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ENGINEERING CHANGE NOTICE

Page 1 of 2

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13a. Description of Change

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

The document has been totally revised to include the results of recent sampling to address technical issues associated with the waste, and to update the best basis standard inventory.

14a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[ ]	Environmental	[ ]	Facility Deactivation	[ ]
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16. Design Verification Required

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17. Cost Impact

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18. Schedule Impact (days)

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

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

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

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DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-T-112

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

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Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-T-112. This report supports the requirements of the Tri-Party Agreement Milestone M-44-15B.

Kara M. Broz 6/11/98
Release Approval Date

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Tank Characterization Report for Single-Shell Tank 241-T-112

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LIST OF TERMS

224	lanthanum fluoride waste from uranium recovery operations
2C	second cycle $BiPO_4$ waste, no distinction for time period
2C1	second cycle $BiPO_4$ waste, 1944 to 1951
2C2	second cycle $BiPO_4$ waste, 1950 to 1956
AES	atomic emission spectroscopy
Btu/hr	British thermal units per hour
Ci	curie
Ci/g	curies per gram
Ci/L	curies per liter
CI	confidence interval
cm	centimeter
DQO	data quality objective
DSC	differential scanning calorimetry
DW	wash solution from equipment decontamination at T Plant
ft	feet
g	gram
g/cm^3	grams per cubic centimeter
GEA	gamma energy analysis
g/gal	grams per gallon
g/L	grams per liter
g/mL	grams per milliliter
HDW	Hanford defined waste
HTCE	historical tank content estimate
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
LFL	lower flammability limit
LL	lower limit
m	meter
m^2	square meters
M	molarity
M/L	moles per liter
mg	milligram
mL	milliliter
mm	millimeter

LIST OF TERMS (Continued)

mRad/hr	millirads per hour
n/a	not applicable
ND	not determined
n/r	not reported
PHMC	Project Hanford Management Contractor
ppm	parts per million
QC	quality control
RPD	relative percent difference
SAP	sampling and analysis plan
SMM	supernatant mixing model
SU	supernatant
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
W	watt
WSTRS	Waste Status and Transaction Record Summary
wt%	weight percent
%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
μCi/g	microcuries per gram
μCi/gal	microcuries per gallon
μCi/L	microcuries per liter
μCi/mL	microcuries per milliliter
μeq/g	microequivalents per gram
μg/g	micrograms per gram
μg/L	micrograms per liter
μg/mL	micrograms per milliliter
μm	micrometer

1.0 INTRODUCTION

A major function of the Tank Waste Remediation System (TWRS) is to characterize waste in support of waste management and disposal activities at the Hanford Site. Analytical data from sampling and analysis and other available information about a tank are compiled and maintained in a tank characterization report (TCR). This report and its appendices serve as the TCR for single-shell tank 241-T-112. The objectives of this report are 1) to use characterization data in response to technical issues associated with tank 241-T-112 waste and 2) to provide a standard characterization of this waste in terms of a best-basis inventory estimate. Section 2.0 summarizes the response to technical issues, Section 3.0 shows the best-basis inventory estimate, Section 4.0 makes recommendations about the safety status of the tank and additional sampling needs. The appendices contain supporting data and information. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1997), Milestone M-44-15b, change request M-44-97-03, to "issue characterization deliverables consistent with the Waste Information Requirements Documents developed for 1998."

1.1 SCOPE

The characterization information in this report originated from sample analyses and known historical sources. The results of recent sample events will be used to fulfill the requirements of the data quality objectives (DQOs) and memoranda of understanding specified in Brown et al. (1997) for this tank. Other information can be used to support conclusions derived from these results. Appendix A contains historical information for tank 241-T-112 including surveillance information, records pertaining to waste transfers and tank operations, and expected tank contents derived from a process knowledge model. Appendix B summarizes recent sampling events (see Table 1-1), sample data obtained before 1989, and sampling results. Appendix C reports the statistical analysis and numerical manipulation of data used in issue resolution. Appendix D contains the evaluation to establish the best basis for the inventory estimate. Appendix E is a bibliography that resulted from an in-depth literature search of all known information sources applicable to tank 241-T-112 and its respective waste types. The reports listed in Appendix E are available in the Tank Characterization and Safety Resource Center.

Table 1-1. Summary of Recent Sampling.

Sample/Date[1]	Phase	Location	Segmentation	% Recovery
Combustible gas test 2/26/97 and 2/27/97	Gas	Tank headspace, Riser 2, 6.1 m (20 ft) below top of riser	n/a	n/a
Combustible gas test 3/18/97 and 3/19/97	Gas	Tank headspace, Riser 7, 6.1 m (20 ft) below top of riser	n/a	n/a
Push core 2/26/96 and 2/27/97	Solid/liquid	Riser 2	2 segments: liquids only on upper segment; upper half and lower half solids on lower segment	82% to 100%
Push core 3/18/97 and 3/19/97	Solid	Riser 7	2 segments: first segment empty and lower half solids on lower segment	0% to 74%

Note:

n/a = not applicable

[1]Dates are in the mm/dd/yy format.

1.2 TANK BACKGROUND

Table 1-2 summarizes the description of tank 241-T-112. The tank has an operating capacity of 2,010 kL (530 kgal) and presently contains an estimated 254 kL (67 kgal) of noncomplexed waste (Hanlon 1997). The tank is not on the Watch List (Public Law 101-510).

Table 1-2. Description of Tank 241-T-112.

TANK DESCRIPTION	
Type	Single-shell
Constructed	1943-1944
In service	1946
Diameter	22.9 m (75 ft)
Operating depth	5.2 m (17 ft)
Capacity	2,010 kL (530 kgal)
Bottom shape	Dish
Ventilation	Passive
TANK STATUS	
Waste classification	Noncomplexed
Total waste volume[1]	254 kL (67 kgal)
Supernatant volume	27 kL (7 kgal)
Saltcake volume	0 kL (0 kgal)
Sludge volume	227 kL (60 kgal)
Drainable interstitial liquid volume	0 kL (0 kgal)
Waste surface level	50.3 cm (19.8 in.)
Temperature (12/4/76 to 11/30/97)[2]	12 °C (54 °F) to 28 °C (83 °F)
Integrity	Sound
Watch List	None
Flammable Gas Facility Group	III
SAMPLING DATE	
Core sample	February 1997, March 1997
Vapor sample	February 1997, March 1997
SERVICE STATUS	
Declared inactive	1976
Interim stabilization	1981
Intrusion prevention	1981

Notes:

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

[2]Dates are in the mm/dd/yy format.

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2.0 RESPONSE TO TECHNICAL ISSUES

Four technical issues have been identified for tank 241-T-112 (Brown et al. 1997).

- **Safety Screening**: Does the waste pose or contribute to any recognized potential safety problems?
- **Hazardous Vapor Safety Screening**: Do hazardous storage conditions exist associated with gases and vapors in the tank?
- **Organic Complexants**: Does the possibility exist for a point source ignition in the waste followed by a propagation of the reaction in the solid/liquid phase of the waste?
- **Organic Solvents**: Does an organic solvent pool exist that may cause a fire or ignition of organic solvents in entrained waste solids?

The sampling and analysis plan (SAP) (Thompson 1997) provides the types of sampling and analysis used to address the above issues. Data from the analysis of push core samples and tank headspace measurements, along with available historical information, provided the means to respond to the technical issues. Sections 2.1 and 2.2 provide the response. See Appendix B for sample and analysis data for tank 241-T-112.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-T-112 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 condition is addressed separately below.

2.1.1 Exothermic Conditions (Energetics)

The first requirement outlined in the safety screening DQO (Dukelow et al. 1995) is to ensure there are not sufficient organic constituents in tank 241-T-112 to pose a safety hazard. Because of this requirement, the energetics in tank 241-T-112 waste were evaluated. The safety screening DQO required the waste sample profile be tested for energetics every 24 cm (9.5 in.) to determine whether the energetics exceeded the safety threshold limit. The threshold limit for energetics is 480 J/g on a dry weight basis. Results obtained using differential scanning calorimetry (DSC) indicated that no sample obtained from tank 241-T-112 had mean exothermic reactions (on a dry-weight basis) exceeding the safety screening DQO limit. In fact, no exotherms were reported for the solids or liquid portions of the segments.

2.1.2 Flammable Gas

Headspace measurements were taken from risers 2 and 7 before taking the February and March 1997, respectively, push core samples. Flammable gas was not detected in the tank headspace (0 percent of the lower flammability limit [LFL]) before sampling. During sampling, the LFL in the tank headspace was never recorded as anything other than 0 percent. The safety screening limit is 25 percent of the LFL. Appendix B provides data for the two sets of flammable gas measurements. See Table B2-6 for results.

2.1.3 Criticality

The safety screening DQO threshold for criticality, based on the total alpha activity, is 1 g/L. Because total alpha activity is measured in μCi/mL rather than g/L, the 1 g/L limit is converted into units of μCi/mL by assuming that all alpha decay originates from ^{239}Pu. 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 1.39 g/mL (maximum bulk density measured in either core), then 1 g/L of ^{239}Pu is 44.2 μCi/g of alpha activity. The maximum total alpha activity result was 0.312 μCi/g (core 186, segment 2). The maximum upper limit to a 95 percent confidence interval on the mean for alpha was 0.469 μCi/g, for core 186, segment 2, lower half, indicating the potential for a criticality event is extremely low. Therefore, criticality is not a concern for this tank. Appendix C contains the method used to calculate confidence limits.

2.2 ORGANIC COMPLEXANTS

The data required to support the issue of organic complexants are documented in *Memorandum of Understanding for the Organic Complexant Safety Issue Data Requirements* (Schreiber 1997). Although the memorandum was published after the sampling for tank 241-T-112 was completed, it still is important to note that no exotherms were found in either core. The memorandum of understanding requires total organic carbon (TOC) measurements if greater than 25 percent of the samples exhibited exotherms. Neither the solid nor the liquid sample collected by push mode sampling had any exotherms. Consequently, organic complexants are not a safety issue for this tank.

2.3 HAZARDOUS VAPOR SAFETY SCREENING

Hazardous vapor safety screening involves two separate issues: flammability and toxicity of gases in the headspace. Table B2-6 shows that flammable gases, as measured during the core sampling events of 1997, did not exist. Ammonia was the only hazardous gas measured at that time, and the maximum concentration recorded was 30 parts per million. Hazardous vapors are not a safety issue for tank 241-T-112.

2.4 ORGANIC SOLVENTS

Organic solvent pool sizes are determined by a calculation that involves values for nonhydrocarbon methane within the headspace. Because a measurement of that analyte was not performed for tank 241-T-112, there is insufficient data to make a statement about any solvent pool at this time. However, because supernatant results consistently show lack of exothermic reactions, it is reasonable to assume any hazard associated with this tank would be minimal.

2.5 OTHER TECHNICAL ISSUES

A factor in assessing tank safety is the heat generation and temperature of the waste. Heat is generated in the tanks from radioactive decay. An estimate of the tank heat load based on 1997 sample events was not possible because radionuclide analyses were not required. However, the heat-load estimate based on the tank process history was 3.44 W (11.8 Btu/hr) (Agnew et al. 1997). The heat-load estimate based on the tank headspace temperature was 263 W (904 Btu/hr) (Kummerer 1995). An analysis using the data derived from the best-basis portion of this report (see Appendix D) uses values for both ^{90}Sr and ^{137}Cs derived from tank 241-T-111 waste data. The total inventory in tank 241-T-112 for these isotopes is calculated to be 1,590 and 49.1 curies, respectively. This radioactivity converts to a heat generation of 10.9 W (37.1 Btu/hr). All three estimates are quite low and are well below the limit of 11,700 W (40,000 Btu/hr) that separates high- and low-heat-load tanks (Smith 1986).

2.6 SUMMARY

The results of all analyses performed to address potential safety issues showed that primary analytes did not exceed safety decision threshold limits. Some uncertainty exists as to the degree in which waste type 224 is present among the second cycle bismuth phosphate waste. However, the analytical data bears out the presence of 224. This will be discussed in more detail in Appendix D. The safety issue results are displayed in Table 2-1.

Table 2-1. Summary of Technical Issues.

Issue	Sub-issue	Result
Safety screening	Energetics	No exotherms were observed in any sample.
	Flammable gas	The vapor measurement was reported at 0 percent of the LFL (combustible gas meter).
	Criticality	All analyses were well below 48 μCi/g total alpha (within 95 percent confidence limit on each sample).
Hazardous vapor screening	Flammability	Vapor measurement reported 0 percent of LFL.
	Toxic gases	Ammonia was at a low concentration level.
Organic complexants	Safety categorization	Safe; no exotherms were observed in any sample.
Organic solvents	Solvent pool	Not measured; there was a lack of exotherms in supernatant.

Note:

The organic complexants and organic solvent safety issues are expected to be closed in fiscal year 1998.

3.0 BEST-BASIS STANDARD INVENTORY ESTIMATE

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

Chemical and radiological inventory information are generally derived using one of three approaches: 1) component inventories are estimated using results of sample analyses; 2) component inventories are estimated using the Hanford defined waste (HDW) model (Agnew et al. 1997) 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. The information derived from these different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as the standard characterization for waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-T-112 was performed and includes the following:

- Data from two 1997 core samples (Steen 1997)
- An inventory estimate generated by the HDW model
- A comparison of total waste concentrations with similar 241-T Tank Farm tank samples from tank 241-T-111 (Field et al. 1997).

Based on this evaluation, a best-basis inventory was developed for tank 241-T-112 (see Tables 3-1 and 3-2). The evaluation used the sample-based analytical data from tank 241-T-112. Where analyses were absent for tank 241-T-112 samples, the evaluation used sample-based analytical data from tank 241-T-111 to define the best-basis inventory because tank 241-T-111 historically contains the same waste types as tank 241-T-112. The best-basis inventory used sample analyses because the estimates provided in Agnew et al. (1997) for several chemical components were not consistent with the sample-based data for tanks 241-T-111 and 241-T-112. The noticeable presence of manganese and lanthanum in the solids clearly indicates that 224 wastes were deposited in tank 241-T-112, at concentrations similar to those found in tank 241-T-111. This indicates that dry weight analytical values from tank 241-T-111, adjusted for tank 241-T-112 weight percent water, are more representative of tank waste than the Agnew model.

The inventories of analytes are calculated using a solids volume of 227 kL (60 kgal), a liquid volume of 26.5 kL (7 kgal), and a solids density of 1.28 g/cm^3 established by the sample analyses (Steen 1997). The HDW model bases were used as the best basis where there were poor (or no) sample bases. Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997).

Best-basis tank inventory values were derived for 46 key radionuclides (Kupfer et al. 1997, Section 3.1), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have reported only ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am have been reported infrequently. For this reason, it was necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to separations plant waste streams, and track their movement with tank waste transactions. These computer models are described in Kupfer et al. (1997), Section 6.1, and in Watrous and Wootan (1997). Model-generated values for radionuclides in any of 177 tanks are reported in Agnew et al. (1997). The best-basis value for any one analyte may be a model result, a sample-based result, or an engineering assessment-based result, if available. For a discussion of typical errors between model-derived values and sample-derived values, see Kupfer et al. (1997).

The inventory values reported in Tables 3-1 and 3-2 are subject to change. Refer to the Tank Characterization Database for the most current inventory values.

Table 3-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-T-112. Effective Date May 1, 1998. (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	1,480	S	
Bi	8,370	S	
Ca	550	S	Based on a "limiting value" in tank data
Cl	138	S	
TIC as CO_3	1,440	E	Tank 241-T-111 sample basis for solids used
Cr	632	S	
F	582	S/C	Charge balance with lanthanum as well as analytical data (supernatant)
Fe	4,770	S	
Hg	0.462	E	Tank 241-T-111 sample basis for solids used
K	385	E/S	Tank 241-T-111 sample basis for solids used

Table 3-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-T-112. Effective Date May 1, 1998. (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, E, or C)[1]	Comment
La	1,390	S	
Mn	1,730	S	
Na	21,100	S	
Ni	43.4	E/S	Tank 241-T-111 sample basis for solids used
NO_2	9,210	S	
NO_3	5,660	S	
OH_{TOTAL}	14,700	C	Calculated assuming zero ion charge balance (see Appendix B, Section B3.0).
Pb	116	E/S	Tank 241-T-111 sample basis for solids used
PO_4	3,660	S	ICP phosphorus value adjusted for compound
Si	2,560	S	
SO_4	2,870	S	ICP sulfur value adjusted for compound
Sr	91.0	S	
TOC	1,010	E	Tank 241-T-111 sample basis for solids used
U_{TOTAL}	925	E/S	Tank 241-T-111 sample basis for solids used
Zr	0	E	Zirconium is not expected to be in this tank based on process history and flowsheets.

Notes:

[1]S = sample-based, M = Hanford defined waste model-based (Agnew et al. 1997a), E = engineering assessment-based, C = calculated by charge balance; includes oxides as hydroxides but does not include CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-T-112 Decayed to January 1, 1994. Effective Date May 1, 1998. (3 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	0.00720	M	
^{14}C	0.00283	M	
^{59}Ni	8.03E-04	M	
^{60}Co	7.62E-04	M	
^{63}Ni	0.0733	M	
^{79}Se	5.97E-04	M	
^{90}Sr	1,580	E	Tank 241-T-111 sample basis
^{90}Y	1,580	E	Equilibrium value with ^{90}Sr
^{93m}Nb	0.00237	M	
^{93}Zr	0.00283	M	
^{99}Tc	2.56	E	Tank 241-T-111 sample basis
^{106}Ru	3.88E-10	M	
^{113m}Cd	0.00745	M	
^{125}Sb	7.75E-04	M	
^{126}Sn	9.03E-04	M	
^{129}I	3.72E-05	M	
^{134}Cs	3.56E-05	M	
^{137m}Ba	46.2	E	Equilibrium value with ^{137}Cs
^{137}Cs	48.8	E	Tank 241-T-111 sample basis
^{151}Sm	2.21	M	
^{152}Eu	0.00347	M	
^{154}Eu	0.0145	M	
^{155}Eu	0.233	M	
^{226}Ra	1.21E-07	M	Based on total alpha analysis/HDW radionuclide distribution model
^{227}Ac	6.27E-07	M	
^{228}Ra	9.57E-12	M	
^{229}Th	1.86E-09	M	Based on total alpha analysis/HDW radionuclide distribution model
^{231}Pa	1.41E-06	M	Based on total alpha analysis/HDW radionuclide distribution model

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-T-112 Decayed to January 1, 1994. Effective Date May 1, 1998. (3 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}Th	7.73E-13	M	Based on total alpha analysis/HDW radionuclide distribution model
^{232}U	7.31E-06	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{233}U	3.35E-07	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{234}U	0.304	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{235}U	0.0134	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{236}U	3.11E-03	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{237}Np	1.23E-04	M	Based on total alpha analysis/HDW radionuclide distribution model
^{238}Pu	0.539	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{238}U	0.309	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{239}Pu	67.0	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{240}Pu	6.54	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{241}Am	0.0276	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{241}Pu	23.7	E/M/S	Based on $^{241}Pu/^{240}Pu$ ratio model
^{242}Cm	2.55E-04	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-T-112 Decayed to January 1, 1994. Effective Date May 1, 1998. (3 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{242}Pu	1.08E-04	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{243}Am	2.00E-07	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{243}Cm	5.25E-06	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{244}Cm	4.76E-06	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model

Note:

[1]S = sample-based, M = Hanford defined waste model-based (Agnew et al. 1997a), E = engineering assessment-based

4.0 RECOMMENDATIONS

Safety screening DQO (Dukelow et al. 1995) issues were reviewed, and no exotherms were detected. The flammable gas concentrations were 0 percent of the LFL during the entire sampling activity, and the maximum total alpha activity is significantly below the threshold for criticality at the 95 percent confidence interval of the mean for each set of measurements. There are no safety screening issues of concern. Because less than 25 percent of the samples (none, in fact) had exotherms, Schreiber (1997) indicates that organic complexants are not an issue.

