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PNL-10512

UC-721

Sludge Pretreatment Chemistry Evaluation: Enhanced Sludge Washing Separation Factors

N. G. Colton

March 1995

**Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830**

**Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
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BATTELLE MEMORIAL INSTITUTE
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UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RLO 1830

Printed in the United States of America

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Available to the public from the National Technical Information Service,
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Richland, Washington 99352**

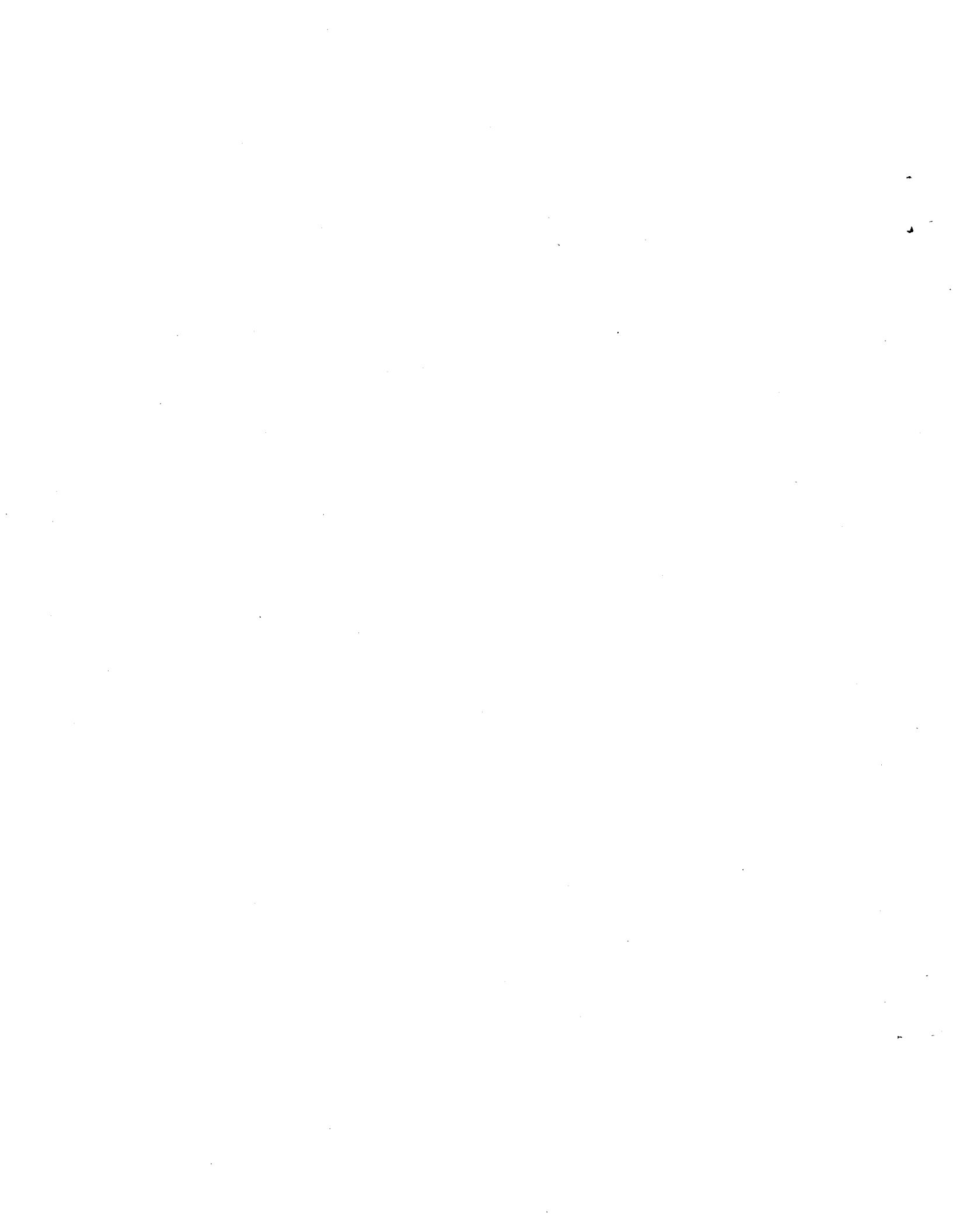
Summary

This report presents the work conducted in Fiscal Year 1994 by the Sludge Pretreatment Chemistry Evaluation Subtask for the Tank Waste Remediation System (TWRS) Tank Waste Treatment Science Task. The main purpose of this task, led by Pacific Northwest Laboratory^(a), is to provide the technical basis and scientific understanding to support TWRS baseline decisions and actions, such as the development of an enhanced sludge washing process to reduce the volume of waste that will require high-level waste (HLW) vitrification.

The effect of this enhanced sludge washing strategy on final waste volumes is evaluated in systems engineering studies by using assumptions about the chemical and physical behavior of the wastes. Included in the chemical assumptions are wash and leach factors, or the fraction of each waste component that will dissolve or will be leached from waste streams during various processing steps. Current evaluations use wash factors and waste stream compositions derived from the overall single-shell tank (SST) and double-shell tank (DST) waste inventories, *i.e.*, idealized blends of SST and DST tank wastes. In actuality, wastes will be blended in batches that could result in larger-than-anticipated HLW volumes. Evaluating the effect of different blending strategies on HLW volumes requires that pretreatment scenarios based on specific tank or waste-type inventories also be evaluated. For that evaluation, wash factors for these tank/waste-type inventories need to be established.

One objective within the Sludge Pretreatment Chemistry Evaluation Subtask was to establish wash factors for various SST sludges. First, analytical data were compiled from existing tank waste characterization reports. These data were summarized on tank-specific worksheets that provided a uniform format for reviewing and comparing data, as well as the means to verify whether the data set for each tank was complete. Worksheets were completed for 27 SST wastes. The analytical water wash data provided tank-specific information about the fraction of each component that dissolves with water, *i.e.*, an estimate of tank-specific wash factors for evaluating tank-by-tank processing. These wash data were then used collectively to evaluate some of the wash factors that are assumed for the overall SST waste inventory; specifically, wash factors for elements that would be found primarily in sludges. The final step in this study was to incorporate the characterization and wash factor data into a spreadsheet that provides insight into the effect of enhanced sludge washing on individual tank sludges as well as for groups of sludges that may be representative of different waste types. Spreadsheet results include the estimated mass and percentage of each element that would be removed with washing and leaching. Furthermore, estimated compositions are given of the final wash and leach streams and residual solids, in terms of both concentration and dry weight percent.

