 2)	Concentration μg/g	Concentration μg/g	Sludge[1] Tank Inventory (kg)
PO_4	2,190	1,630	1,360	1,727	16.8	3,410
P	93.2	391	278	254	n/r	502
S	472	293	343	369	n/r	730
Si	1,330	1,060	1,360	1,250	1,430	2,470
SO_4	2,270	1,300	897	1,489	1,950	2,940
Sr	424	378	456	419	2.84E-06	829
TOC	1,730	293	n/r	1,012	35.9	2,000
U	6,690	8,686	8,480	7,952	6,550	15,700
Zn	20.1	24	25.1	23.1	n/r	45.6
Zr	33.6	131	36	66.9	0.121	132
	μCi/g	μCi/g	μCi/g	μCi/g	μCi/g	Ci
^{90}Sr	310	290.3	n/r	300	n/r	594,000
^{137}Cs	36.2	87.4	93.08	72	n/r	143,000
$^{239/240}Pu$	0.282	n/r	n/r	0.2820	n/r	558
density	1.74	1.87	1.74	1.783	1.51	1.783

Note:

[1]Based on the average of these tanks (241-S-101, 241-S-104 and 241-S-107)

D.3.4 INVENTORY COMPARISONS

The engineering assessment-based inventory values, the sampling-based inventories and the HDW model-based inventories are compared in Table D3-3. Selected comparisons follow.

Table D3-3. Comparison of Selected Component Inventory Estimates for Tank 241-S-104 Waste.

Component	Engineering Assessment-Based Inventory (kg)[1]	Sampling-Based Inventory (kg)	HDW Model-Based Inventory (kg)
Al	198,000	214,000	95,700
Bi	90.4	<74.9	0.966
Cl	4,690	5,840	3,120
Cr	3,800	4,290	25,800
Fe	3,190	3,140	24,500
Mn	2,630	2,100	1.84
Na	201,000	221,000	163,000
NO_3	231,000	349,000	204,000
NO_2	60,200	38,000	92,900
Si	2,470	2,430	2,390
SO_4	2,940	4,140	3,270
Sr	829	774	5E-06
TOC	2,000	2,770	60.5
U	15,700	12,200	11,000
Zr	132	61.3	0.204
^{90}Sr	594,000	566,000	587,000
^{137}Cs	143,000	114,000	211,000
$^{239/240}Pu$	558	515	326
H_2O (percent)	n/r	31.6	48.4

Note:

[1]Based on the average concentration for tanks 241-S-101, 241-S-104, 241-S-107.

Aluminum. The sample-based inventory is about twice the HDW model estimate. Because there is CWR in this tank and the molarity of Al in CWR is about twice that for R, it is quite possible the larger amount of Al in this tank is due to the CWR waste. The HDW model-based molarities for Al are also lower than those of the process flowsheet (Table D3-1).

Sodium. The HDW model inventory is about 25 percent lower than the tank 241-S-104 sample-based inventory. The concentration for sodium in Table 3-2 is higher for the sample-based and engineering assessment-based inventories. In addition, the HDW model assumes a lower density than the analytical samples indicate. Calculated sample values are thus higher than for the HDW model.

Silicon. The Si inventory predicted by the engineering assessment and the HDW model are approximately the same as the sample-based inventory. Both this assessment and the HDW model estimate only about 10 to 11 percent of the Si partitions with the solids in these waste types.

Uranium. The U inventory predicted by this assessment, the HDW model, and the sample-based inventory are about the same. As stated previously, it is concluded that some of the U partitions to the supernatant and interstitial liquid, likely as a soluble uranyl complex, but most remains with the solids. The process flowsheet and the HDW flowsheet show the same molarity of U.

Nitrate. The sample-based inventory is approximately 60 percent higher than that predicted by the HDW model. The process flowsheet molarity is about 15 percent higher than the molarity used for the HDW model. The HDW also assumes less nitrate partitions to the solids. Because of the self evaporation in this tank, it appears that more nitrate precipitated than predicted.