Table 4-1 summarizes the Project Hanford Management Contractor (PHMC) TWRS Program review status and acceptance of the sampling and analysis results reported in this TCR. All issues required to be addressed by sampling and analysis are listed in column 1 of Table 4-1. Column 2 indicates by "yes" or "no" whether issue requirements were met by the sampling and analysis performed. Column 3 indicates concurrence and acceptance by the program in PHMC/TWRS that is responsible for the applicable issue. A "yes" in column 3 indicates no additional sampling or analyses are needed; "no" indicates additional sampling or analysis may be needed to satisfy issue requirements.

Table 4-1. Acceptance of Tank 241-T-112 Sampling and Analysis.

Issue	Sampling and Analysis Performed	Program[1] Acceptance
Safety screening data quality objective	Yes	Yes
Organic safety complexant memorandum of understanding	Yes	Yes
Hazardous vapor safety screening data quality objective	Yes	Yes
Organic solvents data quality objective	No	Yes

Note:
[1]PHMC TWRS Program Office

Table 4-2 summarizes the status of PHMC TWRS Program review and acceptance of the evaluations and other characterization information contained in this report. Column 1 lists the different evaluations performed in this report. Column 2 shows whether issue evaluations have been completed or are in progress. Column 3 indicates concurrence and acceptance with the evaluation by the program in PHMC/TWRS that is responsible for the applicable issue. A "yes" indicates that the evaluation is completed and meets all issue requirements.

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-T-112.

Issue	Evaluation Performed	TWRS[1] Program Acceptance
Safety screening data quality objective	Yes	Yes
Organic safety complexant analysis	Yes	Yes
Hazardous vapor safety screening data quality objective	Yes	Yes
Organic solvents data quality objective	Yes	Yes

Note:
[1]PHMC TWRS Program Office

At present, there is no reason to recommend further sampling of tank 241-T-112. There are no exotherms, the waste is composed mostly of a single well-characterized waste type, and it is shallow. There are no anomalies noted in temperature behavior or in flammable gas measurements. In view of this information, tank 241-T-112 is considered safe.

5.0 REFERENCES

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APPENDIX A

HISTORICAL TANK INFORMATION

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APPENDIX A

HISTORICAL TANK INFORMATION

Appendix A describes tank 241-T-112 based on historical information. For this report, historical information includes information about the fill history, waste types, surveillance, or modeling data related to the tank. This information is necessary for providing a balanced assessment of the sampling and analytical results.

This appendix contains the following information:

- **Section A1.0**: Current tank status, including the current waste levels and the stabilization and isolation status of the tank
- **Section A2.0**: Information about the tank design
- **Section A3.0**: Process knowledge about the tank, the waste transfer history, and the estimated contents of the tank based on modeling data
- **Section A4.0**: Surveillance data for tank 241-T-112, including surface-level readings, temperatures, and a description of the waste surface based on photographs
- **Section A5**: Appendix A References.

Historical sampling results (results from samples obtained before 1989 and a compatibility grab sample taken in 1994) are included in Appendix B.

A1.0 CURRENT TANK STATUS

As of November 30, 1997, tank 241-T-112 contained an estimated 254 kL (67 kgal) of waste classified as noncomplexed (Hanlon 1997). The liquid waste volume is estimated by a photographic evaluation. The solid waste volume is estimated using a combination of a surface level gauge and a photographic evaluation. The solid waste volume was last updated on April 28, 1982. Table A1-1 shows the amounts of waste phases in the tank.

Tank 241-T-112 is out of service as are all single-shell tanks, and it is sound. The tank is not on any Watch Lists and is passively ventilated (Hanlon 1997). Interim stabilization and intrusion prevention have been completed. All monitoring systems were in compliance with documented standards as of November 30, 1997 (Hanlon 1997).

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

Waste Type	kL (kgal)
Total waste	254 (67)
Supernatant liquid	26 (7)
Sludge	227 (60)
Saltcake	0 (0)
Drainable interstitial liquid	0 (0)
Drainable liquid remaining	26 (7)
Pumpable liquid remaining	26 (7)

Note:
[1]Hanlon (1997)

A2.0 TANK DESIGN AND BACKGROUND

The 241-T Tank Farm was constructed during 1943 and 1944 in the 200 West Area. The farm contains twelve 100 series tanks and four 200 series tanks. The 100 series tanks have a capacity of 2,010 kL (530 kgal) and diameter of 23 m (75 ft) (Stahl 1997). Built according to the first generation design, the 241-T Tank Farm was designed for nonboiling waste with a maximum fluid temperature of 104 °C (220 °F) (Brevick et al. 1997). A cascade line 76 mm (3 in.) in diameter connects 241-T-112 as the third tank in a cascade of three tanks that begin with tanks 241-T-110 and 241-T-111. Each tank in the cascade is set 0.3 m (1 ft) lower in elevation from the preceding tank.

The tank has a dished bottom with a 1.2-m- (4-ft-) radius knuckle. Tank 241-T-112 was designed with a primary mild steel liner and a concrete dome with risers. The tank is set on a reinforced concrete foundation. The tank and foundation were waterproofed by a coating of tar covered by a three-ply, asphalt-impregnated, waterproofing fabric. The waterproofing was protected by a cement-like mixture reinforced with welded wire. Two coats of primer were sprayed on all exposed interior tank surfaces (Rogers and Daniels 1944). The tank ceiling dome was covered with three applications of a magnesium zinc fluorosilicate wash. Lead flashing was used to protect the joint where the steel liner meets the concrete dome. Asbestos gaskets were used to seal the risers in the tank dome.

According to the drawings, tank 241-T-112 has 11 risers that range in diameter from 102 mm (4 in.) to 305 mm (12 in.). Table A2-1 lists the numbers, diameters, and descriptions of the risers; and the inlet, overflow, and spare nozzles. Figure A2-1 is a plan view showing the riser and nozzle configuration. Risers 1, 4, and 13B (102 mm [4 in.] in diameter) and risers 2 and 7 (305 mm [12 in.] in diameter) are available for use (Lipnicki 1997). Riser 1 would require removal of a plastic liner before core sampling. Figure A2-2 shows a tank cross section with the approximate waste level and a schematic of the tank equipment.

Table A2-1. Tank 241-T-112 Risers.[1, 2, 3]

Riser Number	Diameter (in.)	Description and Comments
R1[4]	4	Flange (Benchmark Change Engineering Order-36930 on 12/08/86[5]) (Food Instrument Corporation removed Engineering Change Order-619371 on 4/10/94). Needs plastic liner removed.
R2[4]	12	B-222 observation port/flange
R3	12	Recirculating dip tube/flange
R4[4]	4	Flange
R5	4	Flange
R6	12	Breather filter/flange—recommended as alternate riser
R7[4]	12	Flange
R8	4	Thermocouple tree
R13	12	Flange, (Benchmark Change Engineering Order-36930 on 12/08/86)
R13A	4	ENRAF[6], 854 ATG Engineering Change Order-619371 on 4/10/94
R13B[4]	4	Flange—recommended as alternate riser
N1	3	Overflow inlet
N2	3	Spare capped
N3	3	Spare capped
N4	3	Drain sealed in diversion box 241-T-153
N5	3	Spare capped

Notes:

[1]Alstad (1993)
[2]Tran (1996)
[3]Vitro (1988)
[4]Denotes risers tentatively available for sampling (Lipnicki 1997)
[5]Dates are in the mm/dd/yy format.
[6] ENRAF is a registered trademark of ENRAF Corporation, Houston, Texas.

Figure A2-1. Riser Configuration for Tank 241-T-112.

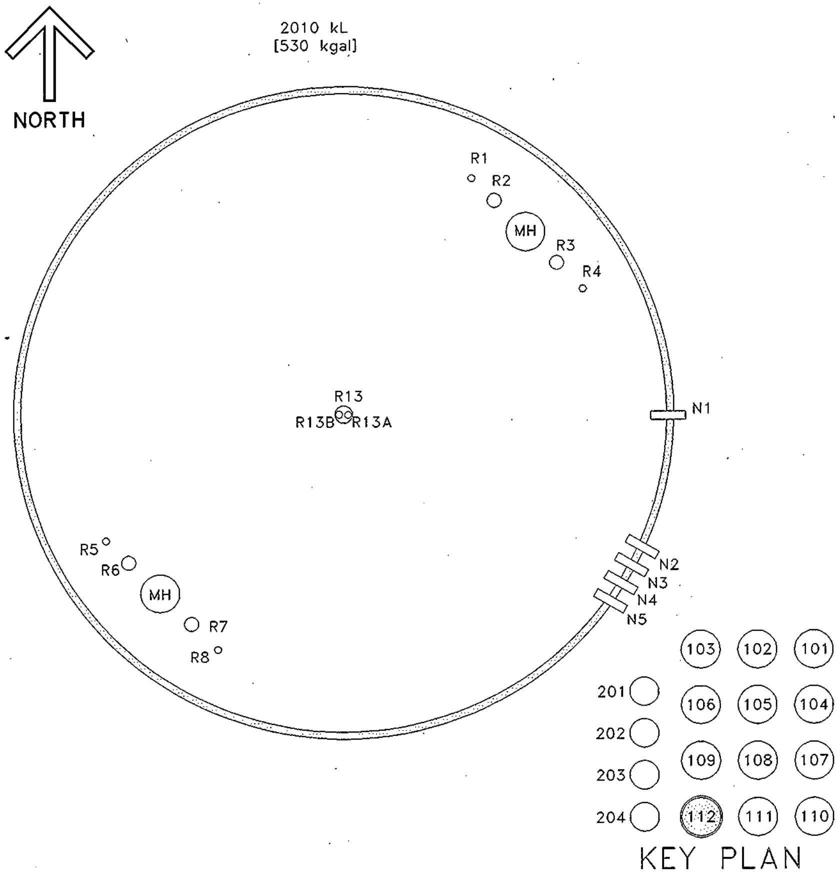
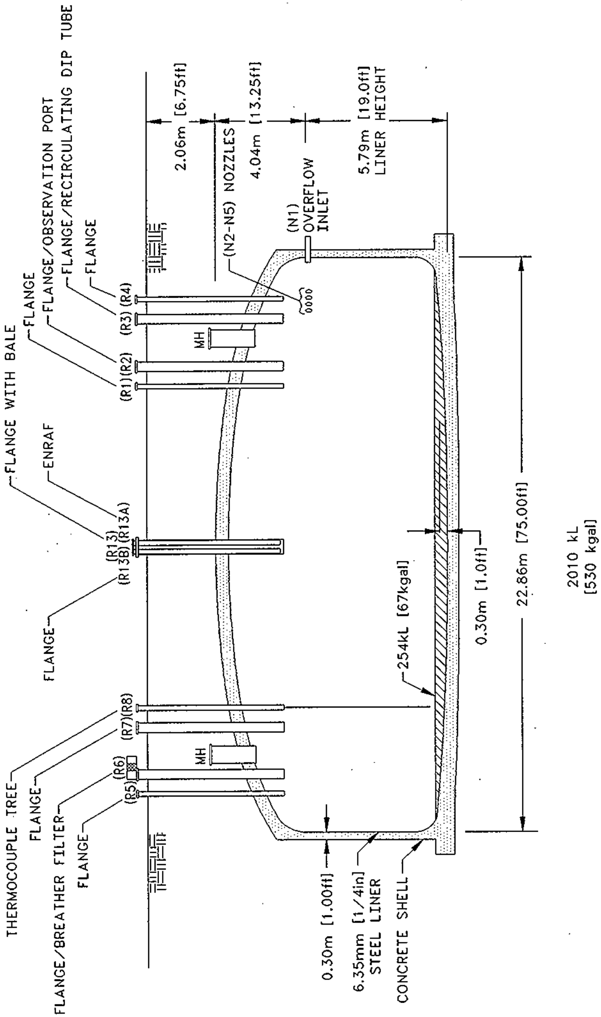


Figure A2-2. Tank 241-T-112 Cross Section and Schematic.



A3.0 PROCESS KNOWLEDGE

The following sections 1) provide information about the waste transfer history of tank 241-T-112, 2) describe the process wastes that were transferred, and 3) estimate the current tank contents based on waste transfer history.

A3.1 WASTE TRANSFER HISTORY

Table A3-1 summarizes the waste transfer history of tank 241-T-112 (Agnew et al. 1997b). Waste began cascading into tank 241-T-112 from tank 241-T-111 in January 1946. The waste was second cycle waste (2C) from the $BiPO_4$ process at T Plant. Waste from tank 241-T-112 was deposited into the T-006 crib in the fourth quarter of 1947. The cascade again received 2C1 in the fourth quarter of 1948 after supernatant waste was sent from tank 241-T-112 to crib T-007. Supernatant waste was sent from tank 241-T-112 to the T-007 crib until the third quarter of 1956. The cascade of waste from 241-T-110 through to tank 241-T-112 continued until the first quarter of 1952 with 2C and lanthanum fluoride waste (224) from uranium recovery operations. Supernatant waste was sent from tank 241-T-112 to crib T-005 in second quarter of 1955.

In the first quarter of 1960, tank 241-T-112 began receiving decontamination waste from 221-T. Decontaminated waste was sent sporadically until the second quarter of 1973. Waste was sent to the TY crib in the second and fourth quarters of 1960, the fourth quarter of 1962, and the second and third quarters of 1966. Beginning in the second quarter of 1967, tank 241-T-112 began exchanging evaporator waste with tank 241-TX-118. Supernatant was sent to tank 241-TX-118 from tank 241-T-112, and evaporator bottoms waste was returned to tank 241-T-112. This continued until the second quarter of 1972. Waste was sent to tank 241-TY-103 in the second quarter of 1969.

Supernatant waste was sent from tank 241-T-112 to tank 241-U-107 from the third quarter of 1972 until the second quarter of 1973. Flush water from miscellaneous sources was added in the first quarter of 1973. The last waste addition to tank 241-T-112 occurred in the second quarter of 1973 when supernatant was received from tank 241-T-106. In the second and third quarters of 1974, tank 241-T-112 sent supernatant waste to tank 241-S-110.

Table A3-1. Tank 241-T-112 Major Transfers.[1,2] (2 sheets)

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Waste Volume	
				kL	kgal
241-T-111		2C	1946	1,980	824
	T-006 Crib	SU	1947	-76	-20
	T-007 Crib	SU	1948-1956	-74,500	-19,700
241-T-111		2C, 224	1948-1956	74,900	19,800
	T-005 Crib	SU	1955	-934	-247
221-T		DW	1960, 1962, 1963, 1966-1973	16,700	4,400
	TY Crib	SU	1960, 1962, 1966	-1,060	-281
241-TX-118		SU	1967- 972	12,879	3,402
	241-TX-118	SU	1967-1972	-2,630	-6,950
	241-U-107	SU	1972-1973	-3,290	-869
Miscellaneous sources		Flush water	1973	76	20
241-T-106		SU	1973	1,330	350
	241-S-110	SU	1974	-1,548	-409
	241-TX-118	SU	1978	-49	-13

Notes:

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

2C = second cycle waste from $BiPO_4$ process (T Plant)
224 = lanthanum fluoride finishing waste
DW = wash solution from equipment decontamination at T Plant
SU = supernatant waste

[1]Agnew et al. 1997a
[2]Because only major transfers are listed, the sum of these transfers will not equal the current tank waste volume.

A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS

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

- The *Waste Status and Transaction Record Summary*: *WSTRS Rev. 4* (Agnew et al. 1997b) is a tank-by-tank quarterly summary spreadsheet of waste transactions.

- The *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4* (Agnew et al. 1997a) contains the HDW list, the supernatant mixing model (SMM), the tank layer model (TLM), and the historical tank content estimate (HTCE).

- The HDW list is comprised of approximately 50 waste types defined by concentration for major analyses/compounds for sludge and supernatant layers.

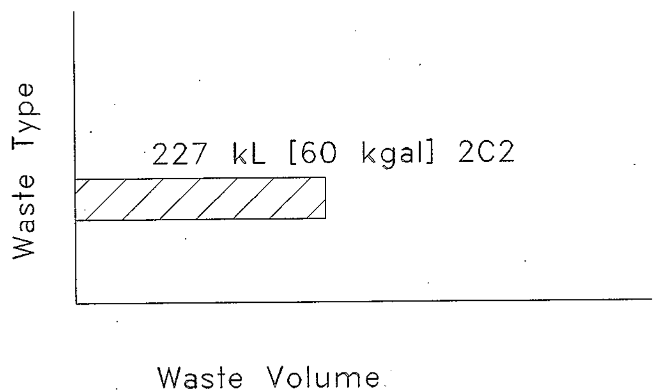
- The TLM defines the sludge and saltcake layers in each tank using waste composition and waste transfer information.

- 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 the WSTRS, the TLM, and the HDW list to describe the supernates and concentrates in each tank. Together, the WSTRS, TLM, HDW, and SMM are used to determine each tank's inventory estimate. These model predictions are considered estimates that require further evaluation using analytical data.

Based on the TLM and SMM, tank 241-T-112 contains a solids layer consisting of 227 kL (60 kgal) of 2C2 (1952 to 1956), and a top layer of 26 kL (7 kgal) of supernatant resting on the solid waste surface. Figure A3-1 is a graphical representation of the estimated waste type and volume for the solids layer.

Figure A3-1. Tank Layer Model.



The 2C2 layer should contain, from highest concentration above one weight percent, the following constituents: iron, hydroxide, nitrate, sodium, carbonate, and phosphate. Constituents contained in this layer above a tenth of a weight percent are: calcium, bismuth, sulfate, and fluoride. Currently, data are unavailable on the exact contents of the supernatant layer. Tables A3-2 and A3-3 show an estimate of the expected concentrations of analytes and radionuclides, respectively, in the waste.