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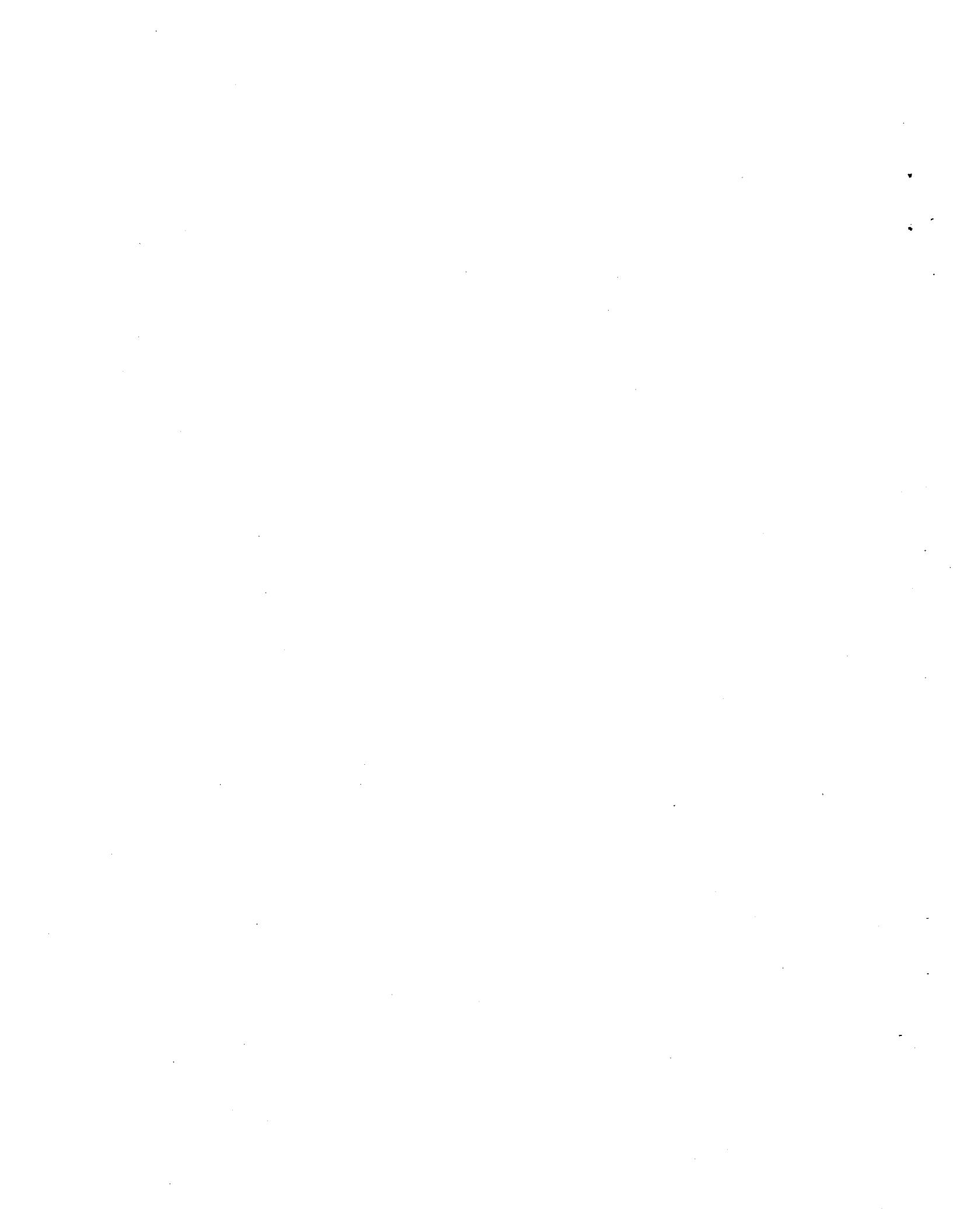
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Acknowledgments

The author wishes to thank the following persons who provided valuable assistance and input to this subtask: A. L. Boldt, M. J. Kupfer, and L. W. Shelton (Systems Engineering), and S. L. Lambert (Vitrification Development) from Westinghouse Hanford Company and J. L. Swanson from Pacific Northwest Laboratory.

1.0 Introduction

1.0 Introduction

The Tank Waste Remediation System (TWRS) was established by the U.S. Department of Energy (DOE) to safely manage and dispose of high-level wastes (HLW), transuranic waste, and low-level wastes (LLW) stored in underground tanks on the Hanford Site. A key element to the disposal efforts involves pretreatment technologies for separating and/or destroying waste components to reduce waste volumes and to produce waste fractions that are compatible with the final waste forms (glass). Accordingly, work for TWRS to support pretreatment activities is focusing on a strategy to remove radionuclides from aqueous streams to the extent that these streams are suitable for LLW vitrification. TWRS also is focusing on the development of an enhanced sludge washing process to reduce the volume of waste that will require HLW vitrification.

The enhanced sludge washing process involves washing tank sludges with retrieval solutions, *i.e.*, corrosion-inhibited water or dilute caustic, followed by at least one caustic or caustic permanganate wash to remove aluminum, phosphorous, and chromium. Removal of aluminum, a bulk component in some sludges, is expected to reduce HLW glass volumes by reducing the mass of feed to HLW vitrification. Phosphorous and chromium tend to interfere with HLW glass integrity; therefore, removal of these components from the HLW vitrification feed allows higher loading of nonproblematic components and is expected to produce a more homogeneous HLW glass. The enhanced sludge washing process also involves blending wastes to adjust final component concentrations to meet glass feed specifications for acceptable glass formulation.

The effect of this enhanced sludge washing strategy on final waste volumes is evaluated in systems engineering studies by using assumptions about the chemical and physical behavior of the wastes. Chemical assumptions include wash and leach factors, or the fraction of each waste component that will dissolve or will be leached from waste streams during various processing steps. Current evaluations use wash factors and waste stream compositions derived from the overall single-shell tank (SST) and double-shell tank (DST) waste inventories, *i.e.*, idealized blends of SST and DST tank wastes that consist mainly of sodium salts. In actuality, wastes will be blended in batches that could result in larger-than-anticipated HLW volumes. When considering the effect of different blending strategies on HLW volumes, pretreatment scenarios based on specific tank or waste-type inventories also must be evaluated. For that evaluation, wash factors for these tank/waste-type inventories need to be established.

One objective within the Sludge Pretreatment Chemistry Evaluation (Subtask 0503) of the TWRS Tank Waste Treatment Science Task is to establish wash factors for different SST sludges. Efforts so far have focused on compiling selected SST characterization data for review; evaluating current sludge wash factors used in system engineering studies; and developing a spreadsheet to evaluate the effect of enhanced sludge washing on specific tanks sludges. This report presents the work conducted to date and the results derived from the overall efforts. The information is presented as follows:

Section 2.0, a discussion of the SST data compilation. This section includes characterization data summaries for 27 SST wastes. These summaries, compiled in a format that is easy to use, provide a first step for evaluating tank-specific wash factors needed for the systems engineering studies.

Section 3.0, a discussion of how these SST data were used to evaluate some of the currently assumed sludge wash factors for the overall SST waste inventory and a comparison, for selected elements, of calculated wash factors with assumed system engineering wash factors.

Section 4.0, an introduction to the spreadsheet and the assumptions used to provide insight into the effect of enhanced sludge washing on various tank sludges. This section also provides a comparison of the calculated results from the spreadsheet with recently measured experimental sludge washing results. This section includes spreadsheet evaluation summaries for 5 core composites, 20 tank-specific sludges, and 15 sludge groups that represent different waste types. Tank-specific sludge compositions were derived by averaging core composite data; waste-type compositions were derived by mass-weight-averaging tank compositions.

2.0 SST Data Compilation and Review

2.0 SST Data Compilation and Review

The first step used to establish wash factors for SST sludges involved compiling data from existing tank waste characterization reports. These data were summarized on tank-specific worksheets that show how much of each element went into solution with water and rigorous acid ($\text{HNO}_3\text{-HCl}$) digestions and how much of each element had to be fused with caustic before going into solution prior to analysis. These worksheets provided a uniform format for reviewing and comparing data, as well as the means to verify whether the data set for each tank was complete. The characterization data summary worksheets, along with a key to help interpret them, are provided at the end of this section.

Worksheets were completed for the 27^(a) SSTs listed in Table 2.1. This table also provides, for each tank, the volume of waste; the percentage of solids accounted for with analysis; and the potentially important components that were omitted from analysis. Note that the anions that were omitted from analysis could account for up to 15 to 40 dry weight percent of each waste in Tanks A-102, A-103, A-106, BX-104, C-104, and C-105. The SO_4^{2-} , Cl^- , and F^- anions are especially important because of their potential impact on HLW vitrification.

-
- (a) Characterization reports were obtained for 29 SSTs; however, data for Tanks T-105 and B-202 were not entered onto spreadsheets. Data for Tank T-105 were not included because these data represented segment analyses instead of core composite analyses. Because of insufficient sample size, no composites were prepared for analysis. No concise data summary tables were obtained for Tank B-202, and data for this tank will be entered onto spreadsheets at a later date.