Nitrite. The sample-based inventory for NO_2 is approximately 40 percent of that predicted by the HDW model. The R flowsheet does not contain this analyte. The CWR molarity for the process flowsheet is 50 percent higher than that used for the HDW model. Why the model predicts higher is not due to solubility and thus is unknown at this time. The HDW model may assume significant radiolysis of nitrate to nitrite, which could account for this situation.

Manganese. The sample-based inventory for manganese is 1,000 times that predicted by the HDW model. Mn is listed on earlier process flowsheets for R, and the engineering assessment comparison (2,630 kg) supports the 2,100 kg found in this tank, based on the sampling of tank 241-S-104. The HDW model does not assume Mn was used in the flowsheets.

Chromium. The HDW model-based inventory is about 6 times higher than the sampling-based inventory. The HDW model flowsheet molarity is one half that of the process flowsheet. However, the HDW model shows about 65 percent of the Cr partitioning to the solids, whereas the sample shows only 7.5 percent partitioning.

Iron. The HDW model predicts 8.7 times more iron than does the sampling-based inventory. The HDW flowsheet shows between 3 to 4 times the molarity of iron as does the process flowsheet. The HDW model also predicts that iron will fully partition to the solids, whereas the sampling-based inventory shows only 70 percent of the iron partitioning to the solids.

TOC. TOC is not a process flowsheet analyte. The sampling-based inventory lists 2,900 kg of TOC, and only 60.5 kg is predicted by the HDW model. The engineering assessment-based inventory (2,000 kg) supports the sampling-based information. The HDW model does not account for this organic inventory in its treatment of this and similar tanks.

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessments associated with waste management activities, and 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 and facilities for retrieving wastes and processing them into a form suitable for long-term storage. Chemical and radiological inventory information is generally derived using one of three approaches: (1) component inventories are estimated using results of sample analyses; (2) component inventories are estimated using the HDW Model based on process knowledge and historical information; or (3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data. Not surprisingly, the information derived from these different approaches is often inconsistent.

An effort is underway to provide inventory estimates that will serve as the standard characterization for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available chemical information for tank 241-S-104 was performed, including:

- Data from three push mode 1992 core samples (See Appendix B, Section B2.0)
- An inventory estimate generated by the HDW model (Agnew et al. 1996)

- Comparison with the R/CWR sludge values based on the concentration and partitioning of these wastes within the tank, which can be evaluated by comparison to similar tanks.

- Comparison with the average composite analytical segment concentrations of similar tanks containing these waste types.

Based on this evaluation, a best-basis inventory was developed for tank 241-S-104 for which sampling information was available. For the following reasons, the sampling-based inventory was chosen as the best basis for those analytes for which sampling-based analytical values were available:

- The sampling-based inventory analytical concentrations compared favorably to those of two other R tanks (to the extent this is known at this time)

- The HDW model does not agree with the other sampling-based inventories for R tanks in several cases

- The engineering assessment using the original process flow streams supports the assumption that the sampling-based data appear reasonable

- Comparison of similar waste segment levels from tanks with the same wastes supports the assumption that the sampling-based data appear reasonable

- For those few analytes where no values were available from the sampling-based inventory, the engineering assessment-based inventory, or the engineering check comparison-based inventory, the HDW model-based inventory values were used, with the notation that they were of lower reliability

The best-basis inventory for tank 241-S-104 is presented in Tables D4-1 and D4-2.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-104 (December 4, 1996).