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

Total Inventory Estimate					
Physical Properties				-95 CI	+95 CI
Total waste	2.82E+05 (kg) (67.0 kgal)				
Heat load	3.44E-03 (kW) (11.8 Btu/hr)			2.62E-03	4.26E-03
Bulk density	1.11 (g/cm³)			1.09	1.13
Water wt%	83.1			80.7	86.2
TOC wt% C (wet)	0			0	0
Chemical Constituents	*M*/L	ppm	kg[3]	-95 CI (*M*/L)	+95 CI (*M*/L)
Na^+	1.07	2.22E+04	6.25E+03	0.818	1.33
Al^{3+}	0	0	0	0	0
Fe^{3+} (total Fe)	0.703	3.53E+04	9.95E+03	0.680	0.725
Cr^{3+}	4.58E-03	214	60.4	3.49E-03	5.67E-03
Bi^{3+}	3.68E-02	6.91E+03	1.95E+03	3.39E-03	5.76E-02
La^{3+}	0	0	0	0	0
Hg^{2+}	0	0	0	0	0
Zr (as $ZrO(OH)_2$)	0	0	0	0	0
Pb^{2+}	0	0	0	0	0
Ni^{2+}	1.35E-03	71.5	20.2	1.03E-03	5.73E-03
Sr^{2+}	0	0	0	0	0
Mn^{4+}	0	0	0	0	0
Ca^{2+}	0.247	8.91E+03	2.51E+03	0.158	0.337
K^+	3.12E-03	110	31.0	2.38E-03	3.87E-03
OH^-	2.17	3.31E+04	9.34E+03	2.10	2.24

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

Total Inventory Estimate					
Chemical Constituents	*M*/L	ppm	kg[3]	-95 CI (*M*/L)	+95 CI (*M*/L)
NO_3^-	0.575	3.21E+04	9.04E+03	0.441	0.709
NO_2^-	1.12E-02	462	130	6.46E-03	1.71E-02
CO_3^{2-}	0.247	1.33E+04	3.76E+03	0.158	0.337
PO_4^{3-}	0.126	1.07E+04	3.03E+03	7.13E-02	0.168
SO_4^{2-}	2.27E-02	1.96E+03	554	1.73E-02	2.81E-02
Si (as SiO_3^{2-})	1.65E-02	416	117	1.26E-02	7.52E-02
F^-	9.79E-02	1.67E+03	472	7.47E-02	0.121
Cl^-	1.44E-02	458	129	1.10E-02	1.78E-02
Citrate[3]	0	0	0	0	0
$EDTA^{4-}$	0	0	0	0	0
$HEDTA^{3-}$	0	0	0	0	0
$glycolate^-$	0	0	0	0	0
$acetate^-$	0	0	0	0	0
$oxalate^{2-}$	0	0	0	0	0
DBP	0	0	0	0	0
Butanol	0	0	0	0	0
NH_3	3.48E-06	5.33E-02	1.50E-02	1.56E-06	6.55E-06
$Fe(CN)_6^{4-}$	0	0	0	0	0

Notes:

CI = confidence interval

[1]Agnew et al. (1997a)
[2]These predictions have not been validated and should be used with caution.
[3]Differences exist among the inventories in this column and the inventories calculated from the two sets of concentrations.

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

Total Inventory Estimate					
Physical Properties				**-95 CI**	**+95 CI**
Total waste	2.82E+05 (kg) (67.0 kgal)				
Heat load	3.44E-03 (kW) (11.8 Btu/hr)			2.62E-03	4.26E-03
Bulk density	1.11 (g/cm^3)			1.09	1.13
Water wt%	83.1			80.7	86.2
TOC wt% C (wet)	0			0	0
Radiological Constituents	**Ci/L**	**μCi/g**	**Ci**	**-95 CI (Ci/L)**	**+95 CI (Ci/L)**
^{3}H	2.84E-08	2.55E-05	7.20E-03	1.63E-08	4.39E-08
^{14}C	1.11E-08	1.00E-05	2.83E-03	8.50E-09	1.38E-08
^{59}Ni	3.17E-09	2.85E-06	8.03E-04	2.42E-09	1.34E-08
^{63}Ni	2.89E-07	2.60E-04	7.33E-02	2.20E-07	1.22E-06
^{60}Co	3.01E-09	2.70E-06	7.62E-04	2.29E-09	3.72E-09
^{79}Se	2.35E-09	2.12E-06	5.97E-04	1.79E-09	2.91E-09
^{90}Sr	1.12E-03	1.01	285	8.57E-04	1.39E-03
^{90}Y	1.12E-03	1.01	285	8.58E-04	1.39E-03
^{93}Zr	1.12E-08	1.00E-05	2.83E-03	8.51E-09	1.38E-08
^{93m}Nb	9.33E-09	8.39E-06	2.37E-03	7.11E-09	1.15E-08
^{99}Tc	7.75E-08	6.97E-05	1.97E-02	5.91E-08	9.59E-08
^{106}Ru	1.53E-15	1.37E-12	3.88E-10	1.17E-15	1.89E-15
^{113m}Cd	2.94E-08	2.64E-05	7.45E-03	2.24E-08	3.64E-08
^{125}Sb	3.06E-09	2.75E-06	7.75E-04	2.33E-09	3.78E-09
^{126}Sn	3.56E-09	3.20E-06	9.03E-04	2.72E-09	4.41E-09
^{129}I	1.47E-10	1.32E-07	3.72E-05	1.12E-10	1.82E-10
^{134}Cs	1.40E-10	1.26E-07	3.56E-05	1.07E-10	1.74E-10
^{137}Cs	1.28E-03	1.15	325	9.76E-04	1.58E-03
^{137m}Ba	1.21E-03	1.09	307	9.23E-04	1.50E-03
^{151}Sm	8.70E-06	7.83E-03	2.21	6.63E-06	1.08E-05
^{152}Eu	1.37E-08	1.23E-05	3.47E-03	1.36E-08	1.38E-08
^{154}Eu	5.74E-08	5.16E-05	1.45E-02	4.37E-08	7.10E-08
^{155}Eu	9.18E-07	8.25E-04	0.233	9.11E-07	9.24E-07

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

Total Inventory Estimate					
Radiological Constituents	Ci/L	μCi/g	Ci	-95 CI (Ci/L)	+95 CI (Ci/L)
^{226}Ra	4.78E-13	4.30E-10	1.21E-07	3.64E-13	5.91E-13
^{228}Ra	3.77E-17	3.39E-14	9.57E-12	3.75E-17	3.80E-17
^{227}Ac	2.47E-12	2.22E-09	6.27E-07	1.88E-12	3.06E-12
^{231}Pa	5.57E-12	5.01E-09	1.41E-06	4.25E-12	6.90E-12
^{229}Th	7.35E-15	6.61E-12	1.86E-09	7.29E-15	7.40E-15
^{232}Th	3.05E-18	2.74E-15	7.73E-13	2.32E-18	3.77E-18
^{232}U	3.49E-12	3.14E-09	8.84E-07	2.66E-12	4.32E-12
^{233}U	1.60E-13	1.44E-10	4.05E-08	1.22E-13	1.98E-13
^{234}U	1.45E-07	1.30E-04	3.67E-02	1.10E-07	1.79E-07
^{235}U	6.40E-09	5.76E-06	1.62E-03	4.88E-09	7.92E-09
^{236}U	1.48E-09	1.34E-06	3.76E-04	1.13E-09	1.84E-09
^{238}U	1.47E-07	1.33E-04	3.74E-02	1.12E-07	1.82E-07
^{237}Np	4.84E-10	4.35E-07	1.23E-04	3.69E-10	5.99E-10
^{238}Pu	5.75E-07	5.17E-04	0.146	5.91E-08	1.88E-06
^{239}Pu	7.14E-05	6.42E-02	18.1	7.33E-06	2.33E-04
^{240}Pu	6.97E-06	6.27E-03	1.77	7.16E-07	2.27E-05
^{241}Pu	2.52E-05	2.27E-02	6.40	2.59E-06	8.23E-05
^{242}Pu	1.15E-10	1.04E-07	2.92E-05	1.18E-11	3.76E-10
^{241}Am	2.94E-08	2.65E-05	7.47E-03	2.25E-08	3.64E-08
^{243}Am	2.13E-13	1.91E-10	5.40E-08	1.62E-13	2.63E-13
^{242}Cm	2.71E-10	2.44E-07	6.88E-05	2.69E-10	2.73E-10
^{243}Cm	5.59E-12	5.03E-09	1.42E-06	5.55E-12	5.63E-12
^{244}Cm	5.07E-12	4.56E-09	1.29E-06	3.87E-12	6.28E-12
Totals	*M*	μg/g	kg	-95 CI *M* or g/L	+95 CI *M* or g/L
Pu	1.18E-03 (g/L)	----	0.299	1.21E-04	3.85E-03
U	1.85E-03	397	112	1.41E-03	2.29E-03

Notes:
[1]Agnew et al. (1997b)
[2]These predictions have not been validated and should be used with caution.

A4.0 SURVEILLANCE DATA

Tank 241-T-112 surveillance includes surface-level measurements (liquid and solid) and temperature monitoring inside the tank (waste and headspace). The data provide the basis for determining tank integrity.

Liquid-level measurements may indicate whether a major leak occurs from a tank. Solid surface-level measurements indicate a physical change in the consistency of the solid layers.

A4.1 SURFACE-LEVEL READINGS

The waste surface level for tank 241-T-112 was measured by a Food Instrument Corporation gauge until July 1995 in the automatic mode and until September 1995 in the manual mode. A manual ENRAF® system began recording readings in September 1995. On November 30, 1997, the waste surface level was 808 mm (31.8 in.) as measured by the manual ENRAF® system. A graphical representation of the volume measurements is presented as a level history graph in Figure A4-1.

A4.2 DRY WELL READINGS

Tank 241-T-112 has three dry wells. None of them are active.

A4.3 INTERNAL TANK TEMPERATURES

Tank 241-T-112 has a single thermocouple tree with 11 thermocouples to monitor waste temperature through riser 8. The elevations of the thermocouples on this tree are unavailable. Temperature data, recorded from December 1976 through November 1997, were obtained from the Surveillance Automated Computer System (LMHC 1998). The average temperature of the data is 17.7°C (63.9°F), the minimum temperature is 12°C (54°F), and the maximum temperature is 28°C (83°F). The average temperature of data from November 1996 through November 1997 was 16.4 °C (61.3 °F), the minimum temperature was 12.5 °C (54.5 °F), and the maximum temperature was 20.1°C (68.2 °F). The temperatures vary seasonally, peaking around September with a minimum temperature around March. Figure A4-2 is a graph of the weekly high temperatures. Plots of the individual thermocouple readings can be found in (Brevick et al. (1997), or from LHMC (1998).

A4.4 TANK 241-T-112 PHOTOGRAPHS

The August 1984 photographic montage of the interior of tank 241-T-112 shows a dark-colored, coarse solid surface mixed with supernatant pools. Various pieces of equipment have been labeled. The waste level has not changed since the photographs were taken; therefore, this photographic montage should accurately represent the current appearance of the tank's waste. However, because the colors in the montage are inconsistent, the photograph itself adds little to knowledge of tank contents other than confirm the existence of a supernatant phase within the tank. Although the photograph is not included in this report, it is available in the Tank Characterization Resource and Safety Center.

Figure A4-1. Tank 241-T-112 Level History.

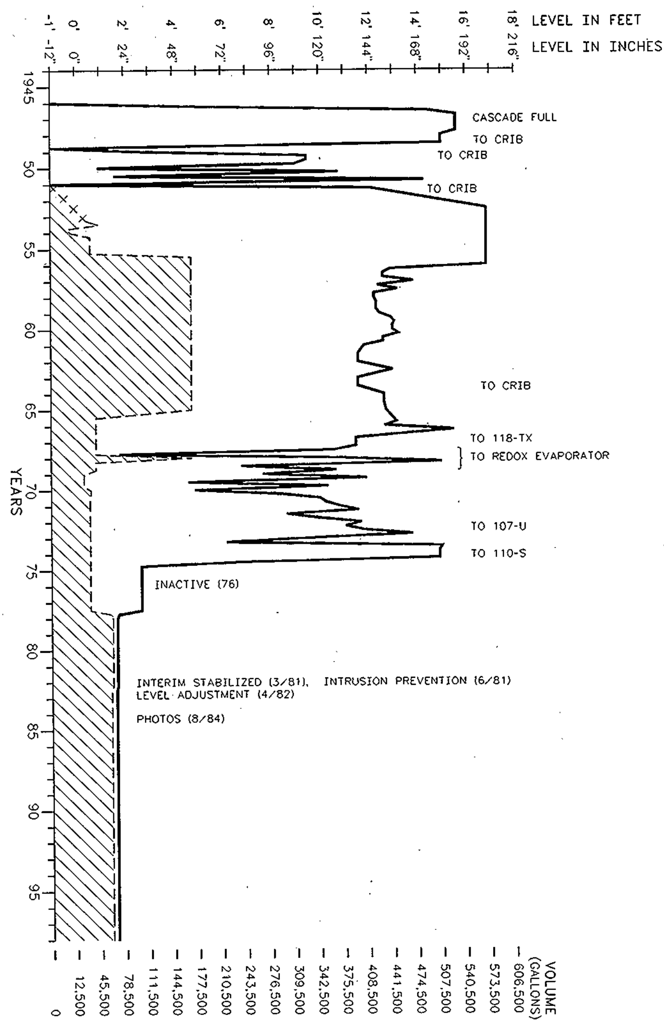
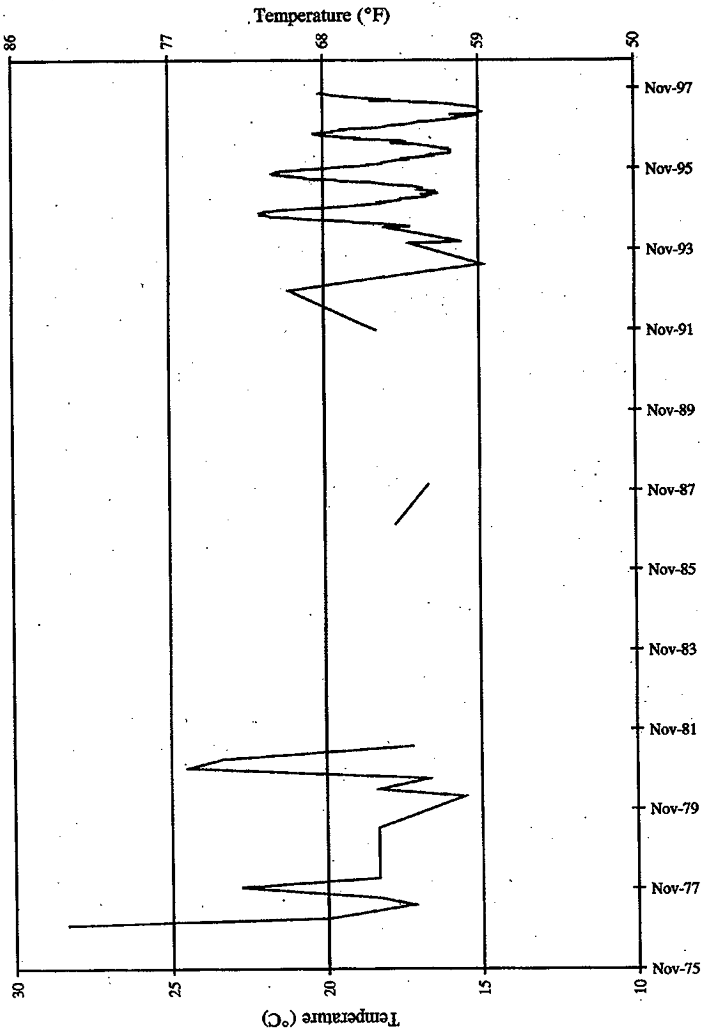


Figure A4-2. Tank 241-T-112 Weekly High Temperature Plot.



A5.0 APPENDIX A REFERENCES

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APPENDIX B

SAMPLING OF TANK 241-T-112

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APPENDIX B

SAMPLING OF TANK 241-T-112

Appendix B provides sampling and analysis information for each known sampling event for tank 241-T-112, and it assesses push mode core sample results. It includes the following.

- **Section B1.0**: Tank Sampling Overview
- **Section B2.0**: Sampling Events
- **Section B3.0**: Assessment of Characterization Results
- **Section B4.0**: Appendix B References

Future sampling information for tank 241-T-112 will be appended to Appendix B.

B1.0 TANK SAMPLING OVERVIEW

This section describes the February and March 1997 sampling and analysis events for tank 241-T-112. Push mode core samples were taken to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995). The sampling and analyses were performed in accordance with the *Tank 241-T-112 Push Mode Core Sampling and Analysis Plan* (Thompson 1997). Several liquid samples were also taken from this tank in 1965, 1974, and 1987; and a grab sample was taken in 1994 to satisfy compatibility requirements.

B2.0 SAMPLING EVENTS

This section describes tank 241-T-112 sampling events. The analytical results used to characterize current tank contents are from the 1997 core samples and from the attendant vapor sampling using a combustible gas meter.

B2.1 1997 PUSH MODE CORE SAMPLING EVENT

Two push mode core samples were collected from tank 241-T-112 in 1997. Core 185 was obtained from riser 2 on February 27, and core 186 was obtained from riser 7 on March 18 and 19. The time delay between cores was caused by time spent resolving an Authorization Basis for push mode sampling. Core 185 was received by the 222-S Laboratory on February 28 and extruded on March 11, 1997. Core 186 was received by the 222-S Laboratory on March 25 and extruded on March 31, 1997. The delays violated the tank sampling and analysis plan requirement (Thompson 1997) that no more than three calendar days expire between sampling and the sample's arrival at the laboratory.

Core sampling was used after a study of in-tank photographs indicated significant quantities of supernatant were in the tank, mixed with the solid phase. The 2C2 waste type, which was predicted to constitute the major portion of the solid waste, has been shown to be sampled successfully by this method. The waste depth was expected to be little more than one segment (48 cm [19 in.]). Each core, however, failed to retrieve solids in the upper segment. Core 185 retrieved 324 g of supernatant in segment 1, but the top segment of core 186 was found to be empty on extrusion at the 222-S Laboratory. This error is attributed to combined error tolerances of truck leveling, zip cord measurement, and riser elevations. Because the anticipated sample was 9.4 cm (3.7 in.), slight variations in any of these three factors could have lead to the failure to collect sample. Because both solid segments (one from each core) provided adequate materials for the safety screening DQO (Dukelow et al. 1995), resampling is not required.

Table B2-1 summarizes the sampling and analytical requirements from applicable DQOs.

Table B2-1. Integrated Data Quality Objective Requirements for Tank 241-T-112.

Sampling Event	Applicable DQOs	Sampling Requirements	Analytical Requirements
Push mode core sampling	Safety screening - Energetics - Moisture content - Total alpha - Flammable gas Dukelow et al. (1995) Organic complexants Schreiber (1997)	Core samples from a minimum of two risers separated radially to the maximum extent possible. Combustible gas measurement	Flammability, energetics, moisture, total alpha activity, density. The TOC, if greater than 25%, of half segments that have exotherms.

B2.1.1 Sample Handling

Core 185, riser 2, provided two segments. Segment 1, identified as 97-46, had a total weight of 324.2 g of clear, yellow liquid with no visible organic layer. Segment 2, identified as 97-47, was divided into two half segments. The upper half contained 113.8 g, and the lower half contained 100.8 g of a dark brown solid resembling a sludge slurry. Segment 2 also yielded 90 mL of a dark brown, opaque liquid. The sample was homogenized and subsampled for further laboratory analyses and archiving.

Core 186, riser 7, provided a single segment, identified as 97-49. This segment was divided into two half segments. The upper half contained 144.8 g, and the lower half contained 154.7 g of a dark brown solid resembling a sludge slurry. No liquids were recovered in this sample. The material was homogenized and subsampled for laboratory analyses and archiving. Table B2-2 shows the subsampling scheme and sample description.