Table 2.1. Characterized SST Sludge-type Wastes

Tank	kgal solids ^(a) in tank	dry wt% solids identified	Components omitted from analysis
A-102	37	86	Cl ⁻ , F ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ , NO ₂ ⁻
A-103	366	73	Cl ⁻ , F ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ , NO ₂ ⁻
A-106	125	86	Cl ⁻ , F ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ , NO ₂ ⁻
B-110	245	103	
B-111	236	103	
B-201	28	111	
BX-104	96	62	Cl ⁻ , F ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ , NO ₂ ⁻
BX-105	46	96	Cl ⁻ , F ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ , NO ₂ ⁻
BX-107	344	105	
C-103	62	114	Cl ⁻ , F ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ , NO ₂ ⁻
C-104	295	83	Cl ⁻ , F ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ , NO ₂ ⁻
C-105	150	57	Cl ⁻ , F ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ , NO ₂ ⁻
C-106	229	103	Cl ⁻ , F ⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ , NO ₂ ⁻
C-109	62	93	Bi
C-110	187	98	
C-112	104	107	Bi
S-104	293	102	
T-102	19	99	
T-104	442	101	
T-107	171	98	
T-111	453	94	
TY-101	118	107	CO ₃ ²⁻ , NO ₂ ⁻ , Ca, Mg, K
TY-103	162	101	Ca, Mg, K
TY-104	43	97	Ca, Mg, K
TY-105	231	75	CO ₃ ²⁻ , NO ₂ ⁻ , SO ₄ ²⁻ , Ca, Mg, K
TY-106	17	101	Ca, Mg, K
U-110	186	100	
Total	4,747		

(a) Hanlon (1994).

2.1 Key for Interpreting Characterization Data Summary Worksheets

This section provides the key to terms and abbreviations used in the data summary worksheets that follow.

Waste Type	CC	Complexed Concentrate Waste	POS	Purex Organic Solvent
	CW	Cladding Waste	PSS	Purex Sludge Supernatant
	DSSF	Double-shell Slurry Feed	SRS	Strontium Recovery Sludge
	EB	Evaporator Bottom	TBP	Uranium Recovery
	Evap	Evaporator Feed	1C	1st Cycle, BiPO ₄
	F	Ferrocyanide scavenged	2C	2nd Cycle, BiPO ₄
	HS	Hot Semi Works	224	Concentration Cycle, BiPO ₄
	IX	Ion exchange Waste	5-6	Tank 5-6, B Plant
	NC	Non-complexed Waste		
Density (g/mL)		Reported density of sludge. This is an averaged value of the core composites data in the characterization reports.		
Volume (L)		Volume of waste in tank reported in <i>Tank Farm Surveillance and Waste Status Summary Report for October 1993, WHC-EP-0182-67</i> .		
Mass (kg)		Mass of waste in tank [density (kg/L) x volume (L)].		
Solids (μg/g)		Reported μg solids/g sludge; remaining mass is assumed to be interstitial and hydration waters. This is an averaged value of the core composite data in the characterization reports.		
pH		Reported or estimated pH of sludge.		
Oxide Factor		"Oxide Factor" is used to convert an element to the oxide form; this factor is applied to the elements in the acid and fusion leaches so that the amount of dry solids dissolved with these treatments can be estimated.		
WATER μg/g sludge (element)		Reported μg element (or anion) dissolved with water/g sludge sample. This is an averaged value of the core composite data in the characterization reports. Approximately 1 g sample is contacted with 100 mL water. Column total: the approximate waste mass (dry solids basis) that is removed with water or that might be removed with a dilute caustic wash.		

WATER kg/tank (element)	Estimated elemental mass that might be removed from tank with washing.
WATER % element dissolved	μg element (or anion) in water wash/ μg total element in sludge x 100 (also referred to as "wash factor").
ACID $\mu\text{g/g}$ sludge (element)	Reported μg element dissolved with acid digestion/g sludge. This is an averaged value of the core composites data in the characterization reports. Sample is generally contacted with HNO_3 and boiled; contacted again with HNO_3 followed by HCl (boiling); contacted again with HCl . A 100-mg sample might be contacted with a total of 10 mL acid (5 mL HNO_3 and 5 mL HCl).
ACID kg/tank (element)	Maximum elemental mass that might be removed from tank with rigorous acid treatment.
ACID $\mu\text{g/g}$ sludge (oxide)	Estimated mass of oxide species dissolved with acid/g sludge. Column total: the approximate waste mass (dry solids basis) that is removed with a rigorous acid digestion. In most cases, this would be considered a maximum.
ACID % element dissolved	μg element in acid leach/ μg total element in sludge x 100.
FUSION $\mu\text{g/g}$ sludge (element)	Reported μg element dissolved with a caustic fusion/g sludge. This is an averaged value of the core composites data in the characterization reports. The sample is treated with KOH; fused at very high temperatures to form a "melt"; and dissolved with water.
FUSION kg/tank (element)	Minimum elemental mass that would remain in tank after washing and rigorous acid treatments.
FUSION $\mu\text{g/g}$ sludge (oxide)	Estimated mass of oxide species dissolved with fusion/g sludge. Column total: the approximate residual waste mass (dry solids basis) that would remain after a water wash followed by an acid dissolution treatment sequence.

FUSION $\mu\text{g element in fusion}/\mu\text{g total element in sludge} \times 100$.
% element dissolved

TOTAL
 $\mu\text{g/g sludge}$
(element)

Reported total $\mu\text{g element (or anion)}/\text{g sludge sample}$.
End of column percentage: summation of percent solids dissolved from the water wash, acid leach, and caustic treatment. This figure should be $100 \pm 10\%$. If this figure is less than 90%, chances are that an important element/elements was not analyzed.

Note: Analytical results are usually valid to three significant figures; therefore, calculated values in the worksheets should be considered significant to three figures only.

Characterization Data Summary Worksheets

A-102 (DSSF)

Density (g/mL)	1.590
Volume (L)	140045
Mass (kg)	222672
Solids (ug/g)	648500
~pH	13.1