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	214,000	S	
Bi	<74.9	S	Engineering assessment = 90.4
Ca	7,700	S	
Cl	5,840	S	
TIC as CO_3	7,560	S	
Cr	4,290	S	
F	292	E	
Fe	3,140	S	
Hg	74.5	M	
K	548	S	
La	2E-06	M	
Mn	1,890	S	
Na	220,000	S	
Ni	102	S	
NO_2	38,000	S	
NO_3	349,000	S	
OH	n/r		
Pb	65.7	E	The M value = 2,240
P as PO_4	518	S	
Si	2,430	S	
S as SO_4	4,140	S	
Sr	774	S	
TOC	2,770	S	
U_{TOTAL}	12,200	S	
Zr	61.2	S	

Notes:

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

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-104 (Radionuclides decayed to January 1, 1994) (December 4, 1996).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	6.15	S	
^{14}C	1.64	S	
^{90}Sr	566,000	S	
^{90}Y	566,000	S	From ^{90}Sr
^{99}Tc	44.2	S	
^{137}Cs	114,000	S	
^{137m}Ba	107,000	S	From ^{137m}Cs
^{239}Pu	515	S	*includes ^{240}Pu

Notes:

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

D5.0 APPENDIX D REFERENCES

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young 1995, *Waste Status and Transaction Record Summary (WSTRS Rev. 2)*, WHC-SD-WM-TI-615, 614, 669, and 689, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

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.

Hanlon, B. M., 1996, *Waste Tank Summary Report for Month Ending June 30, 1996*, WHC-EP-0182-99, Westinghouse Hanford Company, Richland, Washington.

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

Kruger, Albert A, B. J. Morris and L. J. Fergestrom, 1996, *Tank Characterization Report for Single-Shell Tank 241-S-101*, WHC-SD-WM-ER-613, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, L. W. Shelton, R. A. Watrous, S. L. Lambert, D. E. Place, R. M. Orme, G. L. Borsheim, N. G. Colton, M. D. LeClair, D. Hedengren, R. T. Winward, and W. W. Schulz, 1996, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

Simpson, Brett C., J. G. Field, D. W. Engel and D. S. Daly, 1996, *Tank Characterization Report for Single-Shell Tank 241-S-107*, WHC-SD-WM-ER-589, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

This page intentionally left blank.

APPENDIX E

BIBLIOGRAPHY FOR TANK 241-S-104

APPENDIX E

BIBLIOGRAPHY FOR TANK 241-S-104

Appendix E provides a bibliography of information that supports the characterization of tank 241-S-104. This bibliography represents an in-depth literature search of all known information sources that provide sampling, analysis, surveillance, and modeling information, as well as processing occurrences associated with tank 241-S-104 and its respective waste types.

The references in this bibliography are separated into three broad categories containing references broken down into subgroups. These categories and their subgroups are listed below.

I. NON-ANALYTICAL DATA

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

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

- IIa. Sampling of Tank 241-S-104

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

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

This bibliography is broken down into the appropriate sections of material to use, with an annotation at the end of each reference describing the information source. Where possible, a reference is provided for information sources. A majority of the information listed below may be found in the Lockheed Martin Hanford Corporation Tank Characterization Resource Center.

I. NON-ANALYTICAL DATA

Ia. Models/Waste Type Inventories/Campaign 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 tank layer and supernatant models and the historical tank content estimate for Hanford Site underground waste storage tanks, as well as a list of Hanford Site waste types.

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

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

Boldt, A. L., 1966, *REDOX Chemical Flowsheet HW No. 9*, ISO-335, Isochem, Inc., Richland, Washington.

- Document contains compositions of material balance for REDOX process as well as a separations plan denoting process stream waste before transfer to 200 Area waste tanks.

Crawley, D. T., 1960, *REDOX Chemical for sheet HW-No. 6*, HW-66203, Hanford Atomic Products Operation, General Electric Company, Richland, Washington.

- Document contains compositions of material balance for REDOX process as well as a separations plan denoting process stream waste before transfer to 200 Area waste tanks.

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

- A model based on process knowledge and radioactive decay estimations using ORIGEN for different compositions of process waste streams assembled for total, solution, and solids compositions per tank. Assumptions about waste/waste types and solubility parameters/constraints are also given.