Table B2-2. Tank 241-T-112 Subsampling Scheme and Sample Description.[1]

Riser	Sample ID	Weight (g)	Sample Portion	Sample Characteristics
2	97-46	324.2 (Drainable)	Drainable liquid	Clear, yellow, aqueous liquid
2	97-47	97.5 (Drainable)	Drainable liquid	Dark brown, opaque, aqueous liquid
		113.8 (Solids)	Upper half	Dark brown sludge slurry
		100.8 (Solids)	Lower half	Dark brown sludge slurry
7	97-48	0.0	n/a	Sampler empty
7	97-49	144.8 (Solids)	Upper half	Dark brown sludge slurry
		154.7 (Solids)	Lower half	Dark brown sludge slurry

Note:
[1]Steen (1997)

B2.1.2 Sample Analysis

The analyses performed on the core samples were not limited to those required by the safety screening DQO (Dukelow et al. 1995). The analyses required by the safety screening DQO included analyses for thermal properties by DSC, moisture content by thermogravimetric analysis (TGA), and content of fissile material by total alpha activity analysis. Opportunistic ICP and ion chromatography (IC) analyses were performed on the solid half segments as requested in Kristofzski (1996).

Quality control tests included performing the analyses in duplicate and using standards. Moisture content was measured by a gravimetric method.

Total alpha activity measurements were performed on samples that had been fused in a solution of potassium hydroxide, then dissolved in acid. The resulting solution was dried on a counting planchet and counted in an alpha proportional counter. Quality control tests included standards, spikes, blanks, and duplicate analyses.

Ion chromatography was performed on samples that had been prepared by water digestion. Quality control tests included standards, spikes, blanks, and duplicate analyses. The SAP (Thompson 1997) required measuring the full suite of IC analytes.

Inductively coupled plasma spectrometry was performed initially on samples that had been prepared by a fusion procedure followed by dissolution in acid. Quality control tests included standards, blanks, spikes, and duplicate analyses. The SAP (Thompson 1997) required the full suite of ICP elements be analyzed.

All reported analyses were performed according to approved laboratory procedures. Table B2-3 lists procedure numbers and applicable analyses.

Table B2-4 summarizes the sample portions, sample numbers, and analyses performed on each sample.

Table B2-3. Analytical Procedures.[1]

Analysis	Method	Procedure Number[2]
Energetics	Differential scanning calorimetry	LA-514-113 LA-514-114
Percent water	Thermogravimetric analysis	LA-560-112 LA-514-114
Total alpha activity	Alpha proportional counter	LA-508-101
Metals by ICP/AES	Inductively coupled plasma spectrometry	LA-505-151 LA-505-161
Anions by IC	Ion chromatograph	LA-533-105
Specific gravity	Gravimetry	LA-510-112
Bulk density	Gravimetry	LO-160-103
Flammable gas	Combustible gas analyzer	WHC-IP-0030 IH 1.4 and 2.1[2]

Notes:

AES = atomic emission spectroscopy

[1]Steen (1997)

[2]Safety Department Administrative Manuals, Westinghouse Hanford Company, Richland, Washington:
IH 1.4, Industrial Hygiene Direct Reading Instrument Survey
IH 2.1, Standard Operating Procedure, MSA Model 260 Combustible Gas and Oxygen Analyzer

Table B2-4. Tank 241-T-112 Sample Analysis Summary.

Riser	Sample Identification	Sample Portion	Sample Number	Analyses
2	Core 185, segment 1	Drainable liquid	S97T000374	TGA, specific gravity, ICP, IC, DSC, alpha
2	Core 185, segment 2	Drainable liquid	S97T000376	TGA, specific gravity, ICP, IC, DSC, alpha
		Upper half	S97T000370	TGA, DSC/TGA
			S97T000591	ICP
			S97T000592	IC
		Lower half	S97T000369	Bulk density
			S97T000371	TGA, DSC/TGA
			S97T000380	ICP, alpha
			S97T000593	IC
7	Core 186, segment 2	Upper half	S97T000433	Bulk density
			S97T000435	DSC/TGA
			S97T000594	IC
			S97T000596	ICP
		Lower half	S97T000434	Bulk density
			S97T000436	DSC/TGA
			S97T000438	ICP, alpha
			S97T000595	IC

B2.1.3 Analytical Results

This section summarizes the sampling and analytical results associated with the February and March 1997 sampling and analysis of tank 241-T-112. Table B2-5 shows the total alpha activity, percent water, energetics, IC, and ICP analytical results associated with this tank. These results are documented in Steen (1997).

Table B2-5. Analytical Tables.

Analysis	Table Number
Inductively coupled plasma/atomic emission spectrometry	B2-7 through B2-43
Ion chromatography	B2-44 through B2-51
Bulk density	B2-52
Percent water by thermogravimetric analysis	B2-53
Specific gravity	B2-54
Total alpha	B2-55
Historical analytical information	B2-57 through B2-59

The quality control (QC) parameters assessed in conjunction with tank 241-T-112 samples were standard recoveries, spike recoveries, duplicate analyses (RPDs [relative percent differences]), and blanks. The QC criteria are specified in Thompson (1997). Sample and duplicate pairs, in which any QC parameter was outside these limits, are footnoted in the sample mean column of the following data summary tables with an a, b, c, d, e, or f as follows:

- "a" indicates the standard recovery was below the QC limit
- "b" indicates the standard recovery was above the QC limit
- "c" indicates the spike recovery was below the QC limit
- "d" indicates the spike recovery was above the QC limit
- "e" indicates the RPD was above the QC limit
- "f" indicates blank contamination.

In the analytical tables in this section, the "mean" is the average of the result and duplicate value. All values, including those below the detection level (denoted by "<"), were averaged. If both sample and duplicate values were nondetected, the mean is expressed as a nondetected value. If one value was detected and the other was not, the mean is expressed as a detected value. If both values were detected, the mean is expressed as a detected value.

B2.1.3.1 Total Alpha Activity. Analyses for total alpha activity were performed on the samples recovered from tank 241-T-112. The samples were prepared by fusion digestion. Two fusions were prepared for each sample (for duplicate results). Each sample and sample duplicate were counted twice, and the results were averaged and reported as one value. The highest result was 0.312 μCi/g.

B2.1.3.2 Thermogravimetric Analysis. Thermogravimetric analysis measures the mass of a sample as its temperature is increased at a constant rate. Nitrogen is passed over the sample during heating to remove any released gases. A decrease in the weight of a sample during

TGA represents a loss of gaseous matter from the sample, 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 caused by 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. The mean weight percent water for the solids was 73.9 percent, which is consistent with sludge/slurries.

B2.1.3.3 Differential Scanning Calorimetry. In a DSC analysis, heat absorbed or emitted by a substance 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. No exothermic reactions were noted; therefore, an upper limit of a 95 percent confidence interval on the mean for each sample was not calculated.

B2.1.3.4 Inductively Coupled Plasma. Samples were prepared by fusion with potassium hydroxide in nickel crucibles. Although a full suite of analytes was reported, it was taken only as part of opportunistic analyses. Therefore, the quality control parameters are token and were not reviewed by the laboratory. Phosphorus was analyzed as a cross check for the phosphate results reported from IC analyses. Sulfur was analyzed as a cross check for the sulfate results reported from IC analyses. The potassium and nickel results for the ICP fusion analyses are not reported because the samples were prepared in a nickel crucible by fusion using potassium hydroxide. Major analytes, listed by concentration, include: sodium, bismuth, iron, silicon, manganese, aluminum, and lanthanum. Because lithium was never found to be in concentration above detection limits, contamination by hydrostatic head fluid is discounted.

B2.1.3.5 Ion Chromatography (Anions). Samples were prepared by water digestion. Although a full suite of analytes was reported, it was taken only as part of opportunistic analyses. Therefore, the QC parameters are minimal and were not reviewed by the laboratory. Major analytes, listed by concentration, include nitrite, nitrate, sulfate and phosphate. Quality control parameters apply only to bromide. Bromide is the primary analyte of concern and was used to track any hydrostatic head fluid contamination of the sample. Bromide was never observed above the method detection limit.

B2.1.3.6 Specific Gravity and Bulk Density. Specific gravities and bulk densities were performed gravimetrically on liquid and solid samples, respectively. The values are important in determining inventory values. The mean bulk density of tank 241-T-112 sludge slurry is 1.28 g/mL; the supernatant liquid has a mean specific gravity value of 1.10.

B2.2 VAPOR PHASE MEASUREMENT

Before and during each tank 241-T-112 core sampling event in February and March 1997, vapor phase measurements were taken to address flammability issues. The vapor phase measurements were taken 6.1 m (20 ft) below risers 2 and 7 in the tank headspace, and results were obtained in the field (that is, no gas sample was sent to the laboratory for analysis). The vapor phase measurement results are provided in Table B2-6.

Table B2-6. Tank 241-T-112 Vapor Phase Measurement Results.

Measurement	Result	
	February 27, 1997	March 18, 1997
Total organic carbon	<1 ppm	1.7 ppm
Lower explosive limit	0.0% of lower explosive limit	0.0% of lower explosive limit
Oxygen	20.8%	20.8%
Ammonia	30 ppm	5 ppm

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Table B2-7. Tank 241-T-112 Analytical Results: Aluminum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	6,150	6,910	6,530
S97T000380		Lower half	3,550	3,430	3,490
S97T000596	186:2	Upper half	6,290	5,910	6,100
S97T000438		Lower half	4,060	4,610	4,340
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<10.1	<10.1	<10.1
S97T000376	185:2	Drainable liquid	<10.1	<10.1	<10.1

Table B2-8. Tank 241-T-112 Analytical Results: Antimony (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<1,190	<1,170	<1,180
S97T000380		Lower half	<1,180	<1,180	<1,180
S97T000596	186:2	Upper half	<1,090	<1,110	<1,100
S97T000438		Lower half	<684	<673	<679
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	<12.1	<12.1	<12.1
S97T000376	185:2	Drainable liquid	<12.1	<12.1	<12.1

Table B2-9. Tank 241-T-112 Analytical Results: Arsenic (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<1,980	<1,960	<1,970
S97T000380		Lower half	<1,970	<1,970	<1,970
S97T000596	186:2	Upper half	<1,820	<1,850	<1,840
S97T000438		Lower half	<1,140	<1,120	<1,130
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	<20.1	<20.1	<20.1
S97T000376	185:2	Drainable liquid	<20.1	<20.1	<20.1

Table B2-10. Tank 241-T-112 Analytical Results: Barium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<991	<978	<985
S97T000380		Lower half	<987	<985	<986
S97T000596	186:2	Upper half	<908	<923	<916
S97T000438		Lower half	<570	<561	<566
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	<10.1	<10.1	<10.1
S97T000376	185:2	Drainable liquid	<10.1	<10.1	<10.1

Table B2-11. Tank 241-T-112 Analytical Results: Beryllium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<99.1	<97.8	<98.4
S97T000380		Lower half	<98.7	<98.5	<98.6
S97T000596	186:2	Upper half	<90.8	<92.3	<91.5
S97T000438		Lower half	<57	<56.1	<56.5
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	<1.01	<1.01	<1.01
S97T000376	185:2	Drainable liquid	<1.01	<1.01	<1.01

Table B2-12. Tank 241-T-112 Analytical Results: Bismuth (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	27,400	29,700	28,600
S97T000380		Lower half	31,400	32,700	32,100
S97T000596	186:2	Upper half	31,500	26,700	29,100
S97T000438		Lower half	21,200	29,600	25,400[QC:e]
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	45.1	41.6	43.4
S97T000376	185:2	Drainable liquid	46.3	43	44.6

Table B2-13. Tank 241-T-112 Analytical Results: Boron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	<991	<978	<985
S97T000380		Lower half	<987	<985	<986
S97T000596	186:2	Upper half	<908	<923	<916
S97T000438		Lower half	<570	<561	<566
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<10.1	<10.1	<10.1
S97T000376	185:2	Drainable liquid	<10.1	<10.1	<10.1

Table B2-14. Tank 241-T-112 Analytical Results: Cadmium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	<99.1	<97.8	<98.4
S97T000380		Lower half	<98.7	<98.5	<98.6
S97T000596	186:2	Upper half	<90.8	<92.3	<91.5
S97T000438		Lower half	<57	<56.1	<56.5
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	2.87	2.88	2.88
S97T000376	185:2	Drainable liquid	2.76	2.84	2.8

Table B2-15. Tank 241-T-112 Analytical Results: Calcium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	<1,980	<1,960	<1,970
S97T000380		Lower half	<1,970	<1,970	<1,970
S97T000596	186:2	Upper half	<1,820	<1,850	<1,840
S97T000438		Lower half	2,160	1,400	1,780[QC:e]
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<20.1	<20.1	<20.1
S97T000376	185:2	Drainable liquid	<20.1	<20.1	<20.1

Table B2-16. Tank 241-T-112 Analytical Results: Cerium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	<1,980	<1,960	<1,970
S97T000380		Lower half	<1,970	<1,970	<1,970
S97T000596	186:2	Upper half	<1,820	<1,850	<1,840
S97T000438		Lower half	<1,140	<1,120	<1,130
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<20.1	<20.1	<20.1
S97T000376	185:2	Drainable liquid	<20.1	<20.1	<20.1

Table B2-17. Tank 241-T-112 Analytical Results: Chromium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	1,930	2,070	2,000
S97T000380		Lower half	2,300	2,350	2,330
S97T000596	186:2	Upper half	1,840	1,770	1,810
S97T000438		Lower half	2,260	2,350	2,310
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	699	684	692
S97T000376	185:2	Drainable liquid	690	691	691

Table B2-18. Tank 241-T-112 Analytical Results: Cobalt (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	<396	<391	<394
S97T000380		Lower half	<395	<394	<395
S97T000596	186:2	Upper half	<363	<369	<366
S97T000438		Lower half	<228	<224	<226
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<4.02	<4.02	<4.02
S97T000376	185:2	Drainable liquid	<4.02	<4.02	<4.02

Table B2-19. Tank 241-T-112 Analytical Results: Copper (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	<198	<196	<197
S97T000380		Lower half	<197	<197	<197
S97T000596	186:2	Upper half	<182	<185	<184
S97T000438		Lower half	<114	<112	<113
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<2.01	<2.01	<2.01
S97T000376	185:2	Drainable liquid	<2.01	<2.01	<2.01

Table B2-20. Tank 241-T-112 Analytical Results: Iron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	13,200	22,200	17,700[QC:e]
S97T000380		Lower half	16,000	16,000	16,000
S97T000596	186:2	Upper half	22,200	12,700	17,500[QC:e]
S97T000438		Lower half	14,700	14,300	14,500
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	< 10.1	< 10.1	< 10.1
S97T000376	185:2	Drainable liquid	< 10.1	< 10.1	< 10.1

Table B2-21. Tank 241-T-112 Analytical Results: Lanthanum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	4,880	4,230	4,560
S97T000380		Lower half	5,270	5,470	5,370
S97T000596	186:2	Upper half	5,320	4,670	5,000
S97T000438		Lower half	4,110	4,480	4,300
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	< 10.1	< 10.1	< 10.1
S97T000376	185:2	Drainable liquid	< 10.1	< 10.1	< 10.1

Table B2-22. Tank 241-T-112 Analytical Results: Lead (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<1,980	<1,960	<1,970
S97T000380		Lower half	<1,970	<1,970	<1,970
S97T000596	186:2	Upper half	<1,820	<1,850	<1,840
S97T000438		Lower half	<1,140	<1,120	<1,130
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	45.3	48.4	46.8
S97T000376	185:2	Drainable liquid	44.3	44.9	44.6

Table B2-23. Tank 241-T-112 Analytical Results: Lithium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<198	<196	<197
S97T000380		Lower half	<197	<197	<197
S97T000596	186:2	Upper half	<182	<185	<184
S97T000438		Lower half	<114	<112	<113
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	<2.01	<2.01	<2.01
S97T000376	185:2	Drainable liquid	<2.01	<2.01	<2.01

Table B2-24. Tank 241-T-112 Analytical Results: Magnesium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	<1,980	12,100	<7,040[QC:e]
S97T000380		Lower half	<1,970	<1,970	<1,970
S97T000596	186:2	Upper half	5,450	<1,850	<3,650[QC:e]
S97T000438		Lower half	<1,140	<1,120	<1,130
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<20.1	<20.1	<20.1
S97T000376	185:2	Drainable liquid	<20.1	<20.1	<20.1

Table B2-25. Tank 241-T-112 Analytical Results: Manganese (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	4,610	5,350	4,980
S97T000380		Lower half	4,520	4,630	4,580
S97T000596	186:2	Upper half	5,030	4,330	4,680
S97T000438		Lower half	9,350	9,940	9,650
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<2.01	<2.01	<2.01
S97T000376	185:2	Drainable liquid	<2.01	<2.01	<2.01

Table B2-26. Tank 241-T-112 Analytical Results: Molybdenum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<991	<978	<985
S97T000380		Lower half	<987	<985	<986
S97T000596	186:2	Upper half	<908	<923	<916
S97T000438		Lower half	<570	<561	<566
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	41.7	41.7	41.7
S97T000376	185:2	Drainable liquid	41.1	41.3	41.2

Table B2-27. Tank 241-T-112 Analytical Results: Neodymium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<1,980	<1,960	<1,970
S97T000380		Lower half	<1,970	<1,970	<1,970
S97T000596	186:2	Upper half	<1,820	<1,850	<1,840
S97T000438		Lower half	<1,140	<1,120	<1,130
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	<20.1	<20.1	<20.1
S97T000376	185:2	Drainable liquid	<20.1	<20.1	<20.1

Table B2-28. Tank 241-T-112 Analytical Results: Nickel (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	23.9	22.6	23.3
S97T000376	185:2	Drainable liquid	24.2	24.9	24.5

Table B2-29. Tank 241-T-112 Analytical Results: Phosphorus (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	4,130	4,700	4,420
S97T000380		Lower half	4,150	4,010	4,080
S97T000596	186:2	Upper half	4,300	3,960	4,130
S97T000438		Lower half	3,460	3,540	3,500
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	670	651	661
S97T000376	185:2	Drainable liquid	647	647	647

Table B2-30. Tank 241-T-112 Analytical Results: Potassium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	597	599	598
S97T000376	185:2	Drainable liquid	610	604	607

Table B2-31. Tank 241-T-112 Analytical Results: Samarium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
S97T000591	185:2	Upper half	<1,980	<1,960	<1,970
S97T000380		Lower half	<1,970	<1,970	<1,970
S97T000596	186:2	Upper half	<1,820	<1,850	<1,840
S97T000438		Lower half	<1,140	<1,120	<1,130
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000374	185:1	Drainable liquid	<20.1	<20.1	<20.1
S97T000376	185:2	Drainable liquid	<20.1	<20.1	<20.1

Table B2-32. Tank 241-T-112 Analytical Results: Selenium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000374	185:1	Drainable liquid	<20.1	<20.1	<20.1
S97T000376	185:2	Drainable liquid	<20.1	<20.1	<20.1

Table B2-33. Tank 241-T-112 Analytical Results: Silicon (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			**µg/g**	**µg/g**	**µg/g**
S97T000591	185:2	Upper half	6,980	15,400	11,200[QC:e]
S97T000380		Lower half	6,890	7,900	7,400
S97T000596	186:2	Upper half	13,800	6,650	10,200[QC:e]
S97T000438		Lower half	6,300	6,520	6,410
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000374	185:1	Drainable liquid	<10.1	<10.1	<10.1
S97T000376	185:2	Drainable liquid	<10.1	<10.1	<10.1

Table B2-34. Tank 241-T-112 Analytical Results: Silver (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<198	<196	<197
S97T000380		Lower half	<197	<197	<197
S97T000596	186:2	Upper half	<182	<185	<184
S97T000438		Lower half	<114	<112	<113[QC:c]
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	4.43	4.24	4.34
S97T000376	185:2	Drainable liquid	4.38	4.33	4.36