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL		
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide) % element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide) % element dissolved	ug/g sludge (element)	kg/tank (element)	
Aluminum	1.889	11950.000	2660.9	51.36	NA			11315.000	2519.5	21374.035	48.64	23265.000	5180.5
Barium	1.117	3.085	0.7	0.35	NA			879.000	195.7	981.843	99.65	882.085	196.4
Bismuth	1.115	67.900	15.1	3.91	NA			1670.000	371.9	1862.050	96.09	1737.900	387.0
Boron	3.220	14.200	3.2	100.00	NA			0.000	0.0	0.000	0.00	14.200	3.2
Cadmium	1.142	15.400	3.4	23.75	NA			49.450	11.0	56.472	76.25	64.850	14.4
Calcium	1.399	86.600	19.3	3.34	NA			2505.000	557.8	3504.495	96.66	2591.600	577.1
Chromium	1.462	130.000	28.9	2.24	NA			5665.000	1261.4	8282.230	97.76	5795.000	1290.4
Cobalt	1.407	6.950	1.5	25.14	NA			20.700	4.6	29.125	74.86	27.650	6.2
Copper	1.252	2.320	0.5	2.79	NA			80.800	18.0	101.162	97.21	83.120	18.5
Iron	1.430	5.555	1.2	0.04	NA			13930.000	3101.8	19919.900	99.96	13935.555	3103.1
Lead	1.077	50.000	11.1	4.22	NA			1135.500	252.8	1222.934	95.78	1185.500	264.0
Magnesium	1.658	1.565	0.3	0.11	NA			1380.000	307.3	2288.040	99.89	1381.565	307.6
Manganese	1.582	123.200	27.4	5.73	NA			2027.500	451.5	3207.505	94.27	2150.700	478.9
Nickel	1.409	14.500	3.2	2.76	NA			511.500	113.9	720.704	97.24	526.000	117.1
Phosphate	1.000	13380.000	2979.3	85.15	NA			2334.000	519.7	2334.000	14.85	15714.000	3499.1
Potassium	1.000	2435.000	542.2	86.49	NA			380.500	84.7	380.500	13.51	2815.500	626.9
Silicon	2.139	129.500	28.8	0.78	NA			16400.000	3651.8	35079.600	99.22	16529.500	3680.6
Silver	1.074	6.170	1.4	2.50	NA			241.000	53.7	258.834	97.50	247.170	55.0
Sodium	1.000	172500.000	38410.8	92.22	NA			14545.000	3238.8	14545.000	7.78	187045.000	41649.6
Strontium	1.183	0.386	0.1	0.40	NA			97.200	21.6	114.988	99.60	97.586	21.7
Zinc	1.245	NR	NR		NA			NR	NR	NR		NR	NR
Zirconium	1.351	37.200	8.3	2.58	NA			1402.000	312.2	1894.102	97.42	1439.200	320.5
Uranium	1.202	5.715	1.3	0.06	NA			9535.000	2123.2	11461.070	99.94	9540.715	2124.4
Nitrate	1.000	178500.000	39746.9	≤100.00	NA			NR	NR	NR		178500.000	39746.9
Chloride	1.000	NR	NR		NA			NR	NR	NR		NR	NR
Fluoride	1.000	NR	NR		NA			NR	NR	NR		NR	NR
Hydroxide (1)	1.000	30100.000	6702.4	≤100.00	NA			NR	NR	NR		≥ 30100.000	6702.4
Carbonate	1.000	NR	NR		NA			NR	NR	NR		NR	NR
TOC	2.450	18546.500	1685.6	≤100.00	NA			NR	NR	NR		≥ 7570.000	1685.6
Nitrite	1.000	NR	NR		NA			NR	NR	NR		NR	NR
Sulfate	1.000	NR	NR		NA			NR	NR	NR		NR	NR
Total		428111.746			0.000			129618.587				86.00 % mass balance	
		66.02 %total solids in wash			0.00 %total solids in acid			19.99 %total solids in fusion					
Radionuclides	uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	
Pu-239,240	0.067	14.9	3.33		NA			1.935	430.9	96.87	2.002	445.7	
C-14	0.001	0.3	≤100.00		NA			0.000	0.0	0.00	≥ 0.001	0.3	
Sr-90	0.843	187.6	0.14		NA			603.500	134382.3	99.86	604.343	134569.9	
Tc-99	0.100	22.3	≤100.00		NA			0.000	0.0	0.00	0.100	22.3	
Am-241	0.003	0.6	0.21		NA			1.210	269.3	99.79	1.212	269.9	
Co-60	0.002	0.5	0.29		NA			0.824	183.5	99.71	0.826	184.0	
Cs-137	96.950	21588.0	69.50		NA			42.550	9474.7	30.50	139.500	31062.7	
I-129	0.000039	0.01	≤100.00		NA			NR	NR		≥ 0.000039	0.01	

NOTES:

1. Hydroxide estimated based on Al concentration.

2. TOC on water leach only

3. Nitrate on water leach only, would not account for any nitrate associated with cancrinite

4. Reported value of 3.9e-5 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

A-103 (DSSF)

Density (g/mL)	1.35
Volume (L)	1385310
Mass (kg)	1863242
Solids (ug/g)	598000
-pH	13.3

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	14850.000	27669.1	89.62	NA				1720.000	3204.8	3249.080	10.38	16570.000	30873.9
Barium	1.117	4.305	8.0	0.75	NA				571.000	1063.9	637.807	99.25	575.305	1071.9
Bismuth	1.115	86.200	160.6	48.85	NA				90.250	168.2	100.629	51.15	176.450	328.8
Boron	3.220	22.250	41.5	100.00	NA				0.000	0.0	0.000	0.00	22.250	41.5
Cadmium	1.142	88.950	128.5	76.24	NA				21.490	40.0	24.542	23.76	90.440	168.5
Calcium	1.399	140.500	261.8	8.19	NA				1575.000	2934.6	2203.425	91.81	1715.500	3196.4
Chromium	1.462	45.900	85.5	3.00	NA				1485.000	2766.9	2171.070	97.00	1530.900	2852.4
Cobalt	1.407	0.000	0.0	0.00	NA				1.735	3.2	2.441	100.00	1.735	3.2
Copper	1.252	3.230	6.0	24.30	NA				10.060	18.7	12.595	75.70	13.290	24.8
Iron	1.430	6.340	11.8	1.79	NA				348.500	649.3	498.355	98.21	354.840	661.2
Lead	1.077	258.500	481.6	71.05	NA				105.350	196.3	113.462	28.95	363.850	677.9
Magnesium	1.658	2.905	5.4	0.37	NA				792.500	1476.6	1313.965	99.63	795.405	1482.0
Manganese	1.582	28.450	53.0	22.89	NA				95.850	178.6	151.635	77.11	124.300	231.6
Nickel	1.409	37.000	68.9	39.66	NA				56.300	104.9	79.327	60.34	93.300	173.8
Phosphate	1.000	6390.000	11906.1	98.14	NA				121.050	225.5	121.050	1.86	6511.050	12131.7
Potassium	1.000	2360.000	4397.3	93.15	NA				173.500	323.3	173.500	6.85	2533.500	4720.5
Silicon	2.139	383.000	713.6	3.47	NA				10665.000	19871.5	22812.435	96.53	11048.000	20585.1
Silver	1.074	1.980	3.7	8.01	NA				22.750	42.4	24.434	91.99	24.730	46.1
Sodium	1.000	204000.000	380101.4	97.79	NA				4605.000	8580.2	4605.000	2.21	208605.000	388681.6
Strontium	1.183	0.000	0.0	0.00	NA				11.970	22.3	14.161	100.00	11.970	22.3
Zinc	1.245	0.000	0.0	0.00	NA				15.705	29.3	19.553	100.00	15.705	29.3
Zirconium	1.351	13.800	25.7	6.61	NA				195.000	363.3	263.445	93.39	208.800	389.0
Uranium	1.202	9.680	18.0	0.67	NA				1425.000	2655.1	1712.850	99.33	1434.680	2673.2
Nitrate	1.000	113500.000	211478.0	≤100.00	NA				NR	NR			113500.000	211478.0
Chloride	1.000	NR	NR		NA				NR	NR			NR	NR
Fluoride	1.000	NR	NR		NA				NR	NR			NR	NR
Hydroxide (3)	1.000	37400.000	69685.2	≤100.00	NA				NR	NR			≥37400.000	69685.2
Carbonate	1.000	NR	NR		NA				NR	NR			NR	NR
TOC	2.450	14839.970	11285.9	≤100.00	NA				NR	NR			≥6057.131	11285.9
Nitrite	1.000	NR	NR		NA				NR	NR			NR	NR
Sulfate	1.000	NR	NR		NA				NR	NR			NR	NR
Total		394452.960			0.000				40304.759				72.70 % mass balance	
		65.96 %total solids in wash			0 %total solids in acid				6.74 %total solids in fusion					
Radionuclides	uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank
Pu-239,240	0.046	84.8	35.00		NA				0.085	157.4	65.00		0.130	242.2
C-14	0.003	5.6	≤100.00		NA				0.000	0.0			≥ 0.003	5.6
Sr-90	1.790	3335.2	1.87		NA				93.800	174772.1	98.13		95.590	178107.3
Tc-99	0.117	218.0	≤100.00		NA				0.000	0.0			≥ 0.117	218.0
Am-241	0.034	63.4	27.09		NA				0.092	170.5	72.91		0.126	233.8
Co-60	0.034	62.4	30.88		NA				0.075	139.7	69.12		0.109	202.2
Cs-137	199.500	371716.8	99.08		NA				1.850	3447.0	0.92		201.350	375163.8
I-129	0.000019	0.04	≤100.00		NA				NR	NR			≥ 0.000019	0.04

NOTES:

1. Nitrate on water leach only, would not account for any nitrate associated with cancrinite
2. TOC on water leach only
3. Hydroxide estimated based on Al concentration.
4. Reported value of 1.9e-5 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

A-106 (CC, NC, EB, B-Plant)

Density (g/mL)	1.55
Volume (L)	473125
Mass (kg)	733344
Solids (ug/g)	559500
-pH	12.0