Merrill, E. T. and R. L. Stevenson, 1995, *REDOX Chemical Flowsheet HW No. 5*, HW-38684, Hanford Atomic Products Operation, Richland, Washington.

- Document contains compositions of material balance for REDOX process as well as a separations plan denoting process stream waste before transfer to 200 Area waste tanks.

Schneider, K. J., 1951, *Flow Sheet and Flow Diagrams of Precipitation Separations Process*, HW-23043, General Electric Company, Richland, Washington.

- Document contains compositions of first concentration cycle waste before transfer to 200E waste tanks.

Ib. Fill History/Waste Transfer Records

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1996, *Waste Status and Transaction Record Summary for the Southwest Quadrant of the Hanford 200 East Area*, WHC-SD-WM-TI-614, Rev. 1, Los Alamos National Laboratory, Los Alamos, New Mexico.

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

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

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

Koreski, G. M., 1991, *Operational Waste Volume Projection*, WHC-SD-WM-ER-029, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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

Ic. Surveillance/Tank Configuration

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

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

Baumhart, R. J., 1989, *Single-Shell Tank Leak Volumes*, (letter #89011832BR1 to R. E. Gerton, U.S. Department of Energy, Richland Operations Office, May 17), Westinghouse Hanford Company, Richland, Washington.

- Letter report estimating leak volumes for single-shell tanks.

Baumhart, R. J. 1988, *Interim Isolation of Tanks T-105, T-109, and S-104*, (letter #8856251 to R. E. Gerton, U.S. Department of Energy, Richland Operations Office, October 12), Westinghouse Hanford Company, Richland, Washington.

Graham, M. J., 1981, *Moisture Reading in Dry Wells in S and SX Tank Farms*, (internal memorandum #72710-81-275 to W. F. Hale, August 17), Rockwell Hanford Operations, Richland, Washington.

- Letter report concerning neutron probe readings in dry wells.

Jones, A. L., 1987, *Stabilization of Sludge Tanks*, (internal memorandum #65950-87-093 to J. C. Womack, March 20), Rockwell Hanford Operations, Richland, Washington.

- Memorandum addresses porosity issues for stabilization of sludge tanks.

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

- Document gives an assessment of riser locations for each tank; however not all tanks are included/completed. Also included is an estimate of what risers are available for sampling.

Raymond, H. N., 1972, *Maximum Operating Levels and Cascade Levels in 200W Area Tank Farms*, (internal letter #LET-082172 to C. J. Francis, August 21), Atlantic Richfield Hanford Company, Richland, Washington.

- Letter reports maximum operating level.

Schmidt, W. C, 1977, *Tank Isolation Project Photographs*, (internal memorandum #RI-072077 to W. Schick, July 20), Rockwell International, Richland, Washington.

- Letter contains the dates of in-tank photographs.

Swenson, J. A., 1978, *1978 Surveys of 241S 241U 241-SY Farms*, (internal memorandum #LET-041478 to B. J. Saueressig, March 26), Rockwell Hanford Operation, Richland, Washington.

- Letter contains the results of radiation survey of contaminated risers.

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

- Compilation information on thermocouple trees installed in Hanford Site underground waste tanks.

Welty, R. K., 1988, *Waste Storage Tank Status and Leak Detection Criteria, Volumes I and II*, WHC-SD-WM-TI-356, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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

Id. Sample Planning/Tank Prioritization

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.

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.

- Early characterization planning document.

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

- Document contains Tri-Party Agreement (see Ecology et al. 1996 listing in Section 5.0) requirement-driven TWRS Characterization Program information and a list of tanks addressed in fiscal year 1997.

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.

Ie. Data Quality Objectives (DQO) and Customers of Characterization Data

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

- DQO used to determine if tanks are under safe operating conditions.

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

- Document provides basis for selection of tanks for disposal needs.