Table B2-35. Tank 241-T-112 Analytical Results: Sodium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	69,200	67,600	68,400
S97T000380		Lower half	66,100	69,700	67,900
S97T000596	186:2	Upper half	65,800	65,500	65,700
S97T000438		Lower half	67,600	66,500	67,100
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	58,400	56,800	57,600
S97T000376	185:2	Drainable liquid	56,700	56,900	56,800

Table B2-36. Tank 241-T-112 Analytical Results: Strontium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	289	342	316
S97T000380		Lower half	339	351	345
S97T000596	186:2	Upper half	326	273	300
S97T000438		Lower half	291	292	292
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<2.01	<2.01	<2.01
S97T000376	185:2	Drainable liquid	<2.01	<2.01	<2.01

Table B2-37. Tank 241-T-112 Analytical Results: Sulfur (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μg/g	μg/g	μg/g
S97T000591	185:2	Upper half	3,180	2,450	2,820[QC:e]
S97T000380		Lower half	3,030	3,150	3,090
S97T000596	186:2	Upper half	2,990	2,930	2,960
S97T000438		Lower half	3,200	3,140	3,170
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	3,100	3,020	3,060
S97T000376	185:2	Drainable liquid	3,010	3,010	3,010

Table B2-38. Tank 241-T-112 Analytical Results: Thallium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<3,960	<3,910	<3,940
S97T000380		Lower half	<3,950	<3,940	<3,950
S97T000596	186:2	Upper half	<3,630	<3,690	<3,660
S97T000438		Lower half	<2,280	<2,240	<2,260
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	<40.2	<40.2	<40.2
S97T000376	185:2	Drainable liquid	<40.2	<40.2	<40.2

Table B2-39. Tank 241-T-112 Analytical Results: Titanium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<198	<196	<197
S97T000380		Lower half	<197	<197	<197
S97T000596	186:2	Upper half	<182	<185	<184
S97T000438		Lower half	<114	<112	<113
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	<2.01	<2.01	<2.01
S97T000376	185:2	Drainable liquid	<2.01	<2.01	<2.01

Table B2-40. Tank 241-T-112 Analytical Results: Total Uranium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<9,910	<9,780	<9,850
S97T000380		Lower half	<9,870	<9,850	<9,860
S97T000596	186:2	Upper half	<9,080	<9,230	<9,160
S97T000438		Lower half	<5,700	<5,610	<5,660[QC:c]
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	945	926	936
S97T000376	185:2	Drainable liquid	933	942	938

Table B2-41. Tank 241-T-112 Analytical Results: Vanadium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<991	<978	<985
S97T000380		Lower half	<987	<985	<986
S97T000596	186:2	Upper half	<908	<923	<916
S97T000438		Lower half	<570	<561	<566
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	<10.1	<10.1	<10.1
S97T000376	185:2	Drainable liquid	<10.1	<10.1	<10.1

Table B2-42. Tank 241-T-112 Analytical Results: Zinc (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<198	402	<300[QC:e]
S97T000380		Lower half	297	294	296
S97T000596	186:2	Upper half	<182	<185	<184
S97T000438		Lower half	654	268	461[QC:e]
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	4.09	3.95	4.02
S97T000376	185:2	Drainable liquid	4.73	4.47	4.6

Table B2-43. Tank 241-T-112 Analytical Results: Zirconium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µg/g	µg/g	µg/g
S97T000591	185:2	Upper half	<198	<196	<197
S97T000380		Lower half	<197	<197	<197
S97T000596	186:2	Upper half	<182	<185	<184
S97T000438		Lower half	<114	<112	<113
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	7.62	7.51	7.56
S97T000376	185:2	Drainable liquid	7.63	7.72	7.67

Table B2-44. Tank 241-T-112 Analytical Results: Bromide (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			μg/g	μg/g	μg/g
S97T000592	185:2	Upper half	<509	<506	<507
S97T000593		Lower half	<282	<282	<282
S97T000594	186:2	Upper half	<474	<480	<477
S97T000595		Lower half	<269	<267	<268
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	<265	<265	<265
S97T000376	185:2	Drainable liquid	<265	<265	<265

Table B2-45. Tank 241-T-112 Analytical Results: Chloride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			μg/g	μg/g	μg/g
S97T000592	185:2	Upper half	397	396	397
S97T000593		Lower half	427	414	420
S97T000594	186:2	Upper half	486	485	486
S97T000595		Lower half	405	415	410
Liquids			μg/mL	μg/mL	μg/mL
S97T000374	185:1	Drainable liquid	489	521	505
S97T000376	185:2	Drainable liquid	515	519	517

Table B2-46. Tank 241-T-112 Analytical Results: Fluoride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000592	185:2	Upper half	373	375	374
S97T000593		Lower half	143	131	137
S97T000594	186:2	Upper half	468	483	476
S97T000595		Lower half	372	370	371
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	424	410	417
S97T000376	185:2	Drainable liquid	455	468	462

Table B2-47. Tank 241-T-112 Analytical Results: Nitrate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000592	185:2	Upper half	15,500	15,000	15,300
S97T000593		Lower half	19,500	20,200	19,800
S97T000594	186:2	Upper half	17,700	18,500	18,100
S97T000595		Lower half	16,300	16,000	16,100
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	23,800	23,800	23,800
S97T000376	185:2	Drainable liquid	22,400	23,200	22,800

Table B2-48. Tank 241-T-112 Analytical Results: Nitrite (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000592	185:2	Upper half	24,100	24,300	24,200
S97T000593		Lower half	33,800	33,600	33,700
S97T000594	186:2	Upper half	28,900	28,400	28,700
S97T000595		Lower half	25,500	26,000	25,700
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	40,500	41,000	40,700
S97T000376	185:2	Drainable liquid	37,100	36,800	37,000

Table B2-49. Tank 241-T-112 Analytical Results: Phosphate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000592	185:2	Upper half	2,620	2,590	2,600
S97T000593		Lower half	2,810	2,760	2,780
S97T000594	186:2	Upper half	2,590	3,040	2,820
S97T000595		Lower half	2,260	2,310	2,290
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	1,960	1,930	1,950
S97T000376	185:2	Drainable liquid	1,880	1,850	1,860

Table B2-50. Tank 241-T-112 Analytical Results: Sulfate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000592	185:2	Upper half	6,300	6,320	6,310
S97T000593		Lower half	8,190	8,720	8,460
S97T000594	186:2	Upper half	7,400	8,040	7,720
S97T000595		Lower half	6,550	6,920	6,740
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	9,500	10,100	9,800
S97T000376	185:2	Drainable liquid	8,970	9,450	9,210

Table B2-51. Tank 241-T-112 Analytical Results: Oxalate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000592	185:2	Upper half	626	542	584
S97T000593		Lower half	1,350	1,260	1,300
S97T000594	186:2	Upper half	1,040	592	814[QC:e]
S97T000595		Lower half	944	845	894
Liquids			µg/mL	µg/mL	µg/mL
S97T000374	185:1	Drainable liquid	1,410	1,470	1,440
S97T000376	185:2	Drainable liquid	1,170	2,390	1,780[QC:e]

Table B2-52. Tank 241-T-112 Analytical Results: Bulk Density.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			g/mL	g/mL	g/mL
S97T000369	185:2	Lower half	1.23	n/a	1.23
S97T000433	186:2	Upper half	1.39	n/a	1.39
S97T000434		Lower half	1.22	n/a	1.22

Table B2-53. Tank 241-T-112 Analytical Results: Percent Water (TGA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			%	%	%
S97T000374	185:1	Drainable liquid	85.1	85.2	85.1
S97T000376	185:2	Drainable liquid	84.9	85	85
Solids			%	%	%
S97T000370	185:2	Upper half	78.7	77.8	78.2
S97T000371		Lower half	77.5	75.2	76.3
S97T000435	186:2	Upper half	58.7	72.5	65.6
S97T000436		Lower half	74.2	76.6	75.4

Table B2-54. Tank 241-T-112 Analytical Results: Specific Gravity.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			unitless	unitless	unitless
S97T000374	185:1	Drainable liquid	1.11	1.1	1.1
S97T000376	185:2	Drainable liquid	1.1	1.1	1.1

Table B2-55. Tank 241-T-112 Analytical Results: Total Alpha.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
S97T000374	185:1	Drainable liquid	0.0322	0.0196	0.0259[QC:e]
S97T000376	185:2	Drainable liquid	0.0196	0.0219	0.0207
Solids: fusion			µCi/g	µCi/g	µCi/g
S97T000380	185:2	Lower half	0.222	0.235	0.228[QC:c]
S97T000438	186:2	Lower half	0.253	0.312	0.283[QC:e]

HISTORICAL DATA TABLES

B2.3 DESCRIPTION OF HISTORICAL SAMPLING EVENTS

Analyses of four sampling events for tank 241-T-112 were obtained from historical records. These data have not been validated and should be used with caution.

B2.3.1 October 1987 Sampling Event

A grab sample from tank 241-T-112 was taken in 1987. It was analyzed to determine whether the low-level waste in tank 241-T-112 would solubilize the transuranic waste heel from the Plutonium Reclamation Facility current acid waste if the two wastes were combined in a double-shell tank and held for a period of no longer than 21 days (Gallagher 1987). The results were reported on October 27, 1987. Analyses of the sample obtained from historical records are shown in Table B2-56. The sample was filtered through a 0.45 µm filter and analyzed for plutonium and americium. The sample was also analyzed for metals (specifically aluminum and sodium), hydroxide, nitrate, nitrite, ethylenediaminetetraacetate (EDTA), and N-(2-hydroxyethyl) ethylene-diaminetriacetate (HEDTA). The sample was nontransuranic and noncomplexed. After mixing the two materials and analyzing for transuranic elements over a 21-day period only a relatively small amount of plutonium and americium were found. The second cycle waste is inefective in solubilizing transuranic solids.

B2.3.2 August 1974 Sampling Event

A grab sample from tank 241-T-112 was taken and analyzed in August 1974 and reported on August 14, 1974 (Wheeler 1974). Because the exact sampling date is unknown, the reporting dates for the results are used. The sample was clear, brown liquid with no solids, and it appears to have been taken after transfers to tank 241-T-112 from tank 241-S-110. Analyses of this sample have been obtained from historical records and are shown in Table B2-57. The sample was analyzed for specific constituents and was found to contain primarily sodium, nitrate, carbonate, and nitrite. The radionuclides analyzed were ^{134}Cs and ^{137}Cs. A boildown study was also performed on the sample.

B2.3.3 September 1965 Sampling Event

A grab sample from tank 241-T-112 was taken and analyzed in September 1965 and reported on September 24, 1965 (Godfrey 1965). The exact sampling date is unknown. The sample was used to determine prospective feed supply tanks for the 242-T Evaporator. Analysis results of the sample have been obtained from historical records and are shown in Table B2-58. Specific gravity, sodium, aluminate, chloride, and nitrate were analyzed from two sample waste depths. The reported results indicate that sodium, nitrate, and carbonate were the constituents with the greatest concentration in the sample. The radionuclides analyzed were cesium, antimony, ruthenium-rhodium, and zirconium-niobium. A boildown study was also performed on the sample.

B2.3.4 June 1994 Compatibility Grab Sample

A grab sample was taken from tank 241-T-112 in June 1994. It was sent to the 222-S Laboratory to resolve possible waste compatibility issues. The sample was taken from riser 2 at a depth of approximately 1,100 cm (434 in.). The sampling and analyses are described in Schreiber (1994). Results are reported in WHC 1994 and are summarized in Table B2-59. The results between grab sample results and the current "best basis values for the supernatant are in agreement.

Table B2-56. Tank 241-T-112 Liquid Sample (1987).[1]

Waste Tank 241-T-112 Partial Waste Composition October 27, 1987		
Component	**Lab Value**	**Lab Unit**
Chemical Analysis		
Na	2.73	*M*
Al	1.38×10^{-3}	*M*
Ca	6.34×10^{-4}	*M*
Fe	ND	*M*
Mg	1.79×10^{-5}	*M*
Cr	1.08×10^{-2}	*M*
K	1.48×10^{-2}	*M*
P	3.23×10^{-2}	*M*
H^+	ND	*M*
NO_3	3.89×10^{-1}	*M*
NO_2	9.65×10^{-1}	*M*
OH	4.91×10^{-1}	*M*
CO_3	8.38×10^{-2}	*M*
SO_4	9.13×10^{-2}	*M*
Cl	1.55×10^{-2}	*M*
F	3.54×10^{-2}	*M*
EDTA	1.20×10^{-3}	*M*
HEDTA	$<1.83 \times 10^{-3}$	*M*
TOC	2.52	g/L carbon
Radiological Analysis		
$^{239/240}Pu$	1.85	μCi/L
Am	2.18	μCi/L

Notes:

ND = not determined

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

Table B2-57. Tank 241-T-112 Liquid Sample (1974).[1]

Waste Tank 241-T-112 Analysis of Tank Samples August 14, 1974		
Sample: T-5821		
Component	Lab Value	Lab Unit
Physical Data		
Visible, over-the-top reading	Clear, brown, no solids. 250 mRad/hr	
pH	12.8	
Specific gravity	1.054	
Water	87.32%	
Chemical Analysis		
OH	0.249	*M*
Al	4.42×10^{-2}	*M*
Na	2.36	*M*
NO_2	0.601	*M*
NO_3	5.54×10^{-1}	*M*
Pu	$<6.21 \times 10^{-6}$	g/gal
SO_4	8.42×10^{-2}	*M*
PO_4	2.18×10^{-2}	*M*
F	2.76×10^{-2}	*M*
CO_3	0.365	*M*
Radiological Analysis		
GEA: ^{134}Cs	1.28×10^{4}	μCi/gal
GEA: ^{137}Cs	9.42×10^{5}	μCi/gal

Notes:

GEA = gamma energy analysis

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

Table B2-58. Tank 241-T-112 Liquid Sample (1965).[1]

Waste Tank 241-T-112 Tank 112-T Status September 24, 1965		
Component	**Lab Value**	**Lab Unit**
Physical Data		
pH	12	
Liquid waste level	2.63×10^5 gal	
Sludge waste level	2.60×10^4 gal	
Specific gravity	1.03 g/cm^3	
Specific gravity	1.248 g/cm^3 [2]	
Chemical Analysis		
Free NaOH	0.45	g/L
CO_3^{2-}	2.2	g/L
AlO_2	0.019[2]	g/L
F^-	0.92[2]	g/L
Cl^-	5.28×10^{-2}	g/L
Cl^-	1.98×10^{-2} [2]	g/L
Na^+	19	g/L
Na^+	125[2]	g/L
NO_3^-	10.46	g/L
NO_3^-	75.2[2]	g/L
Radiological Analysis		
^{95}ZrNb	1.92×10^2	µCi/L
^{106}RuRh	1.08×10^3	µCi/L
^{125}Sb	4.48×10^1	µCi/L
^{134}Cs	3.30×10^1	µCi/L
^{137}Cs	1.16×10^3	µCi/L

Notes:

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

[2]Sample was taken from different level.

Table B2-59. Results of June 1994 Compatibility Grab Sample.

Analysis	Units	Sample Value	Duplicate	Best Basis Value
Specific gravity	n/a	1.11	1.11	1.10
% solids	%	13.2	12.9	n/r
Exotherms	n/a	none	none	none
% water	%	83.3	83.4	85.0
pH	n/a	9.92	9.93	n/r
TOC	μg/mL	1,660	1,780	n/r
TIC	μg/mL	6,320	6,290	n/r
^{137}Cs	μCi/mL	180	232	n/r
Na	μg/mL	50,200	49,600	52,000
Cl	μg/mL	512	521	465
NO_2	μg/mL	34,500	34,000	35,300
NO_3	μg/mL	20,300	21,000	21,200
PO_4	μg/mL	2,720	2,710	1,820
SO_4	μg/mL	9,550	9,930	8,260
F	μg/mL	518	493	n/r
$^{239/240}Pu$	μCi/mL	0.0114	0.0106	n/r
^{241}Am	μCi/mL	0.001	0.000949	0.000006
^{90}Sr	μCi/mL	0.120	0.0115	n/r

Note:
n/r = not reported

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS

This section discusses the overall quality and consistency of the current sampling results for tank 241-T-112.

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

B3.1 FIELD OBSERVATIONS

Sample recoveries from cores 185 and 186 were adequate to represent the waste contents of the tank. Poor sample recovery from the uppermost segment of core 186 was disappointing and may have resulted from small inaccuracies in zip cord readings, determining true elevations of risers, or estimations of waste depth. It appears the waste has a depth at or near the top of a single segment length; that is, 48 cm (19 in.). The abundance of supernatant available from core 185 would preclude the need for additional materials from the second core. The delay in shipment of core 186 segments to the laboratory in excess of the three-day requirement might be considered as potentially causal to the poor recovery, but because no liner liquid was present, this consideration was discounted.

B3.2 QUALITY CONTROL ASSESSMENT

The usual QC assessment includes an evaluation of the appropriate standard recoveries, spike recoveries, duplicate analyses, and blanks that are performed in conjunction with the chemical analyses. All pertinent QC tests were conducted on 1997 push mode core samples, allowing a full assessment regarding the accuracy and precision of the data. The SAP (Thompson 1997) established specific criteria for all analytes. Sample and duplicate pairs with one or more QC results, outside the specified criteria, were identified by footnotes in the data summary tables.

The standard and spike recovery results provide an estimate of analysis accuracy. If a standard or spike recovery is above or below the given criterion, the analytical results may be biased high or low, respectively. The precision is estimated by the relative percent difference (RPD), which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times 100. High RPDs (>20 percent) were reported for two of four subsamples submitted for total alpha analysis. The replicate analyses for the sample and duplicate indicated the high RPDs may have been caused by sample inhomogeneity. Because of the low alpha activity in the samples, no reruns were requested. One spike recovery outside the normal (75 to 125 percent) range was reported for sample S97T000380.

The chemist noted the poor spike recovery was due to matrix interference (solids on the sample mount). A reanalysis was performed with no improvement in the spike recovery. The standard recoveries for this analysis were within the required range.

In summary, the vast majority of QC results were within the boundaries specified in the Thompson (1997). The discrepancies mentioned here and footnoted in the data summary tables should not impact data validity or use.

B3.3 DATA CONSISTENCY CHECKS

Comparing different analytical methods is helpful in assessing the consistency and quality of the data. Two comparisons were possible with the data set provided by the two core samples: a comparison of phosphorus as analyzed by ICP to phosphate as analyzed by IC and a comparison of weight percent water by TGA to the weight percent water by gravimetry. In addition, mass and charge balances were calculated to help assess the overall data consistency.

B3.3.1 Comparison of Results from Different Analytical Methods

The following data consistency checks compare the results from two analytical methods. Agreement between the two methods strengthens the credibility of both results, but poor agreement brings the reliability of the data into question. All analytical mean results were taken from Tables B3-5 and B3-6.

B3.3.1.1 Solids. The analytical phosphorus mean result as determined by ICP was 4,030 μg/g, which converts to 12,350 μg/g of phosphate. This did not compare well with the IC phosphate mean result of 2,620 μg/g. The sulfur result by ICP was 3,010 μg/g, which converts to 9,030 μg/g for sulfate. This compares reasonably well with the IC sulfate value of 7,300 μg/g, indicating that the sulfate present is mostly soluble.