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL		
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	
Aluminum	1.889	10310.000	7560.8	45.24	NA			12480.000	9152.1	23574.720	54.76	22790.000	16712.9
Barium	1.117	2.260	1.7	0.11	NA			2150.000	1576.7	2401.550	99.89	2152.260	1578.3
Bismuth	1.115	49.650	36.4	21.34	NA			183.000	134.2	204.045	78.66	232.650	170.6
Boron	3.220	18.800	13.8	100.00	NA			0.000	0.0	0.000	0.00	18.800	13.8
Cadmium	1.142	11.250	8.3	29.22	NA			27.250	20.0	31.120	70.78	38.500	28.2
Calcium	1.399	64.350	47.2	1.22	NA			5205.000	3817.1	7281.795	98.78	5269.350	3864.2
Chromium	1.462	413.000	302.9	8.18	NA			4650.000	3410.0	6798.300	91.84	5063.000	3712.9
Cobalt	1.407	4.060	3.0	30.10	NA			9.430	6.9	13.268	69.90	13.490	9.9
Copper	1.252	4.350	3.2	5.20	NA			79.300	58.2	99.284	94.80	83.650	61.3
Iron	1.430	4.060	3.0	0.02	NA			26350.000	19323.6	37680.500	99.98	26354.060	19326.6
Lead	1.077	36.550	26.8	3.39	NA			1042.500	764.5	1122.773	96.61	1079.050	791.3
Magnesium	1.658	0.607	0.4	0.02	NA			2835.000	2079.0	4700.430	99.98	2835.607	2079.5
Manganese	1.582	90.250	66.2	6.00	NA			1413.500	1036.6	2236.157	94.00	1503.750	1102.8
Nickel	1.409	12.250	9.0	1.96	NA			612.000	448.8	862.308	98.04	624.250	457.8
Phosphate	1.000	49800.000	36520.5	94.78	NA			2743.500	2011.9	2743.500	5.22	52543.500	38532.4
Potassium	1.000	1695.000	1243.0	75.45	NA			551.500	404.4	551.500	24.55	2246.500	1647.5
Silicon	2.139	76.050	55.8	0.20	NA			38300.000	28087.1	81923.700	99.80	38376.050	28142.8
Silver	1.074	4.515	3.3	1.60	NA			277.500	203.5	298.035	98.40	282.015	206.8
Sodium	1.000	102150.000	74911.1	83.87	NA			19650.000	14410.2	19650.000	16.13	121800.000	89321.3
Strontium	1.183	0.449	0.3	0.86	NA			52.000	38.1	61.516	99.14	52.449	38.5
Zinc	1.245	1.850	1.4	100.00	NA			0.000	0.0	0.000	0.00	1.850	1.4
Zirconium	1.351	20.800	15.3	1.70	NA			1204.000	882.9	1626.604	98.30	1224.800	898.2
Uranium	1.202	8.885	6.5	1.11	NA			793.000	581.5	953.186	98.89	801.885	588.1
Nitrate	1.000	78100.000	57274.1	<100.00	NA			NR	NR			> 78100.000	57274.1
Chloride	1.000	NR	NR		NA			NR	NR			NR	NR
Fluoride	1.000	NR	NR		NA			NR	NR			NR	NR
Hydroxide (2)	1.000	26000.000	19066.9	<100.00	NA			NR	NR			> 26000.000	19066.9
Carbonate	1.000	NR	NR		NA			NR	NR			NR	NR
TOC	2.450	15263.500	4568.7	<100.00	NA			NR	NR			> 6230.000	4568.7
Nitrite	1.000	NR	NR		NA			NR	NR			NR	NR
Sulfate	1.000	NR	NR		NA			NR	NR			NR	NR
Total		284142.486			0.000			194814.290				85.60 % mass balance	
		50.79 %total solids in wash			0.00 %total solids in acid			34.82 %total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	
Pu-239,240		0.074	53.9	3.73	NA			1.895	1389.7	96.27	1.969	1443.6	
C-14		0.001	0.7	<100.00	NA			NR	NR		> 0.001	0.7	
Sr-90		3.540	2596.0	0.31	NA			1135.500	832711.8	99.69	1139.040	835307.9	
Tc-99		0.112	82.1	<100.00	NA						> 0.112	82.1	
Am-241		0.004	2.6	0.43	NA			0.817	599.1	99.57	0.821	601.7	
Co-60		0.004	2.9	0.57	NA			0.700	513.3	99.43	0.704	516.3	
Cs-137		104.750	76817.8	71.09	NA			42.600	31240.4	28.91	147.350	108058.2	
I-129		0.000	0.1	<100.00	NA						> 0.00014	0.1	

NOTES:

1. Nitrate on water leach only, would not account for any nitrate associated with cancrinite

2. Hydroxide estimated based on Al concentration.

3. TOC on water leach only

4. Reported value of 1.4e-4 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

B-110 (BiPO₄ 2C, 5-6)

Density (g/mL)	1.35
Volume (L)	927325
Mass (kg)	1251889
Solids (ug/g)	430000
~pH	10

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	<DL			1226.000	1534.8	2315.914	100.00	0.000	0.0	0.000	0.00	1226.000	1534.8
Barium	1.117	<DL			20.250	25.4	22.619	82.23	4.375	5.5	4.887	17.77	24.625	30.8
Bismuth	1.115	42.750	53.5	0.21	19921.500	24939.5	22212.473	99.01	157.250	196.9	175.334	0.78	20121.500	25189.9
Boron	3.220	3.750	4.7	10.87	30.750	38.5	99.015	89.13	0.000	0.0	0.000	0.00	34.500	43.2
Cadmium	1.142	6.250	7.8	20.83	2.500	3.1	2.855	8.33	21.250	28.6	24.268	70.83	30.000	37.6
Calcium	1.399	33.250	41.6	3.44	803.500	1005.9	1124.097	83.09	130.250	163.1	182.220	13.47	967.000	1210.6
Chromium	1.462	70.500	88.3	7.25	896.000	1121.7	1309.952	92.18	5.500	6.9	8.041	0.57	972.000	1216.8
Cobalt	1.407	<DL			<DL	0.0	0.000	ERR	<DL				<DL	
Copper	1.252	28.000	35.1	47.26	17.500	21.9	21.910	29.54	13.750	17.2	17.215	23.21	59.250	74.2
Iron	1.430	118.750	148.7	0.61	19084.000	23891.0	27290.120	98.80	112.750	141.2	161.233	0.58	19315.500	24180.9
Lead	1.077	<DL			649.250	812.8	699.242	98.80	7.875	9.9	8.481	1.20	657.125	822.6
Magnesium	1.658	3.750	4.7	1.96	175.250	219.4	290.565	91.63	12.250	15.3	20.311	6.41	191.250	239.4
Manganese	1.582	<DL			70.750	88.6	111.927	78.39	19.500	24.4	30.849	21.61	90.250	113.0
Nickel	1.409	<DL			88.500	110.8	124.697	100.00	NA				88.500	110.8
Phosphate	1.000	23460.000	29369.3	44.90	26961.750	33753.1	26961.750	51.60	1833.000	2294.7	1833.000	3.51	52254.750	65417.1
Potassium	1.000	309.250	387.1	66.22	157.750	197.5	157.750	33.78	NA				467.000	584.6
Silicon	2.139	376.500	471.3	3.82	312.750	391.5	668.972	3.17	9165.500	11474.2	19605.005	93.01	9854.750	12337.1
Silver	1.074	7.750	9.7	8.93	35.250	44.1	37.859	40.63	43.750	54.8	46.988	50.43	86.750	108.6
Sodium	1.000	90836.500	113717.2	90.71	9062.750	11345.6	9062.750	9.05	242.250	303.3	242.250	0.24	100141.500	125366.0
Strontium	1.183	<DL			216.750	271.3	256.415	100.00	0.000	0.0	0.000	0.00	216.750	271.3
Zinc	1.245	22.500	28.2	4.47	65.750	82.3	81.859	13.07	415.000	519.5	516.675	82.46	503.250	630.0
Zirconium	1.351	<DL			3.500	4.4	4.729	100.00	<DL				3.500	4.4
Uranium	1.202	<DL			404.000	505.8	485.608	100.00	NR	NR	NR		404.000	505.8
Nitrate	1.000	181125.000	226748.3	≤100.00	NR	NR	NR	NR	NR	NR	NR		≥181125.000	226748.3
Chloride	1.000	1152.500	1442.8	≤100.00	NR	NR	NR	NR	NR	NR	NR		≥1152.500	1442.8
Fluoride	1.000	1781.250	2229.9	≤100.00	NR	NR	NR	NR	NR	NR	NR		≥1781.250	2229.9
Free OH	1.000	NR	NR		NR	NR	NR	NR	NR	NR	NR		NR	
Carbonate	1.000	5054.250	6327.4	≤100.00	NR	NR	NR	NR	NR	NR	NR		≥ 5054.250	6327.4
TOC	2.450	918.750	469.5	≤100.00	NR	NR	NR	NR	NR	NR	NR		≥ 375.000	469.5
Nitrite	1.000	10429.500	13056.6	≤100.00	NR	NR	NR	NR	NR	NR	NR		≥10429.500	13056.6
Sulfate	1.000	11250.000	14083.7	≤100.00	NR	NR	NR	NR	NR	NR	NR		≥11250.000	14083.7
Total		327030.750			93343.075				22876.754				103.08 % mass balance	
		76.05 %total solids in wash			21.71 %total solids in acid				5.32 %total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank
Pu-239,240		0.002	1.9	1.30	NA				0.114	142.7	98.70		0.116	144.6
C-14		0.002	2.5	≤100.00	NA				NR	NR			≥ 0.002	2.5
Sr-90		0.170	212.2	0.10	NA				168.333	210734.6	99.90		168.503	210946.8
Tc-99		0.019	23.8	93.44	NA				0.001	1.7	6.56		0.020	25.5
Am-241		0.003	3.6	3.48	NA				0.079	98.9	96.52		0.082	102.5
Co-60		0.000	0.5	≤100.00	NA				NR	NR			≥ 0.000	0.5
Cs-137		8.589	10752.2	56.93	NA				6.498	8134.1	43.07		15.086	18886.3
I-129		<1e-6	<0.001		NA				0.000016	<0.02			<0.000016	<0.02