Slankas, T. J., M. J. Kupfer, and W. W. Schulz, 1995, *Data Needs and Attendant Data Quality Objectives for Tank Waste Pretreatment and Disposal*, WHC-SD-WM-DQO-022, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Documents the needs of the pretreatment function within TWRS.

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

IIa. Sampling of Tank 241-S-104

Cromar, R. D., 1994, *Statistical Characterization Report for Single-Shell Tank 241-S-104*, WHC-SD-WM-WM-652, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains the results of the statistical analysis of data from Tank 241-S-104.

Horton, J. E., 1976, *Characterization & Analysis of Tank S-104 Sludge*, (internal memo #022476 to W. R. Christensen, February 24), Atlantic Richfield Hanford Company, Richland, Washington.

- Letter report of tank 241-S-104 sludge analysis.

Johnston, R. G., 1981, *Submission of Letter Report on Radiolytic Gas Generation in Bitumen Concrete Waste Forms Fulfilling Milestone*, (internal memo #65470-81-065 to I. E. Reep, March 20), Rockwell Hanford Operation, Richland, Washington.

- Letter describes radiolytic gas generation from concrete and bitumen waste form.

Kirk, J. J., 1980, *Permeability, Porosity & Capillarity of Hanford Waste Material & Its Limits of Pumpability*, RHO-CD-925 Rev. 2, Rockwell Hanford Operation, Richland, Washington.

- Study of pumpability and drainability report.

Kocher, K. L., 1993, *Single Shell Waste Characterization Tank 241-S-104 Data Package*, WHC-SD-WM-DP-031, Rev. 0, Richland Washington.

- Laboratory report for 1992 core sampling event.

Wisness, S. H., 1993, *Transmittal of Data Package & Validation Summary for Core Samples from 241-S-104*, (letter #9303061 to S. E. McKinney, Washington State Department of Ecology, April 6), Department of Energy Richland Office, Richland, Washington.

- Letter transmits tank 241-S-104 core sample analyses to Washington State Department of Ecology.

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, 1995, *Hanford Tank Chemical and Radionuclide Inventories: HDW Rev. 3*, LA-UR-96-858, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Document contains waste type summaries as well as primary chemical compound/analyte and radionuclide estimates for sludge, supernatant, and solids.

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

- Document contains major components for waste types, and some assumptions. Purchase records are used to estimate chemical inventories.

Allen, G. K., 1975, *Hanford Liquid Waste Inventory As Of September 30, 1974*, ARH-CD-229, Atlantic Richfield Hanford Company, Richland, Washington.

- Document contains major components for waste types, and some assumptions.

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*, LAUR-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, and E. D. Johnson, 1995, *Historical Tank Content Estimate for the Northwest Quadrant of the Hanford 200 Areas*, WHC-SD-WM-ER-351, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains summary information from the supporting document as well as in-tank photo collages and the solid composite inventory estimates Rev. 0 and Rev. 0A.

Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1995, *Supporting Document for the Historical Tank Content Estimate for T Tank Farm*, WHC-SD-WM-ER-320, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains summary tank farm and tank write-ups on historical data and solid inventory estimates, as well as appendixes for the data. The appendixes contain the following information: Appendix C - Level History AutoCAD sketch; Appendix D - Temperature Graphs; Appendix E - Surface Level Graph; Appendix F, pg. F-1 - Cascade/Drywell Chart; Appendix G - Riser Configuration Drawing and Table; Appendix I In-Tank Photos; and Appendix 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 the tanks.

Endow, N., 1954, *Field Corrosion Test SAE 1020 Carbon Steel in REDOX Process*, HW 32755, General Electric Company, Richland, Washington.

- Report of the corrosion rates in REDOX waste.

Fraser, M. C., 1974, *Radionuclide Inventories in Leaks from Transfer Lines and Tanks*, (internal letter 013074 to H. P. Shaw, January 30), Atlantic Richfield Hanford Company, Richland, Washington.

- Letter reports amount of waste and radionuclide inventory leaked from transfer lines and tanks.