B3.3.1.2 Liquids. The analytical phosphorus mean result as determined by ICP was 654 μg/g, which converts to 2,004 μg/g of phosphate. This compares well with the IC phosphate mean result of 1,910 μg/g. The sulfur result by ICP was 3,040 μg/g, which converts to 9,120 μg/g for sulfate. This compares reasonably well with the IC sulfate value of 9,500 μg/g. The favorable comparisons in the liquid phase are to be expected because both the anions and the cations are soluble by definition. The disparity in the solid phase between the phosphate by phosphorus calculation and the phosphate analyses indicate significant insolubility among the phosphates in the tank.

B3.3.2 Mass and Charge Balance

The principal objective in performing mass and charge balances is to determine whether the measurements are consistent. In calculating the balances, only the analytes listed in Tables B3-5 and B3-6, which were detected at a concentration of 1,000 μg/g or greater, were considered.

Except for sodium, potassium, lithium, and bismuth, all cations listed in Table B3-1 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 and potassium cations. The anions listed in Table B3-2, except silicon dioxide, were assumed to be present as sodium and/or potassium salts and were expected to balance the positive charge exhibited by the cations. Phosphate was assumed to be completely associated with bismuth and does not factor as an anion. Fluoride is almost entirely associated with lanthanum, with a small residual concentration detected analytically. The concentrations of cationic species in Table B3-1, the anionic species in Table B3-2, and the percent water were ultimately used to calculate the mass balance.

The mass balance was calculated by using values from Tables D4-1 and D4-2, and the hydroxide concentration was derived by the difference between the cation and anion charge total. Table B3-3 shows a reconciliation between the cation and anion data for the sludge-slurry, as well as a total mass balance including water. The difference in charge remains zero based on the assumption that the difference is caused by hydroxide anion. The mass balance fractions add up to approximately 100 percent. Similarly, Table B3-4 demonstrates a hydroxide concentration derivation for the supernatants in tank 241-T-112, assuming a net zero charge balance and a sum of mass balance fractions to 99.9 percent.

Table B3-1. Cation Mass and Charge Data (Solids). (2 sheets)

Analyte	Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge (μeq/g)
Aluminum	5110	$Al(OH)_3$	14,800	0
Bismuth	28,800	$Bi(PO_4)$	41,900	0
Chromium	2,110	$Cr(OH)_3$	4,180	0
Iron	16,400	$Fe(OH)_2$	26,400	0
Lanthanum	4,800	LaF_3	6,770	0
Manganese	5,970	$Mn(OH)_2$	9,660	0
Potassium	1,270	K^+	1,270	32.6

Table B3-1. Cation Mass and Charge Data (Solids). (2 sheets)

Analyte	Concentration ($\mu g/g$)	Assumed Species	Concentration of Assumed Species ($\mu g/g$)	Charge ($\mu eq/g$)
Sodium	67,300	Na^+	67,300	2,930
Uranium	3,100	UO_3	3,730	0
Totals			176,000	2,960

Notes:

Concentration is taken from "best basis" value, Tables D4-1 and D4-2.
Charge is computed by dividing the average concentration by the molecular weight and valence. (Adjusted by density for $\mu g/L$).
Density: 1.28 g/mL

Table B3-2. Anion Mass and Charge Data (Solids).

Analyte	Concentration[1] ($\mu g/g$)	Assumed Species	Concentration of Assumed Species ($\mu g/g$)	Charge[2] ($\mu eq/g$)
Nitrate	17,300	NO_3^-	17,300	279
Nitrite	28,100	NO_2^-	28,100	611
TOC	3,470	$C_2O_4^{-2}$	12,700	289
Phosphate	Discounted by high bismuth concentrations.			0
Sulfate	9,030	SO_4^{-2}	9,030	188
Silicon	8,810	SiO_2	18,900	0
Carbonate	4,960	CO_3^{-2}	4,960	165
Hydroxide[3]	24,300	OH^-	24,300	1,430
Totals			115,000	2,960

Notes:

[1]Concentration is taken from "best basis" values, Tables D4-1 and D4-2.

[2]Charge is computed by dividing the average concentration by the molecular weight and valence. (Adjusted by density for $\mu g/L$).

Density: 1.28 g/mL

[3]Hydroxide concentrations were derived from difference in charge between cation and anion totals.

Table B3-3. Mass and Charge Balance Totals.

Totals	Concentrations ($\mu g/g$)	Charge ($\mu eq/g$)
Total from Table B3-1 (cations)	176,000	2,960
Total from Table B3-2 (anions)	115,000	-2,960
Water percent	739,000	0
Total	1,030,000	0

Table B3-4. Cation Mass and Charge Data (Supernatant).

Analyte	Concentration[1] ($\mu g/g$)	Assumed Species	Concentration of Assumed Species ($\mu g/g$)	Charge[2] ($\mu eq/g$)
Sodium	57,200	Na^{+}	57,200	2,490
Nitrate	23,300	NO_3^-	23,300	-376
Nitrite	38,800	NO_2^-	38,800	-843
Phosphate	2,000	PO_4^{-3}	2,000	-63.2
Sulfate	9,090	SO_4^{-2}	9,090	-189
Hydroxide[3]	17,300	OH^-	17,300	-1,020
Water	851,000		851,000	0
Totals			999,000	0

Notes:

[1]Concentration is taken from "best basis" values, Tables D4-1 and D4-2.

[2]Charge is computed by dividing the average concentration by the molecular weight and valence.(Adjusted by density for $\mu g/L$).

Density: 1.10

[3]Hydroxide concentrations derived from difference in charge between cation and anion totals.

In summary, the above calculations yield excellent mass and charge balance values, indicating that the analytical results are generally consistent.

B3.4 MEAN CONCENTRATIONS AND CONFIDENCE INTERVALS

The following evaluation was performed on the analytical data from the samples from tank 241-T-112.

Because an inventory estimate was needed without comparing it to a threshold value, two-sided 95 percent confidence intervals on the mean inventory were computed. This was done with solid and liquid segment-level data and liquid segment sample data. The solid and liquid segment-level data were analyzed separately.

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

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

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

The degrees of freedom for solid segment level data is the number of cores sampled minus one. The degrees of freedom for liquid segment sample data is the number of segments minus one.

B3.4.1 Solid and Liquid Segment Means

The statistics in this section were based on analytical data from the two push mode core samples taken from tank 241-T-112 in 1997. Analysis of variance techniques were used to estimate the mean, and to calculate confidence limits on the mean, for all analytes that had at least 50 percent of reported values above the detection limit. The detection limit was used as the value for nondetected results. No analysis of variance estimates were computed for analytes with less than 50 percent detected values. Only arithmetic means were computed for these analytes.

The results given below are analysis of variance estimates based on core segment data from core 185 and core 186 for tank 241-T-112. Estimates of the mean concentration, and the confidence interval on the mean concentration, are given in Table B3-5 for the solid segment sample data and in Table B3-6 for the liquid segment sample data. The lower limit, to a 95 percent confidence interval can be negative. Because an actual concentration of less than zero is not possible, the lower limit was reported as zero, whenever it occurred.

Because measurements are taken only from one core, spatial variability cannot be measured for tank 241-T-112 liquid. Therefore, estimations can only be made for core 185 and not for the whole tank unless the assumption is made that the liquid part of the tank is homogenous.

Table B3-5. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Solid Segment Sample Data. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
DSC	J/g	0	0	1	0	0
Bulk density	g/mL	1.28E+00	5.51E-02	1	5.80E-01	1.98E+00
% Water	%	7.39E+01	3.38E+00	1	3.09E+01	1.17E+02
Alpha	μCi/g	2.56E-01	2.70E-02	1	0	5.99E-01
$Al_{ICP.f}$	μg/g	5.11E+03	7.20E+02	1	0	1.43E+04
$Sb_{ICP.f}$[1]	μg/g	<1.03E+03	n/a	n/a	n/a	n/a
$As_{ICP.f}$[1]	μg/g	<1.73E+03	n/a	n/a	n/a	n/a
$Ba_{ICP.f}$[1]	μg/g	<8.63E+02	n/a	n/a	n/a	n/a
$Be_{ICP.f}$[1]	μg/g	<8.63E+01	n/a	n/a	n/a	n/a
$Bi_{ICP.f}$	μg/g	2.88E+04	1.53E+03	1	9.40E+03	4.82E+04
$B_{ICP.f}$[1]	μg/g	<8.63E+02	n/a	n/a	n/a	n/a
Bromide[1]	μg/g	<3.84E+02	n/a	n/a	n/a	n/a
$Cd_{ICP.f}$[1]	μg/g	<8.63E+01	n/a	n/a	n/a	n/a
$Ca_{ICP.f}$[1]	μg/g	<1.89E+03	n/a	n/a	n/a	n/a
$Ce_{ICP.f}$[1]	μg/g	<1.73E+03	n/a	n/a	n/a	n/a
Chloride	μg/g	4.28E+02	1.97E+01	1	1.77E+01	6.79E+02
$Cr_{ICP.f}$	μg/g	2.11E+03	1.26E+02	1	5.13E+02	3.70E+03
$Co_{ICP.f}$[1]	μg/g	<3.45E+02	n/a	n/a	n/a	n/a
$Cu_{ICP.f}$[1]	μg/g	<1.73E+02	n/a	n/a	n/a	n/a
Fluoride	μg/g	3.39E+02	8.39E+01	1	0	1.41E+03
$Fe_{ICP.f}$	μg/g	1.64E+04	1.33E+03	1	0	3.33E+04
$La_{ICP.f}$	μg/g	4.80E+03	2.38E+02	1	1.78E+03	7.82E+03
$Pb_{ICP.f}$[1]	μg/g	<1.73E+03	n/a	n/a	n/a	n/a
$Li_{ICP.f}$[1]	μg/g	<1.73E+02	n/a	n/a	n/a	n/a
$Mg_{ICP.f}$[1]	μg/g	<3.45E+03	n/a	n/a	n/a	n/a
$Mn_{ICP.f}$	μg/g	5.97E+03	1.23E+03	1	0	2.16E+04
$Mo_{ICP.f}$[1]	μg/g	<8.63E+02	n/a	n/a	n/a	n/a

Table B3-5. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Solid Segment Sample Data. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
Nd_{ICP}	µg/g	<1.73E+03	n/a	n/a	n/a	n/a
Nitrate	µg/g	1.73E+04	1.02E+03	1	4.33E+03	3.03E+04
Nitrite	µg/g	2.81E+04	2.10E+03	1	1.41E+03	5.47E+04
Oxalate	µg/g	8.99E+02	1.50E+02	1	0	2.80E+03
Phosphate	µg/g	2.62E+03	1.22E+02	1	1,070	4.17E+03
$P_{ICP.f}$	µg/g	4.03E+03	2.16E+02	1	1.28E+03	6.78E+03
$Sm_{ICP.f}$[1]	µg/g	<1.73E+03	n/a	n/a	n/a	n/a
$Si_{ICP.f}$	µg/g	8.81E+03	1.28E+03	1	0	2.51E+04
$Ag_{ICP.f}$[1]	µg/g	<1.73E+02	n/a	n/a	n/a	n/a
$Na_{ICP.f}$	µg/g	6.73E+04	9.00E+02	1	5.58E+04	7.87E+04
$Sr_{ICP.f}$	µg/g	3.13E+02	1.74E+01	1	9.21E+01	5.34E+02
Sulfate	µg/g	7.30E+03	4.84E+02	1	1.15E+03	1.35E+04
$S_{ICP.f}$	µg/g	3.01E+03	8.68E+01	1	1.91E+03	4.11E+03
$Tl_{ICP.f}$[1]	µg/g	<3.45E+03	n/a	n/a	n/a	n/a
$Ti_{ICP.f}$[1]	µg/g	<1.73E+02	n/a	n/a	n/a	n/a
$U_{ICP.f}$[1]	µg/g	<8.63E+03	n/a	n/a	n/a	n/a
$V_{ICP.f}$[1]	µg/g	<8.63E+02	n/a	n/a	n/a	n/a
$Zn_{ICP.f}$[2]	µg/g	3.10E+02	5.71E+01	1	0	1.04E+03
$Zr_{ICP.f}$[1]	µg/g	<1.73E+02	n/a	n/a	n/a	n/a

Notes:

f = fusion

[1]More than 50 percent of the analytical results were below the detection limit.
[2]Some less-than values are in the analytical results.

Table B3-6. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Sample Data. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
DSC	J/g	0	0	1	0	0
Specific gravity	Specific gravity	1.10E+00	1.91E-03	1	1.08E+00	1.13E+00
% water	%	8.51E+01	9.50E-02	1	8.38E+01	8.63E+01
Alpha	µCi/mL	2.33E-02	3.01E-03	1	0	6.15E-02
$Al_{ICP.a}$[1]	µg/mL	<1.01E+01	n/a	n/a	n/a	n/a
$Sb_{ICP.a}$[1]	µg/mL	<1.21E+01	n/a	n/a	n/a	n/a
$As_{ICP.a}$[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
$Ba_{ICP.a}$[1]	µg/mL	<1.01E+01	n/a	n/a	n/a	n/a
$Be_{ICP.a}$[1]	µg/mL	<1.01E+00	n/a	n/a	n/a	n/a
$Bi_{ICP.a}$	µg/mL	4.40E+01	1.05E+00	1	3.06E+01	5.74E+01
$B_{ICP.a}$[1]	µg/mL	<1.01E+01	n/a	n/a	n/a	n/a
Bromide[1]	µg/mL	<2.65E+02	n/a	n/a	n/a	n/a
$Cd_{ICP.a}$	µg/mL	2.84E+00	3.75E-02	1	2.36E+00	3.31E+00
$Ca_{ICP.a}$[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
$Ce_{ICP.a}$[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
Chloride	µg/mL	5.11E+02	7.38E+00	1	4.17E+02	6.05E+02
$Cr_{ICP.a}$	µg/mL	6.91E+02	3.08E+00	1	6.52E+02	7.30E+02
$Co_{ICP.a}$[1]	µg/mL	<4.02E+00	n/a	n/a	n/a	n/a
$Cu_{ICP.a}$[1]	µg/mL	<2.01E+00	n/a	n/a	n/a	n/a
Fluoride	µg/mL	4.39E+02	2.23E+01	1	1.56E+02	7.23E+02
$Fe_{ICP.a}$[1]	µg/mL	<1.01E+01	n/a	n/a	n/a	n/a
$La_{ICP.a}$[1]	µg/mL	<1.01E+01	n/a	n/a	n/a	n/a
$Pb_{ICP.a}$	µg/mL	4.57E+01	1.13E+00	1	3.14E+01	6.00E+01
$Li_{ICP.a}$[1]	µg/mL	<2.01E+00	n/a	n/a	n/a	n/a
$Mg_{ICP.a}$[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
$Mn_{ICP.a}$[1]	µg/mL	<2.01E+00	n/a	n/a	n/a	n/a
$Mo_{ICP.a}$	µg/mL	4.14E+01	2.50E-01	1	3.83E+01	4.46E+01
$Nd_{ICP.a}$[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
$Ni_{ICP.a}$	µg/mL	2.39E+01	6.50E-01	1	1.56E+01	3.22E+01
Nitrate	µg/mL	2.33E+04	5.07E+02	1	1.69E+04	2.98E+04
Nitrite	µg/mL	3.88E+04	1.89E+03	1	1.48E+04	6.29E+04

Table B3-6. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Sample Data. (2 sheets)

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}_{\hat{\mu}}$	df	LL	UL
Oxalate	µg/mL	1.61E+03	2.68E+02	1	0	5.02E+03
Phosphate	µg/mL	1.91E+03	4.15E+01	1	1.38E+03	2.43E+03
$P_{ICP.a}$	µg/mL	6.54E+02	6.75E+00	1	5.68E+02	7.40E+02
$K_{ICP.a}$	µg/mL	6.03E+02	4.50E+00	1	5.45E+02	6.60E+02
$Sm_{ICP.a}$[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
$Se_{ICP.a}$[1]	µg/mL	<2.01E+01	n/a	n/a	n/a	n/a
$Si_{ICP.a}$[1]	µg/mL	<1.01E+01	n/a	n/a	n/a	n/a
$Ag_{ICP.a}$	µg/mL	4.35E+00	4.05E-02	1	3.83E+00	4.86E+00
$Na_{ICP.a}$	µg/mL	5.72E+04	4.02E+02	1	5.21E+04	6.23E+04
$Sr_{ICP.a}$[1]	µg/mL	<2.01E+00	n/a	n/a	n/a	n/a
Sulfate	µg/mL	9.50E+03	2.94E+02	1	5.77E+03	1.32E+04
$S_{ICP.a}$	µg/mL	3.04E+03	2.50E+01	1	2.72E+03	3.35E+03
$Tl_{ICP.a}$[1]	µg/mL	<4.02E+01	n/a	n/a	n/a	n/a
$Ti_{ICP.a}$[1]	µg/mL	<2.01E+00	n/a	n/a	n/a	n/a
$U_{ICP.a}$	µg/mL	9.37E+02	4.33E+00	1	8.81E+02	9.92E+02
$V_{ICP.a}$[1]	µg/mL	<1.01E+01	n/a	n/a	n/a	n/a
$Zn_{ICP.a}$	µg/mL	4.31E+00	2.90E-01	1	6.25E-01	7.99E+00
$Zr_{ICP.a}$	µg/mL	7.62E+00	5.50E-02	1	6.92E+00	8.32E+00

Notes:

LL = lower limit
UL = upper limit

[1]More than 50 percent of the analytical results were below the detection limit.

B3.4.2 Analysis of Variance Models

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

The statistical model fit to the solid segment sample data is

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

$$I=1,\ldots,a,\ j=1,\ldots,b_i,$$

where

Y_{ij}	=	laboratory results from the j^{th} duplicate from the i^{th} core in the tank
μ	=	the grand mean
C_i	=	the effect of the i^{th} core
A_{ij}	=	the effect of the j^{th} analytical result from the i^{th} core
a	=	the number of cores
b_i	=	the number of analytical results from the i^{th} core

The variable C_i is assumed to be a random effect. This variable and A_{ij} are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(C)$, $\sigma^2(S)$ and $\sigma^2(A)$, respectively. Estimates of $\sigma^2(C)$, $\sigma^2(S)$, and $\sigma^2(A)$ were obtained using restricted maximum likelihood estimate techniques. This method, applied to variance component estimation, is described in Harville (1977). The statistical results were obtained using the statistical analysis package S-PLUS[1] (Statistical Sciences 1993).

The statistical model fit to the remaining solid segment sample data is

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

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

where

Y_{ijk}	=	laboratory results from the k^{th} duplicate from the j^{th} sample in the i^{th} core in the tank
μ	=	the grand mean
C_i	=	the effect of the i^{th} core
S_{ij}	=	the effect of the j^{th} sample in the i^{th} core
A_{ijk}	=	the effect of the k^{th} analytical result from the j^{th} sample in the i^{th} core
a	=	the number of cores

[1]S-PLUS is a registered trademark of Statistical Sciences, Seattle Washington.

b_i = the number of samples from the i^{th} core

c_{ij} = the number of analytical results from the j^{th} sample in the i^{th} core.

The variables C_i and S_{ij} are assumed to be random effects. These variables and A_{ijk} are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(C)$, $\sigma^2(S)$, and $\sigma^2(A)$, respectively. Estimates of $\hat{\sigma}^2(C)$, $\sigma^2(S)$, and $\sigma^2(A)$ were obtained using restricted maximum likelihood estimate techniques. This method, applied to variance component estimation, is described in Harville (1977). The statistical results were obtained using the statistical analysis package S-PLUS® (Statistical Sciences 1993).