NOTES:

1. Iodine value less than

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

B-111 (B1P04 2C, 5-6)

Density (g/mL) 1.25
 Volume (L) 893260
 Mass (kg) 1116575
 Solids (ug/g) 363000
 ~pH 11

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	<DL			892.250	996.3	1685.460	65.57	468.500	523.1	884.997	34.43	1360.750	1519.4
Barium	1.117	<DL			28.375	31.7	31.695	67.16	13.875	15.5	15.498	32.84	42.250	47.2
Bismuth	1.115	48.050	53.7	0.24	19553.450	21832.9	21802.097	96.84	589.125	657.8	656.874	2.92	20190.625	22544.3
Boron	3.220	14.500	16.2	21.21	38.000	42.4	122.360	55.58	15.875	17.7	51.118	23.22	68.375	76.3
Cadmium	1.142	<DL	0.0	0.00	<DL	0.0	0.000	0.00	20.000	22.3	22.840	100.00	20.000	22.3
Calcium	1.399	9.000	10.0	1.32	673.750	752.3	942.576	98.68	0.000	0.0	0.000	0.00	682.750	762.3
Chromium	1.462	266.500	297.6	23.26	835.000	932.3	1220.770	72.88	44.250	49.4	64.694	3.86	1145.750	1279.3
Cobalt	1.407	<DL			3.000	3.3	4.221	18.75	13.000	14.5	18.291	81.25	16.000	17.9
Copper	1.252	4.250	4.7	1.92	196.250	219.1	245.705	88.80	20.500	22.9	25.666	9.28	221.000	246.8
Iron	1.430	81.500	91.0	0.50	16278.500	18176.2	23278.255	99.50	0.000	0.0	0.000	0.00	16360.000	18267.2
Lead	1.077	<DL			1541.750	1721.5	1660.465	83.50	304.750	340.3	328.216	16.50	1846.500	2061.8
Magnesium	1.658	<DL			195.750	218.6	324.554	26.53	542.000	605.2	898.636	73.47	737.750	823.8
Manganese	1.582	<DL			79.125	88.3	125.176	71.44	31.825	35.3	50.031	28.56	110.750	123.7
Nickel	1.409	<DL			18.625	20.8	26.243	100.00	NA				18.625	20.8
Phosphate	1.000	22557.750	25187.4	49.49	23020.125	25703.7	23020.125	50.51	0.000	0.0	0.000	0.00	45577.875	50891.1
Potassium	1.000	613.250	684.7	100.00	0.000	0.0	0.000	0.00	NA				613.250	684.7
Silicon	2.139	654.000	730.2	6.78	0.000	0.0	0.000	0.00	8985.625	10033.1	19220.252	93.22	9639.625	10763.4
Silver	1.074	<DL			5.000	5.6	5.370	5.13	92.375	103.1	99.211	94.87	97.375	108.7
Sodium	1.000	80367.750	89736.6	91.90	7085.625	7911.6	7085.625	8.10	0.000	0.0	0.000	0.00	87453.375	97648.3
Strontium	1.183	1.000	1.1	0.45	216.250	241.5	255.824	97.80	3.875	4.3	4.584	1.75	221.125	246.9
Zinc	1.245	<DL			110.375	123.2	137.417	63.80	62.625	69.9	77.968	36.20	173.000	193.2
Zirconium	1.351	<DL			13.875	15.5	18.745	67.68	6.625	7.4	8.950	32.32	20.500	22.9
Uranium	1.202	194.600	217.3	86.54	30.275	33.8	36.391	13.46	<DL				224.875	251.1
Nitrate	1.000	82000.000	91559.2	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	82000.000	91559.2
Chloride	1.000	1025.000	1144.5	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	1025.000	1144.5
Fluoride	1.000	1562.500	1744.6	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	1562.500	1744.6
Free OH	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Carbonate	1.000	22318.750	24920.6	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	22318.750	24920.6
TOC	2.450	2143.750	977.0	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	875.000	977.0
Nitrite	1.000	45000.000	50245.9	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	45000.000	50245.9
Sulfate	1.000	11587.500	12938.3	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	11587.500	12938.3
Total		270449.650			82029.072				22427.825				103.28 % mass balance	
		74.50 %total solids in wash			22.60 %total solids in acid				6.18 %total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	uCi/g	Ci/tank
Pu-239,240		NR	NR	NA				0.097	108.6	≤100.00	0.097	108.6		
C-14		0.008	9.2	≤100.00	NA			NR	0.0	0.00	≥ 0.008	9.2		
Sr-90		NR	NR	NA				496.000	553821.2	≤100.00	496.000	553821.2		
Tc-99		NR	NR	NA				0.114	127.1	≤100.00	0.114	127.1		
Am-241		NR	NR	NA				0.085	94.5	≤100.00	0.085	94.5		
Co-60		NR	NR	NA				0.004	4.5	≤100.00	0.004	4.5		
Cs-137		NR	NR	NA				158.250	176698.0	≤100.00	158.250	176698.0		
I-129		NR	NR	NA				NR	NR	0.000	0.000	0.0		

NOTES:

1. Radionuclide analyses on fused sample only, with exception of C-14
2. Co-60 less than value

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

B-201 (BIP04 224)

Density (g/mL)	1.25
Volume (L)	105980
Mass (kg)	132475
Solids (ug/g)	396000
pH	11.000