Hanlon, B. M., 1996, *Waste Tank Summary Report for Month Ending April 30, 1996*, WHC-EP-0182-97, Westinghouse Hanford Company, Richland, Washington.

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

Husa, E. I., 1993, *Hanford Site Waste Storage Tank Information Notebook*, WHC-EP-0625, 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.

DISTRIBUTION SHEET

To	From	Page 1 of 3
Distribution	Data Assessment and Interpretation	Date 03/10/97
Project Title/Work Order		EDT No. N/A
Tank Characterization Report for Single-Shell Tank 241-S-104, HNF-SD-WM-ER-370, Rev. 1		ECN No. ECN-635446

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
OFFSITE					
Sandia National Laboratory P.O. Box 5800 MS-0744, Dept. 6404 Albuquerque, NM 87815					
D. Powers		X			
Nuclear Consulting Services Inc. P. O. Box 29151 Columbus, OH 43229-01051					
J. L. Kovach		X			
Chemical Reaction Sub-TAP P.O. Box 271 Lindsborg, KS 67456					
B. C. Hudson		X			
Tank Characterization Panel Senior Technical Consultant Contech 7309 Indian School Road Albuquerque, NM 87110					
J. Arvisu		X			
SAIC 20300 Century Boulevard, Suite 200-B Germantown, MD 20874					
H. Sutter		X			
Los Alamos Laboratory CST-14 MS-J586 P. O. Box 1663 Los Alamos, NM 87545					
S. F. Agnew		X			

DISTRIBUTION SHEET

To	From	Page 2 of 3
Distribution	Data Assessment and Interpretation	Date 03/10/97
Project Title/Work Order		EDT No. N/A
Tank Characterization Report for Single-Shell Tank 241-S-104, HNF-SD-WM-ER-370, Rev. 1		ECN No. ECN-635446

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
Los Alamos Technical Associates					
T. T. Tran	B1-44	X			
Tank Advisory Panel					
102 Windham Road					
Oak Ridge, TN 37830					
D. O. Campbell		X			
ONSITE					
Department of Energy - Richland Operations					
J. F. Thompson	S7-54	X			
W. S. Liou	S7-54	X			
J. A. Poppiti	S7-54	X			
N. W. Willis	S7-54	X			
DE&S Hanford, Inc.					
R. J. Cash	S7-14	X			
W. L. Cowley	R2-54	X			
G. L. Dunford	A2-34	X			
G. D. Johnson	S7-14	X			
J. E. Meacham	S7-14	X			
Fluor Daniel Northwest					
J. L. Stroup	S3-09	X			
Lockheed Martin Hanford, Corp.					
K. M. Hodgson	H0-34	X			
J. Jo	R2-12	X			
T. J. Kelley	S7-21	X			
L. M. Sasaki	R2-12	X			
B. C. Simpson	R2-12	X			
L. R. Webb	R2-12	X			
ERC (Environmental Resource Center)	R1-51	X			
Tank Characterization Resource Center	R2-12	5			
Lockheed Martin Services, Inc.					
B. G. Lauzon	R1-08	X			
Central Files	A3-88	X			
EDMC	H6-08	X			

DISTRIBUTION SHEET

To	From	Page 3 of 3
Distribution	Data Assessment and Interpretation	Date 03/10/97
Project Title/Work Order		EDT No. N/A
Tank Characterization Report for Single-Shell Tank 241-S-104, HNF-SD-WM-ER-370, Rev. 1		ECN No. ECN-635446

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
Numatec Hanford Corporation					
J. S. Garfield	H5-49	X			
J. S. Hertzel	H5-61	X			
D. L. Lamberd	H5-61	X			
Pacific Northwest National Laboratory					
A. F. Noonan	K9-91	X			
Rust Federal Services of Hanford, Inc.					
C. T. Narquis	T6-16	X			
SGN Eurisys Services Corp.					
D. B. Engelman	L6-37	X			