The statistical model fit to the liquid segment sample data is

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

$$I=1,...,a,\ j= 1,...,b_i,$$

where

Y_{ij} = laboratory results from the j^{th} duplicate from the i^{th} segment in core 185
μ = the grand mean
S_i = the effect of the i^{th} segment
A_{ij} = the effect of the j^{th} analytical result from the i^{th} segment
a = the number of segments
b_i = the number of analytical results from the i^{th} segment.

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

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

Appendix C documents the results of the analyses and statistical and numerical manipulations required by the DQOs applicable for tank 241-T-112. The analyses required for tank 241-T-112 are as follows:

- **Section C1.0**: Statistical analysis and numerical manipulations supporting the safety screening DQO (Dukelow et al. 1995).
- **Section C2.0**: Appendix C References.

C1.0 STATISTICS FOR SAFETY SCREENING DATA QUALITY OBJECTIVE

The safety screening DQO (Dukelow et al. 1995) defines decision limits in terms of one-sided 95 percent confidence intervals. The safety screening limits are 1 g/L for total alpha activity and 480 J/g for DSC. Using the maximum solids density of 1.39 g/mL , the 1 g/L limit corresponds to 44.2 μCi/g.

Confidence intervals on the mean were calculated for each laboratory sample. The data used in the computations were from the 1997 sampling event data package. The means and confidence intervals for total alpha activity are given in Table C1-1. No statistics were computed on the DSC data because there were no exothermic reactions in any DSC samples.

The upper limit of a one-sided 95 percent confidence interval on the mean is

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

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

Each confidence interval can be used to make the following statement. If the upper limit is less than 44.2 μCi/g, reject the null hypothesis that the alpha is greater than or equal to 44.2 μCi/g at the 0.05 level of significance. The maximum upper bound of the 95 percent confidence intervals was 0.469 μCi/g for core 186 segment 2, well below the threshold limit of 44.2 μCi/g.

Table C1-1. Limits for Total Alpha Activity.

Lab Sample ID	Description	$\hat{\mu}$	df	UL	Units
S97T000374	Core 185, segment 1	2.59E-02	1	6.57E-02	µCi/mL
S97T000376	Core 185, segment 2	2.07E-02	1	2.80E-02	µCi/mL
S97T000380F	Core 185, segment 2, drainable liquid	2.28E-01	1	2.70E-01	µCi/g
S97T000438F	Core 186, segment 2, drainable liquid	2.82E-01	1	4.69E-01	µCi/g

C2.0 APPENDIX C REFERENCES

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-T-112

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-T-112

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for single-shell tank 241-T-112 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

Analytical data from the most recent sampling event for this tank are published in Appendix B of this report. Other information sources include component concentrations based on analytical data from core samples from tank 241-T-111 (Field et al. 1997), which historically contains the same sludge waste type as tank 241-T-112, and the HDW model (Agnew et al. 1997a),which provides tank content estimates in terms of component concentrations and inventories.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Inventories derived from the tank 241-T-112 analytical concentration data (see Appendix B of this report) and HDW model inventories (Agnew et al. 1997a) are compared in Tables D2-1 and D2-2. The tank volume used to generate these inventories is 254 kL (67 kgal) or 227 kL (60 kgal) sludge and 27 kL (7 kgal) supernatant. This volume is reported in Hanlon (1998) and is the same as that reported by Agnew et al. (1997a and 1997b). (The chemical species are reported without charge designation in accordance with the best-basis inventory convention.)

Table D2-1. Sample-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-T-112.

Analyte	Sampling Inventory Estimate[1] (kg)	HDW Model Inventory Estimate[2] (kg)	Previous Best-Basis Value[3]
Al	1,480	0.00	1,490
Bi	8,370	1,950	8,370
Ca	<550	2,510	<550
Cl	138	129	138
Cr	632	60.4	630
F	110	472	110
Fe	4,770	9,950	4,770
Hg	n/r	0.00	0.457
K	n/r	31.0	380
La	1,390	0.00	1,400
Mn	1,730	0.00	1,740
Na	21,100	6,250	13,500
Ni	n/r	20.2	45
NO_2	9,210	130	9,200
NO_3	5,660	9,040	5,650
PO_4	3,660	3,030	3,640
Pb	<500	0.00	116
Si	2,560	117	2,560
SO_4	2,870	554	2,880
Sr	91	0.00	92
TIC as CO_3	n/r	3,760	1,440
TOC	n/r	0.00	1,000
U_{TOTAL}	<2,540	112	925
Zr	<50.5	0.00	<50
H_2O (wt%)	73.9 (solids) 85.1 (liquid)	83.1	73.9 85.1
Density (kg/L)	1.28 (solids) 1.10 (liquid)	1.11	1.28 1.10

Notes:

[1] From Tables B3-5 and B3-6, using 227 kL volume solids and 27 kL volume liquids with respective densities.
[2] Agnew et al. (1997a)
[3] Boldt (1997)

Table D2-2. Sample-Based and Hanford Defined Waste-Based Inventory Estimates for Radioactive Components in Tank 241-T-112.

Analyte	Sampling Inventory Estimate[1] (Ci)	HDW Model Inventory Estimate[2] (Ci)	Previous Best-Basis Value[3]
^{137}Cs	n/r	325	49.1
^{90}Sr	n/r	285	1,590
^{238}Pu	n/r	0.146	0.54
^{239}Pu	n/r	18.1	67.8
^{240}Pu	n/r	1.77	6.6
^{241}Am	n/r	0.00747	0.028
Total alpha	74.4	19.9[4]	75.0[4]

Notes:

[1] As of sample analysis date (Steen 1997)
[2] Appendix E of Agnew et al. (1997a), decayed to January 1, 1994
[3] Boldt (1997)
[4] By summation

D3.0 COMPONENT INVENTORY EVALUATION

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

D3.1 CONTRIBUTING WASTE TYPES

Reported Waste Types in Tank 241-T-112

Anderson (1990): 2C, 224, DW
Agnew et al. (1997a): 2C2, DW

Model-Based Current Inventory (Agnew et al. 1997a)

Waste Type	Waste Volume kL (kgal)
2C2	227 (60)
SU	27 (7)

The following abbreviations were used to designate waste types:

2C	=	Second decontamination cycle $BiPO_4$ waste no distinction for time period
2C1	=	Second decontamination cycle $BiPO_4$ waste (1944 to 1949)
2C2	=	Second decontamination cycle $BiPO_4$ waste (1950 to 1956)
224	=	Waste from final decontamination stage of $BiPO_4$ process
DW	=	Wash solution from equipment decontamination at T Plant
SU	=	Supernatant.

D3.1.1 Waste Transaction History

Tank 241-T-112 is the third tank in a cascade that includes tanks 241-T-110 and 241-T-111. Tank 241-T-112 first received second-cycle decontamination (2C) waste from the bismuth phosphate process (1945 to 1952) cascaded from tank 241-T-111 with supernatants jetted to crib. From 1953 to 1955, tank 241-T-112 was used to cascade 2C waste and bismuth phosphate concentration and purification (224) waste from T Plant to a crib. Tank 241-T-112 remained in 2C service through the third quarter of 1956.

For some reason, Agnew et al. (1997a) does not carry the 2C1 and 224 waste in tank 241-T-111 over to the third tank in the cascade. It is reasonable to assume that some 2C1, 2C2, and 224 was cascaded from 241-T-111 to 241-T-112.

In the first quarter of 1960, tank 241-T-112 began receiving decontamination waste from 221-T. Beginning in the second quarter of 1967, tank 241-T-112 began exchanging evaporator waste with tank 241-TX-118. Supernatant was sent to tank 241-TX-118 from tank 241-T-112, and evaporator bottoms waste was returned to 241-T-112. This continued until the second quarter of 1972.

Both Anderson (1990) and Agnew et al. (1997a) identified decontamination waste from T Plant added to tank 241-T-112 in 1973. Agnew et al. identifies the decontamination waste volume as 16.7 kL (4.4 kgal) containing 1 volume percent solids, but assumes a loss of these solids by the late 1970's.

D3.1.2 Predicted Current Waste Types and Volumes

Based on data (see Tables B3-5 and B3-6) that clearly identify the presence of 224 waste, it is assumed that tank 241-T-112 contains 2C1, 2C2, and 224 waste solids in the same proportions as tank 241-T-111. The resulting predicted waste volumes for tank 241-T-112 are:

Waste Type	Waste Volume kL (kgal)
2C1	69 (18.3)
2C2	140 (37.0)
224	18 (4.7)
SU	27 (7.0)

D3.2 BASIS FOR ASSESSING INVENTORIES IN 241-T-112

Component analyses for tanks 241-T-111 and 241-T-112, with the HDW model predicted concentrations for tank 241-T-112, are shown in Table D3-1.

As shown in Table D3-2, the concentrations of most components in tank 241-T-112 (with the exception of Al, Na, PO_4, and SO_4) agree with those for tank 241-T-111. This close correlation supports the assumption that waste types and relative proportions are comparable for the two tanks. Certainly the presence of lanthanum and manganese substantiates the presence of 224 waste although it was not predicted by Agnew et al. (1997a). Tank 241-T-112 differs slightly from the "sister tanks" farther up the cascade in that decontamination wastes and evaporator bottom wastes were added in later years as well as the 224 waste. The decontamination waste additions could explain the high potassium and manganese values, while the elevated aluminum concentration probably resulted from the evaporator waste bottoms passing through the tank in the 1970s.

The potassium, nickel, carbonate, and TOC solids concentrations on a water-free basis for tank 241-T-111 are considered an appropriate basis for the solids concentrations in tank 241-T-112 where these analytes are not reported. These concentrations are assumed to be the concentrations for calculating the tank 241-T-112 best-basis inventory.

The lead, mercury, and uranium solids concentrations on a water-free basis for tank 241-T-111 are considered an appropriate basis for the lead, mercury, and uranium solids concentrations in tank 241-T-112. These concentrations are reported as less than values. The less than concentrations for calcium in tank 241-T-112 are assumed to be the concentrations for calculating the tank 241-T-112 best-basis inventory. Zirconium is not presumed to be present, based on the process history and flow sheets for second cycle waste.

To provide a common basis for comparison of the data for waste solids in Table D3-1, the reported water mass was removed; that is, the results for waste solids were compared on a water-free basis and are shown in Table D3-2. The HDW model composition for tank 241-T-112 solids (also on a water-free basis) is included in Table D3-2 for comparison.

Table D3-1. Composition of Wastes in Tanks 241-T-111 and 241-T-112. (2 sheets)

Analyte	241-T-111[1] Solids (μg/g)	241-T-112[2]		HDW Model[3] 241-T-112	
		Solids (μg/g)	Supernatant (μg/mL)	Solids (μg/g)	Supernatant (μg/g)
Al	556	5,110	<10.1	0.00	0.00
Bi	24,800	28,800	44.0	7,630	0.00
Ca	2,150	<1,890	<20.1	9,840	0.00
Cr	1,890	2,110	691	236	0.00
Fe	18,300	16,400	<10.1	39,000	0.00
Hg	1.43	n/r	n/r	0.00	0.00
K	1,140	n/r	603	121	0.00
La	4,170	4,800	<10.1	0.00	0.00
Mn	6,310	5,970	<2.01	0.00	0.00
Na	37,000	67,300	57,200	24,500	0.00
Ni	132	n/r	23.9	79	0.00
Pb	356	<1,730	45.7	0.00	0.00
Si	5,670	8,810	<10.1	460	0.00
Sr	299	313	<2.01	0.00	0.00
U	2,790	<8,630	937	438	0.00
Zr	n/r	<173	7.62	0.00	0.00
CO_3	4,470	n/r	n/r	14,700	0.00
Cl	450	428	511	506	0.00
F	2,300	339	439	1,850	0.00
OH	n/r	n/r	n/r	36,600	0.00
NO_3	41,200	17,300	23,300	35,400	0.00
NO_2	897	28,100	38,800	510	0.00
P as PO_4	31,700	12,400	2,000	11,900	0.00
S as SO_4	3,660	9,030	9,090	2,170	0.00
TOC	3,120	n/r	n/r	0.00	0.00
Percent water	76.5	73.9	85.1	81.4	100
Specific gravity, kg/L	1.24	1.28	1.10	1.12	1.00

Table D3-1. Composition of Wastes in Tanks 241-T-111 and 241-T-112. (2 sheets)

Analyte	241-T-111[1] Solids (μg/g)	241-T-112[2] Solids (μg/g)	241-T-112[2] Supernatant (μg/mL)	HDW Model[3] 241-T-112 Solids (μg/g)	HDW Model[3] 241-T-112 Supernatant (μg/g)
Radionuclide	μCi/g[4]	μCi/g[4]	μCi/mL[4]	μCi/g[3]	μCi/g[3]
^{137}Cs	0.166	n/r	n/r	1.27	0.00
^{90}Sr	5.41	n/r	n/r	1.12	0.00
^{99}Tc	0.00792	n/r	n/r	7.70 E-05	0.00
^{238}Pu	n/r	n/r	n/r	5.71 E-04	0.00
^{239}Pu	n/r	n/r	n/r	0.0709	0.00
^{240}Pu	n/r	n/r	n/r	0.00692	0.00
^{241}Am	0.0424	n/r	n/r	2.92 E-05	0.00
$^{239/240}Pu$	0.139	n/r	n/r	0.078[5]	n/r
Total alpha	0.373	0.255	0.0233	0.078[5]	n/r

Notes:

[1] Field et al. (1997)
[2] See Tables B3-5 and B3-6
[3] Agnew et al. (1997a), radionuclides decayed to January 1, 1994
[4] Reported as of the sample analysis date
[5] By summation

Table D3-2. Composition of Tanks 241-T-111 and 241-T-112 Waste Solids, Water-Free Basis. (2 sheets)

Analyte	241-T-111[1] (μg/g)	241-T-112[2] (μg/g)	HDW Model[3] 241-T-112 (μg/g)
Al	2,370	19,600	0.00
Bi	106,000	110,300	41,000
Ca	9,150	<7,240	52,900
Cr	8,040	8,080	1,270
Fe	77,900	62,800	210,000
Hg	6.09	n/r	0.00
K	4,850	n/r	651
La	17,700	18,400	0.00
Mn	26,900	22,900	0.00
Na	157,000	258,000	132,000
Ni	562	n/r	425
Pb	1,510	<6,630	0.00
Si	24,100	33,800	2,470
Sr	1,270	1,200	0.00
U	11,900	<33,100	2,350
Zr	n/r	<663	0.00
CO_3	19,000	n/r	79,000
Cl	1,910	1,640	2,720
F	9,790	1,300	9,950
OH	n/r	n/r	197,000
NO_3	175,000	66,300	190,000
NO_2	38,200	108,000	2,740
P as PO_4	135,000	47,500	64,000
S as SO_4	15,600	34,600	11,700
TOC	13,300	n/r	0.00
Percent water	0.00	0.00	0.00

Table D3-2. Composition of Tanks 241-T-111 and 241-T-112 Waste Solids, Water-Free Basis. (2 sheets)

Analyte	241-T-111[1] (μg/g)	241-T-112[2] (μg/g)	HDW Model[3] 241-T-112 (μg/g)
Radionuclide	μCi/g[4]	μCi/g[4]	μCi/g[3]
^{137}Cs	0.706	n/r	6.83
^{90}Sr	23.0	n/r	6.02
^{99}Tc	0.0337	n/r	4.14 E-04
^{241}Am	0.180	n/r	1.57 E-04
$^{239/240}$Pu	0.591	n/r	0.418[5]
Total alpha	1.59	0.98	0.418[5]

Notes:
[1] Field et al. (1997)
[2] Steen (1997)
[3] Agnew et al. (1997a), radionuclides decayed to January 1, 1994
[4] Radionuclides reported as of the sample analysis date
[5] By summation

The water-free analyte concentrations from tank 241-T-111 were adjusted with the 73.9 wt% water content from tank 241-T-112 to provide concentration values for the tank 241-T-112 solids. The dry weight gram/dry waste gram values were multiplied by a factor (100% - 73.9% = 26.1%) to return the units to gram/gram waste (water included). The inventories of analytes in tank 241-T-112 solids were calculated using a solids volume of 227 kL (60 kgal) and a solids density of 1.28 kg/L established by sample analyses.

The supernatant analyte concentrations in Table D3-1 and supernatant volume of 27 kL (7 kgal) were used to calculate tank 241-T-112 best-basis inventory contributions from the liquid fraction. Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. Please refer to Appendix B, Section B3.0 for details. This charge balance approach is consistent with that used by Agnew et al. (1997a).

Radionuclide analysis for tank 241-T-112 samples was limited to total alpha measurements. The total alpha determination was 0.255 μCi/g in the solid phase and 0.0233 μCi/mL in the liquid phase. For the engineering assessment-based inventory of individual alpha decay radionuclides, the total alpha determination was split between ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am by the fractional distribution predicted by the HDW model (Agnew et al. 1997a). The sample analysis of tank 241-T-111 determined ^{90}Sr, ^{99}Tc, and ^{137}Cs concentrations in the solids (Table D3-1). This concentration, corrected for differences in solids water content

(Table D3-2) is used as the basis for tank 241-T-112 solids ^{99}Tc concentration. There is not an adequate sample basis to determine the other radionuclide inventories in tank 241-T-112. The HDW model (Agnew et al. 1997a) inventories are used for radionuclides other than the alpha decay radionuclides and ^{90}Sr, ^{99}Tc, and ^{137}Cs.

The resulting tank 241-T-112 engineering assessment-based concentrations and inventories for the solid and liquid phases are shown in Table D3-3.

Table D3-3. Tank 241-T-112 Best-Basis Inventory Data for Solid and Liquid Compositions and Inventory. Decayed to January 1, 1994. Effective Date May 1, 1998. (2 sheets)

Analyte	241-T-112 Concentration		Tank 241-T-112 Inventory		
	Solids[1] (μg/g)	Supernatant[1] (μg/mL)	Solids (kg)	Supernatant (kg)	Total (kg)
Al	5,110	<10.1	1,480	0.3	1,480
Bi	28,800	44.0	8,370	1.19	8,370
Ca	<1,890	<20.1	<549	0.543	<550
Cr	2,110	691	613	18.7	632
Fe	16,400	<10.1	4,770	0.273	4,770
Hg[2]	1.59	n/r	0.462	n/r	0.462
K[2]	1,270	603	369	16.3	385
La	4,800	<10.1	1,390	0.273	1,390
Mn	5,970	<2.01	1,730	0.054	1,730
Na	67,300	57,200	19,600	1,540	21,100
Ni[2]	147	23.9	42.7	0.645	43.4
Pb[2]	394	45.7	114	1.23	116
Si	8,810	<10.1	2,560	0.273	2,560
Sr	313	<2.01	90.9	0.0543	91.0
U[2]	3,100	937	900	25.3	925
Zr	<173	7.62	<50.3	0.206	<50.5
CO_3[2]	4,960	n/r	1,440	n/r	1,440
Cl	428	511	124	13.8	138
F[3]	1,960	439	570	11.9	582
OH[4]	48,800	17,300	14,200	467	14,700
NO_3	17,300	23,300	5,030	629	5,660
NO_2	28,100	38,800	8,160	1,050	9,210

Table D3-3. Tank 241-T-112 Best-Basis Inventory Data for Solid and Liquid Compositions and Inventory. Decayed to January 1, 1994. Effective Date May 1, 1998. (2 sheets)

Analyte	241-T-112 Concentration		Tank 241-T-112 Inventory		
	Solids[1] (μg/g)	Supernatant[1] (μg/mL)	Solids (kg)	Supernatant (kg)	Total (kg)
P as PO_4	12,400	2,000	3,600	54.0	3,660
S as SO_4	9,030	9,090	2,620	245	2,870
TOC[2]	3,470	n/r	1,010	n/r	1,010
Percent water	73.9	85.1	2.15E+05	2.30E+04	2.40E+05
Specific gravity kg/L	1.28	1.10	1.28	1.10	1.26
Radionuclides	μCi/g	μCi/g	Ci	Ci	Ci
^{137}Cs[2]	0.184	n/r	53.5	n/r	48.8
^{90}Sr[2]	6.00	n/r	1,740	n/r	1,580
^{99}Tc[2]	0.00880	n/r	2.56	n/r	2.56
Total alpha	0.255	0.0233	74.1	0.629	74.7

Notes:

[1] See Tables B3-5 and B3-6

[2] Field et al. (1997), adjusted from tank 241-T-111 to tank 241-T-112, using percent water values on solids only

[3] Fluoride calculated from balance with lanthanum plus disassociated fluoride ion (see Section B3.3.2)

[4] Calculated from mass/charge balance exercise, Appendix B, Section B3.0. This hydroxide value includes both free hydroxide plus contributions from other hydroxide compounds (includes oxides as hydroxides: excluding carbonate, nitrite, nitrate, phosphate, sulfate, and silicate).