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	50.300	6.7	1.04	3970.000	525.9	7499.330	81.78	834.000	110.5	1575.426	17.18	4854.300	643.1
Barium	1.117	0.920	0.1	0.23	75.300	10.0	84.110	19.00	320.000	42.4	357.440	80.76	396.220	52.5
Bismuth	1.115	12.400	1.6	0.01	103400.000	13697.9	115291.000	99.99	0.000	0.0	0.000	0.00	103412.400	13699.6
Boron	3.220	4.860	0.6	7.48	60.100	8.0	193.522	92.52	0.000	0.0	0.000	0.00	64.960	8.6
Cadmium	1.142	0.480	0.1	1.17	2.520	0.3	2.878	6.38	36.500	4.8	41.683	92.45	39.480	5.2
Calcium	1.399	38.700	5.1	0.28	13730.000	1818.9	19208.270	99.72	0.000	0.0	0.000	0.00	13768.700	1824.0
Chromium	1.462	858.000	113.7	25.63	1870.000	247.7	2733.940	55.85	620.000	82.1	906.440	18.52	3348.000	443.5
Cobalt	1.407	0.920	0.1	1.35	6.380	0.8	8.977	9.35	60.900	8.1	85.686	89.30	68.200	9.0
Copper	1.252	0.480	0.1	0.39	55.000	7.3	68.860	46.27	63.400	8.4	79.377	53.34	118.860	15.7
Iron	1.430	5.930	0.8	0.04	15100.000	2000.4	21593.000	99.96	0.000	0.0	0.000	0.00	15105.930	2001.2
Lead	1.077	5.520	0.7	0.37	1080.000	143.1	1163.160	71.50	425.000	56.3	457.725	28.14	1510.520	200.1
Magnesium	1.658	12.900	1.7	0.38	1700.000	225.2	2818.600	49.81	1700.000	225.2	2818.600	49.81	3412.900	452.1
Manganese	1.582	3.450	0.5	0.01	18380.000	2434.9	29077.160	79.62	4700.000	622.6	7435.400	20.36	23083.450	3058.0
Nickel	1.409	3.070	0.4	0.41	746.000	98.8	1051.114	99.59	NA				749.070	99.2
Phosphate	1.000	1287.000	170.5	7.08	16890.000	2237.5	16890.000	92.92	0.000	0.0	0.000	0.00	18177.000	2408.0
Potassium	1.000	4550.000	602.8	75.96	1440.000	190.8	1440.000	24.04	NA				5990.000	793.5
Silicon	2.139	662.000	87.7	2.72	1870.000	247.7	3999.930	7.69	21790.000	2886.6	46608.810	89.59	24322.000	3222.1
Silver	1.074	0.920	0.1	1.54	7.630	1.0	8.195	12.81	51.000	6.8	54.774	85.64	59.550	7.9
Sodium	1.000	30660.000	4061.7	73.83	7890.000	1045.2	7890.000	19.00	2980.000	394.8	2980.000	7.18	41530.000	5501.7
Strontium	1.183	0.885	0.1	0.10	929.000	123.1	1099.007	99.90	0.000	0.0	0.000	0.00	929.885	123.2
Zinc	1.245	1.840	0.2	0.66	214.000	28.3	266.430	77.11	61.700	8.2	76.817	22.23	277.540	36.8
Zirconium	1.351	0.920	0.1	1.48	7.630	1.0	10.308	12.24	53.800	7.1	72.684	86.29	62.350	8.3
Uranium	1.202	92.000	12.2	14.42	546.000	72.3	656.292	85.58	0.000	0.0	0.000	0.00	638.000	84.5
Nitrate	1.000	50500.000	6690.0	<100.00	NR	NR	NR		NR	NR	NR		50500.000	6690.0
Chloride	1.000	1675.000	221.9	<100.00	NR	NR	NR		NR	NR	NR		≥ 1675.000	221.9
Fluoride	1.000	6000.000	794.9	<100.00	NR	NR	NR		NR	NR	NR		≥ 6000.000	794.9
Lanthanum	1.430	21.200	2.8	0.14	15380.000	2037.5	21993.400	99.86	0.000	0.0	0.000	0.00	15401.200	2040.3
Carbonate	1.000	10460.000	1385.7	65.09	5610.000	743.2	5610.000	34.91	NR	NR	NR		16070.000	2128.9
TOC	2.450	1675.800	90.6	28.93	1680.000	222.6	4116.000	71.07	NR	NR	NR		2364.000	313.2
Nitrite	1.000	881.000	116.7	≤100.00	NR	NR	NR		NR	NR	NR		≥ 881.000	116.7
Sulfate	1.000	347.000	46.0	≤100.00	NR	NR	NR		NR	NR	NR		≥ 347.000	46.0
Total		109813.455			264773.482				63550.861					
		27.73 %total solids in wash			66.86 %total solids in acid				16.05 %total solids in fusion				110.64 % mass balance	
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank
Pu-239,240		NR	NR		NA				0.794	105.2	≤100.00		0.794	105.2
C-14		0.001	0.1	≤100.00	NA				NR	NR			≥ 0.001	0.1
Sr-90		NR	NR		NA				2.271	300.9	≤100.00		2.271	300.9
Tc-99		NR	NR		NA				0.002	0.3	≤100.00		0.002	0.3
Am-241		<DL			NA				0.036	4.8	≤100.00		0.036	4.8
Co-60		<DL			NA				0.030	4.0	≤100.00		0.030	4.0
Cs-137		0.047	6.2	5.24	NA				0.850	112.6	94.76		0.897	118.8
I-129		NR	NR		NA				NR	NR			NR	NR

NOTES:

1. Nitrate on water leach only, would not account for any nitrate associated with cancrinite
2. Total solids for Core 26 were measured as 36.3% and 37.1% in one lab and then 41.8% and 42.0% in another lab. This suggests that samples may have dried before some analyses. This would result in artificially high concentrations.

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

BX-104 (TBP, CW)

Density (g/mL)	1.81
Volume (L)	363360
Mass (kg)	655865
Solids (ug/g)	562500
~pH	11.000

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	1195.000	783.8	2.52	NA				46200.000	30301.0	87271.800	97.48	47395.000	31084.7
Barium	1.117	0.982	0.6	0.06	NA				1645.000	1078.9	1837.465	99.94	1645.982	1079.5
Bismuth	1.115	11.500	7.5	0.82	NA				1390.000	911.7	1549.850	99.18	1401.500	919.2
Boron	3.220	5.680	3.7	50.13	NA				5.650	3.7	18.193	49.87	11.330	7.4
Cadmium	1.142	2.620	1.7	10.62	NA				22.050	14.5	25.181	89.38	24.670	16.2
Calcium	1.399	60.050	39.4	1.24	NA				4785.000	3138.3	6694.215	98.76	4845.050	3177.7
Chromium	1.462	592.000	388.3	15.63	NA				3195.000	2095.5	4671.090	84.37	3787.000	2483.8
Cobalt	1.407	0.000	0.0	0.00	NA				11.755	7.7	16.539	100.00	11.755	7.7
Copper	1.252	7.995	5.2	8.36	NA				87.800	57.5	109.675	91.64	95.595	82.7
Iron	1.430	1.165	0.8	0.02	NA				7160.000	4696.0	10238.800	99.98	7161.165	4696.8
Lead	1.077	10.440	6.8	1.82	NA				562.000	368.6	605.274	98.18	572.440	375.4
Magnesium	1.658	1.023	0.7	0.04	NA				2470.000	1620.0	4095.260	99.96	2471.023	1620.7
Manganese	1.582	20.900	13.7	2.13	NA				960.000	629.6	1518.720	97.87	980.900	643.3
Nickel	1.409	16.800	11.0	10.83	NA				138.350	90.7	194.935	89.17	155.150	101.8
Phosphate	1.000	9585.000	6286.5	83.58	NA				1882.500	1234.7	1882.500	16.42	11467.500	7521.1
Potassium	1.000	501.500	328.9	47.51	NA				554.000	363.3	554.000	52.49	1055.500	692.3
Silicon	2.139	131.000	85.9	0.40	NA				32250.000	21151.6	68982.750	99.60	32381.000	21237.6
Silver	1.074	1.050	0.7	1.17	NA				88.400	58.0	94.942	98.83	89.450	58.7
Sodium	1.000	49250.000	32301.3	71.74	NA				19400.000	12723.8	19400.000	28.26	68650.000	45025.1
Strontium	1.183	0.056	0.0	0.09	NA				61.800	40.5	73.109	99.91	61.856	40.6
Zinc	1.245	0.000	0.0	0.00	NA				111.500	73.1	138.818	100.00	111.500	73.1
Zirconium	1.351	4.815	3.2	0.39	NA				1245.000	816.6	1681.995	99.61	1249.815	819.7
Uranium	1.202	3.315	2.2	0.01	NA				24400.000	16003.1	29328.800	99.99	24403.315	16005.3
Nitrate	1.000	38450.000	25218.0	≤100.00	NA				NR	NR	NR	NR	38450.000	25218.0
Chloride	1.000	NR	NR		NA				NR	NR	NR	NR	NR	NR
Fluoride	1.000	NR	NR		NA				NR	NR	NR	NR	NR	NR
Hydroxide (2)	1.000	2871.000	1883.0	≤100.00	NA				NR	NR	NR	NR	≥ 2871.000	1883.0
Carbonate	1.000	NR	NR		NA				NR	NR	NR	NR	NR	NR
TOC	2.450	5500.250	1472.4	≤100.00	NA				NR	NR	NR	NR	≥ 2245.000	1472.4
Nitrite	1.000	NR	NR		NA				NR	NR	NR	NR	NR	NR
Sulfate	1.000	NR	NR		NA				NR	NR	NR	NR	NR	NR
Total		108224.141			0.000				240983.911				62.08 % mass balance	
		19.24 %total solids in wash			0.00 %total solids in acid				42.84 %total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		0.002	1.0	0.41	NA			0.364	238.7	99.59	0.366	239.7		
C-14		0.001	0.3	≤100.00	NA			NR	NR	NR	≥ 0.001	0.3		
Sr-90		0.280	183.3	0.11	NA			264.500	173476.2	99.89	264.780	173659.6		
Tc-99		0.033	21.6	≤100.00	NA			NR	NR	NR	≥ 0.033	21.6		
Am-241		0.004	2.6	0.63	NA			0.628	411.6	99.37	0.632	414.2		
Co-60		0.022	14.1	31.39	NA			0.047	30.8	68.61	0.069	44.9		
Cs-137		61.750	40499.7	63.24	NA			35.900	23545.5	36.76	97.650	64045.2		
I-129		0.0000435	0.03	≤100.00	NA			NR	NR	NR	≥ 0.0000435	0.03		