D3.3 COMPARISON OF INVENTORY ESTIMATES

Estimated inventories from this evaluation are compared with the HDW model-based inventories (Agnew et al. 1997a) in Table 2-1. The inventories from this evaluation differ significantly from the HDW inventories.

The analyte concentrations in solids samples from tanks 241-T-111 and 241-T-112 are comparable as is expected for tanks operated for solids settling in a cascade. An engineering assessment of predicted solids composition in tank 241-T-111, based on published flowsheet compositions of 2C and 224 wastes, was performed by Field et al. (1997). The results from this evaluation support using the sampling data from tanks 241-T-111 and 241-T-112 as the basis for the best-basis inventory for tank 241-T-112 for the following reasons:

1. Data from two tank 241-T-111 core composite samples were used to estimate the component inventories. The core sample recovery was complete.

2. With the exception of PO_4 and U, results from the engineering flowsheet assessment compare favorably with the sample-based results.

3. The inventory estimate generated by the HDW model is based on a predicted 2C:224 waste volume ratio 92:8, whereas sample analyses of components that are unique to these two waste types indicate a higher contribution of 224 waste, such as 80:20 or 75:25.

4. The fraction precipitated basis used for the independent analysis for major components resulted in inventory estimates that compare favorably with sample analyses. The concentration factors calculated for fully precipitated components (that is, bismuth) were based on comparing flowsheet concentrations with analytical-based concentrations. The relative concentrations of components in the waste solids are consistent with those expected for waste resulting from $BiPO_4$ process 2C and 224 process flowsheets. For nearly all components, the calculated concentration factor and partition factor resulted in inventories consistent with the predicted chemical behaviors of the components in alkaline media.

5. The flowsheet bases and waste volumes used for the tank 241-T-111 assessment are believed to reflect the processing conditions more closely than those that govern the HDW model inventories.

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, as well as regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing them into a form that is suitable for long-term storage/disposal.

Chemical and radiological inventory information is generally derived using 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. The information derived from these different approaches is seldom completely consistent.

An effort is underway to provide waste inventory estimates that will serve as the standard characterization for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-T-112 was performed, including the following:

- Data from two 1997 core samples (Steen 1997)
- An inventory estimate generated by the HDW model (Agnew et al. 1997a)
- Comparison of total waste concentrations with a similar T Tank Farm tank sample (T-111).

Based on this evaluation, a best-basis inventory was developed for tank 241-T-112 (see Tables D4-1 and D4-2). The evaluation used the sample-based analytical data from tank 241-T-112. The evaluation also used sample-based analytical data from tank 241-T-111, which historically contains the same waste types as tank 241-T-112, to define the best-basis inventory where analyses were absent for the tank 241-T-112 samples. The best-basis inventory used sample analyses because the estimates provided in Agnew et al. (1997a) for several chemical components were not consistent with the sample-based data for tanks 241-T-111 and 241-T-112. The noticeable presence of manganese and lanthanum in the solids clearly indicates that 224 wastes were deposited in tank 241-T-112, in concentrations similar to those found in tank 241-T-111. This would indicate that dry weight analytical values from tank 241-T-111, adjusted for tank 241-T-112 weight percent water, would be more representative of tank waste than the HDW model.

The inventories of analytes were calculated using a solids volume of 227 kL (60 kgal), a liquid volume of 27 kL (7 kgal), and a solids density of 1.28 g/cm^3 established by the sample analyses (Steen 1997). The HDW model bases were used as best basis where there were poor (or no) sample bases. Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997a).

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am have been infrequently reported. For this reason, it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste

Table D4-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-T-112. Effective Date May 1, 1998. (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Si	2,560	S	
SO_4	2,870	S	ICP sulfur value adjusted for compound
Sr	91.0	S	
TOC	1,010	E	Tank 241-T-111 sample basis for solids used
U_{TOTAL}	925	E/S	Tank 241-T-111 sample basis for solids used
Zr	0	E	Zirconium is not expected to be in this tank based on process history and flowsheets.

Notes:

[1]S = sample-based, M = Hanford defined waste model-based (Agnew et al. 1997a), E = engineering assessment-based, C = calculated by charge balance; includes oxides as hydroxides but does not include CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-T-112 Decayed to January 1, 1994. Effective Date May 1, 1998. (3 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	0.00720	M	
^{14}C	0.00283	M	
^{59}Ni	8.03E-04	M	
^{60}Co	7.62E-04	M	
^{63}Ni	0.0733	M	
^{79}Se	5.97E-04	M	
^{90}Sr	1,580	E	Tank 241-T-111 sample basis
^{90}Y	1,580	E	Equilibrium value with ^{90}Sr
^{93m}Nb	0.00237	M	
^{93}Zr	0.00283	M	
^{99}Tc	2.56	E	Tank 241-T-111 sample basis
^{106}Ru	3.88E-10	M	
^{113m}Cd	0.00745	M	
^{125}Sb	7.75E-04	M	
^{126}Sn	9.03E-04	M	
^{129}I	3.72E-05	M	
^{134}Cs	3.56E-05	M	
^{137m}Ba	46.2	E	Equilibrium value with ^{137}Cs
^{137}Cs	48.8	E	Tank 241-T-111 sample basis
^{151}Sm	2.21	M	
^{152}Eu	0.00347	M	
^{154}Eu	0.0145	M	
^{155}Eu	0.233	M	
^{226}Ra	1.21E-07	M	Based on total alpha analysis/HDW radionuclide distribution model
^{227}Ac	6.27E-07	M	
^{228}Ra	9.57E-12	M	
^{229}Th	1.86E-09	M	
^{231}Pa	1.41E-06	M	
^{232}Th	7.73E-13	M	

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-T-112 Decayed to January 1, 1994. Effective Date May 1, 1998. (3 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}U	7.31E-06	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{233}U	3.35E-07	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{234}U	0.304	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{235}U	0.0134	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{236}U	3.11E-03	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{237}Np	1.23E-04	M	
^{238}Pu	0.539	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{238}U	0.309	M/E	Uranium isotopics derived by model from total uranium that came from tank 241-T-111 data
^{239}Pu	67.0	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{240}Pu	6.54	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{241}Am	0.0276	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{241}Pu	23.7	E/M/S	Based on $^{241}Pu/^{240}Pu$ ratio model
^{242}Cm	2.55E-04	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{242}Pu	1.08E-04	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{243}Am	2.00E-07	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-T-112 Decayed to January 1, 1994. Effective Date May 1, 1998. (3 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{243}Cm	5.25E-06	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model
^{244}Cm	4.76E-06	E/M/S	Based on total alpha analysis/HDW radionuclide distribution model

Note:

[1]S = sample-based, M = Hanford defined waste model-based (Agnew et al. 1997a), E = engineering assessment-based

D5.0 APPENDIX D REFERENCES

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

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997b, *Waste Status and Transaction Record Summary (WSTRS Rev. 4)*, LA-UR-97-311, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

Boldt, A. L., 1997, *Preliminary Tank Characterization Report for Single-Shell Tank 241-T-112, Best-Basis Inventory*, HNF-SD-WM-ER-699, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Field, J. G., J. H. Baldwin, M. J. Kupfer, and L. Jensen, 1997, *Tank Characterization Report for Single-Shell Tank 241-T-111*, HNF-SD-WM-ER-540, Rev. 1, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Hanlon, B. M., 1998, *Waste Tank Summary Report for Month Ending January 31, 1998*, WHC-EP-182-118, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., 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 Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, B. C. Simpson, R. A. Watrous, S. L. Lambert, D. E. Place, R. M. Orme, G. L. Borsheim, N. G. Colton), M. D. LeClair), R. T. Winward, and W. W. Schulz, 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Steen, F. H., 1997, *Tank 241-T-112 Cores 185 and 186 Analytical Results for the Final Report*, HNF-SD-WM-DP-243, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Watrous, R. A., and D. W. Wootan, 1997, *Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989,* HNF-SD-WM-TI-794, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-T-112

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-T-112

Appendix E provides a bibliography of information that supports the characterization of tank 241-T-112. 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-T-112 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-T-112
- Iib. Sampling of Similar Waste Type

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, or set of references, 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 Corp. Tank Characterization and Safety Resource Center.

I. NON-ANALYTICAL DATA

Ia. Models/Waste Type Inventories/Campaign Information

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

- Contains single-shell tank fill history and primary campaign/waste type information up to 1981.

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.

- Describes a model for estimating tank waste inventories using process knowledge, radioactive decay estimates using ORIGEN, and assumptions about waste types, solubility, and constraints.

Schneider, K. J., 1951, *Flowsheets and Flow Diagrams of Precipitation Separations Process*, HW-23043, Hanford Atomic Products Operation, Richland, Washington.

- Contains compositions of process stream waste before transfer to 200 Area waste tanks.

Ib. Fill History/Waste Transfer Records

Agnew, S. F., P. Baca, R. A. Corbin, T. B. Duran, and K. A. Jurgensen, 1997, *Waste Status and Transaction Record Summary, WSTRS Rev. 4*, LA-UR-97-311, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains spreadsheets showing all known tank additions/transfers.

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

- Contains tank fill histories and primary campaign/waste type information up to 1981.

Ic. Surveillance/Tank Configuration

Alstad, A. T., 1993, *Riser Configuration Document for Single-Shell Waste Tanks*, WHC-SD-WM-TI-553, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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

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

- Gives an assessment of riser locations for each tank; however, not all tanks are included/completed. Also included is an estimate of the risers available for sampling.

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

- Provides thermocouple location and status information for double- and single-shell tanks.

Welty, R. K., 1988, *Waste Storage Tank Status and Leak Detection Criteria*, WHC-SD-WM-TI-356, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Provides leak detection information for all single- and double-shell tanks. Liquid level, liquid observation well, and dry well readings are included.

Id. Sample Planning/Tank Prioritization

Thompson, R. R., and W. D. Winkelman, 1996, *Tank 241-T-112 Tank Characterization Plan*, WHC-SD-WM-TP-224, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

- Discusses all relevant DQOs and how their requirements will be met for tank 241-T-112.

Brown, T. M., J. W. Hunt, and L. J. Fergestrom, 1997, *Tank Waste Characterization Basis*, WHC-SD-WM-TA-164, Rev. 3, Westinghouse Hanford Company, Richland, Washington.

- Establishes an approach to determine the priority for tank sampling and characterization and identifies high-priority tanks for sampling.

Thompson, R. R., 1997, *Tank 241-T-112 Push Mode Core Sampling and Analysis Plan*, HNF-SD-WM-TSAP-116, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains detailed sampling and analysis scheme for core samples to be taken from tank 241-T-112 to address applicable DQOs.

Mulkey, C. H., 1996, *Single-Shell Tank System Waste Analysis Plan*, WHC-EP-0356, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Document is the waste analysis plan for single-shell tanks as required by WAC-173-303 and 40 CFR Part 265.

Stanton, G. A., 1997, *Baseline Sampling Schedule, Change 98-01*, (internal letter 79520-98-001 to Distribution, February 5), Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Provides a tank waste sampling schedule through fiscal year 2002 and lists samples taken since 1994.

Winkelman, W. D., M. R. Adams, T. M. Brown, J. W. Hunt, D. J. McCain, and L. J. Fergestrom, 1997, *Fiscal Year 1997-1998 Waste Information Requirements Document*, HNF-SD-WM-PLN-126, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains requirements from the *Hanford Federal Facility Agreement and Consent Order*, *Recommendation 93-5 Implementation Plan*, and other requirement sources. These along with managerial and operational constraints are combined to summarize the TWRS characterization program deliverables for fiscal years 1997 and 1998.

Ie. Data Quality Objectives/Customers of Characterization Data

Cash, R. J., 1996, *Scope Increase of "Data Quality Objective to Support Resolution Of the Organic Complexant Safety Issue" Rev. 2* (internal memorandum 79300-96-029 to S. J. Eberlein, July 12), Westinghouse Hanford Company, Richland, Washington.

- Identifies organic solvent test needed for all single-shell tanks.

DOE-RL, 1996, *Recommendation 93-5 Implementation Plan*, DOE/RL-94-0001, Rev. 1, U.S. Department of Energy, Richland, Washington.

- Defines needs and milestones identified by the Defense Nuclear Facility Safety Board.

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.

- Determines whether tanks are under safe operating conditions.

Meacham, J. E., 1996, *Implementation Change Concerning Organic DQO, Rev. 2*, (internal memorandum 2N160-96-006 to Distribution, December 2), DE&S Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Changes organic DQO strategy to test for TOC for any exotherm.

Meacham, J. E., 1996, *Increase Scope To Organic DQO*, (internal memorandum 2N160-96-003 to J. G. Kristofzski, October 31), DE&S Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Increases scope of organic DQO to all single-shell tanks.

Osborne, J. W., and L. L. Buckley, 1995, *Data Quality Objective for Tank Hazardous Vapor Safety Screening*, WHC-SD-WM-DQO-002, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

- Determines whether tank headspaces contain potentially hazardous gases and vapors.

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

- Categorizes organic tanks as "safe," "conditionally safe," or "unsafe" based on fuel and moisture concentrations and supports resolution of the safety issue.

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

Iia. Sampling of Tank 241-T-112

Godfrey, W. L., 1965, *242-T Evaporator Feed*, (internal letter to S. J. Beard, September 24), General Electric Company, Richland, Washington.

- Contains historical sample analysis results.

Wheeler, R. E., 1974, *Analysis of Tank Farm Samples, Sample: T-5821, 112-T*, (internal letter to R. L. Walser, August 14), Atlantic Richfield Hanford Company, Richland, Washington.

- Contains historical sample analysis results.

Gallagher, S. A., 1987, *Tank 112-T Waste/Plutonium Reclamation Facility Current Acid Waste (CAW) Mixing Test*, (internal letter 12221-PCL87-016 to M. J. Klem, October 27), Westinghouse Hanford Company, Richland, Washington.

- Contains historical sample analysis results.

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- Contains historical sample analysis results.

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- Contains February and March 1997 core sample analysis results.

IIb. Sampling of Similar Waste Type

Field, J. G., 1997, *Tank 241-T-111 Characterization Report*, HNF-SD-WM-ER-540, Rev. 1A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on 2C waste type.

McCain, D. J., 1998, *Tank Characterization Report for Single-Shell Tank 241-T-110*, HNF-SD-WM-ER-686, Rev. 1, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on 2C waste type.

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

IIIa. Inventories using both Campaign and Analytical Information

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Rev. 4*, LA-UR-96-3860, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains waste type summaries; primary chemical compound/analyte and radionuclide estimates for sludge, supernatant, and solids; SMM; TLM; and individual tank inventory estimates.

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- Contains summary information for tanks in T, TX, and TY Tank Farms as well as in-tank photograph collages and inventory estimates.

Geier, R. G., 1976, *Estimated Hanford Liquid Wastes Chemical Inventory as of June 30*, 1976, ARH-CD-768, Atlantic Richfield Hanford Company, Richland, Washington.

- Contains major components for waste types and various tanks and some assumptions.

Klem, M. J., 1988, *Inventory of Chemicals Used at Hanford Production Plants and Support Operations (1944 - 1980)*, WHC-EP-0172, Westinghouse Hanford Company, Richland, Washington.

- Provides a list of chemicals used in production facilities and support operations that sent wastes to the single-shell tanks. List is based on chemical process flowsheets, essential materials consumption records, letters, reports, and other historical data.

Kupfer, M. J., A. L. Boldt, and M. D. LeClair, 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains a global component inventory for 200 Area waste .

Boldt, A. L., 1997, *Preliminary Tank Characterization Report for Single-Shell Tank 241-T-112: Best Basis Inventory*, HNF-SD-WM-ER-699, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains inventory estimate derived from model and sampling results.

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

- Contains a global inventory based on process knowledge and radioactive decay estimations using ORIGEN2. Plutonium and uranium waste contributions are taken at one percent of the amount used in processes. Also compares information on ^{99}Tc from both ORIGEN2 and analytical data.

IIIb. Compendium of Existing Physical and Chemical Documented Data Sources

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

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

Brevick, C. H., J. L. Stroup, and J. W. Funk, 1997, *Supporting Document for the Northwest Quadrant Historical Tank Content Estimate Report for T Tank Farm*, WHC-SD-WM-ER-320, Rev. 1, Fluor Daniel Northwest Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains summary information for tanks in the T Tank Farm as well as appendices containing more detailed information including tank waste level history, tank temperature history, cascade and drywell charts, riser information, in-tank photograph collages, and tank layer model bar chart and spreadsheet.

Brevick, C. H., L. A. Gaddis, and E. D. Johnson, 1996, *Tank Waste Source Term Inventory Validation, Vol I, II, and III*, WHC-SD-WM-ER-400, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Contains a quick reference to sampling information in spreadsheet or graphical form for 24 chemicals and 11 radionuclides for all tanks.

Hanlon, B. M., 1998, *Waste Tank Summary Report for Month Ending November 30, 1997*, HNF-EP-0182-116, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- This document, updated monthly, contains a summary of: tank waste volumes, Watch List tanks, occurrences, tank integrity information, equipment readings, tank locations, leak volumes, and other miscellaneous tank information.

Hill, J. G., G. S. Anderson, and B. C. Simpson, 1995, *The Sort on Radioactive Waste Type Model: A Method to Sort Single-Shell Tanks into Characteristic Groups*, PNL-9814, Rev. 2, Pacific Northwest Laboratory, Richland, Washington.

- Describes a system of sorting single-shell tanks into groups based on the major waste types contained in each tank.

Husa, E. I., 1993, *Hanford Site Waste Storage Tank Information Notebook*, WHC-EP-0625, Westinghouse Hanford Company, Richland, Washington.

- Contains in-tank photos and summaries of 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.

- Assesses the relative dryness of tank wastes.

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

- Contains a tank inventory estimate based on analytical information.

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

- Contains a tank inventory estimate based on analytical information.

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

- Contains a tank inventory estimate based on analytical information.

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- Contains selected sample analysis tables before 1993 for single-shell tanks.

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