NOTES:

1. Nitrate analysis on water leach only; would not account for nitrate associated with cancrinite
2. OH estimated based on aluminum concentration in wash.
3. TOC on water leach only
4. Reported value of 4.3e-5 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

BX-105 (TBP, CW with 57t of Portland Cement)

Density (g/mL)	1.69
Volume (L)	174110
Mass (kg)	293375
Solids (ug/g)	430000
~pH	12.0

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	1430.000	419.5	4.22	NA				32450.000	9520.0	61298.050	95.78	33880.000	9939.6
Barium	1.117	2.040	0.6	0.06	NA				3195.000	937.3	3568.815	99.94	3197.040	937.9
Bismuth	1.115	14.200	4.2	1.83	NA				762.000	223.6	849.630	98.17	776.200	227.7
Boron	3.220	5.305	1.6	100.00	NA				0.000	0.0	0.000	0.00	5.305	1.6
Cadmium	1.142	3.220	0.9	7.27	NA				41.050	12.0	46.879	92.73	44.270	13.0
Calcium	1.399	87.600	25.7	1.41	NA				6125.000	1796.9	8568.875	98.59	6212.600	1822.6
Chromium	1.462	151.500	44.4	1.75	NA				8495.000	2492.2	12419.690	98.25	8646.500	2536.7
Cobalt	1.407	0.570	0.2	100.00	NA				NR	0.0	0.000	0.00	0.570	0.2
Copper	1.252	2.800	0.8	10.28	NA				24.500	7.2	30.674	89.74	27.300	8.0
Iron	1.430	2.210	0.6	0.04	NA				6250.000	1833.6	8937.500	99.96	6252.210	1834.2
Lead	1.077	42.500	12.5	7.54	NA				521.000	152.8	561.117	92.46	563.500	165.3
Magnesium	1.658	3.980	1.2	0.12	NA				3250.000	953.5	5388.500	99.88	3253.980	954.6
Manganese	1.582	25.750	7.6	1.72	NA				1468.000	430.7	2322.376	98.28	1493.750	438.2
Nickel	1.409	26.150	7.7	17.80	NA				120.800	35.4	170.207	82.20	146.950	43.1
Phosphate	1.000	46170.000	13545.1	77.27	NA				13578.000	3983.5	13578.000	22.73	59748.000	17528.6
Potassium	1.000	785.500	230.4	54.57	NA				654.000	191.9	654.000	45.43	1439.500	422.3
Silicon	2.139	716.000	210.1	1.73	NA				40750.000	11955.0	87164.250	98.27	41466.000	12185.1
Silver	1.074	1.290	0.4	5.00	NA				24.500	7.2	26.313	95.00	25.790	7.6
Sodium	1.000	79300.000	23264.7	72.06	NA				30750.000	9021.3	30750.000	27.94	110050.000	32286.0
Strontium	1.183	0.714	0.2	1.27	NA				55.500	16.3	65.657	98.73	56.214	16.5
Zinc	1.245	0.000	0.0	0.00	NA				142.650	41.8	177.599	100.00	142.650	41.8
Zirconium	1.351	5.925	1.7	1.77	NA				329.000	96.5	444.479	98.23	334.925	98.3
Uranium	1.202	2.590	0.8	0.06	NA				4405.000	1292.3	5294.810	99.94	4407.590	1293.1
Nitrate	1.000	33250.000	9754.7	≤100.00	NA				NR	NR			≥ 33250.000	9754.7
Chloride	1.000	NR	NR	NR	NA				NR	NR			NR	NR
Fluoride	1.000	NR	NR	NR	NA				NR	NR			NR	NR
Hydroxide	1.000	3600.000	1056.2	≤100.00	NA				NR	NR			≥ 3600.000	1056.2
Carbonate	1.000	NR	NR	NR	NA				NR	NR			NR	NR
TOC	2.450	6811.000	815.6	≤100.00	NA				NR	NR			≥ 2780.000	815.6
Nitrite	1.000	NR	NR	NR	NA				NR	NR			NR	NR
Sulfate	1.000	NR	NR	NR	NA				NR	NR			NR	NR
Total		172440.844			0.000					242317.421			96.46 % mass balance	
		40.10 %total solids in wash			0.00 %total solids in acid					56.35 %total solids in fusion				
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		0.011	3.2	3.94	NA			0.269	78.8	96.06	0.280	82.0		
C-14		0.001	0.3	≤100.00	NA			NR	NR		≥ 0.001	0.3		
Sr-90		2.380	698.2	1.75	NA			134.000	39312.3	98.25	136.380	40010.5		
Tc-99		0.034	9.8	≤100.00	NA			NR	NR		≥ 0.034	9.8		
Am-241		0.012	3.5	1.21	NA			0.982	287.9	98.79	0.994	291.5		
Co-60		0.040	11.6	25.16	NA			0.118	34.5	74.84	0.157	46.1		
Cs-137		45.100	13231.2	83.39	NA			8.980	2634.5	16.61	54.080	15865.7		
I-129		0.00003	0.01	≤100.00	NA			NR	NR		≥ 0.00003	0.01		

NOTES:

1. Nitrate on water leach only, would not account for any nitrate associated with cancrinite
2. Hydroxide based on aluminum concentration in wash
3. Reported value of 3.0e-5 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

BX-107 (BiPO4 1C, TBP)

Density (g/mL)	1.20
Volume (L)	1302040
Mass (kg)	1562448
Solids (ug/g)	432600
~pH	9.7

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum (1)	1.889	134.000	209.4	0.94	14131.000	22079.0	39425.490	98.65	60.000	93.7	113.340	0.42	14325.000	22382.1
Barium	1.117	0.442	0.7	4.84	7.743	12.1	8.649	84.76	0.950	1.5	1.061	10.40	9.135	14.3
Bismuth	1.115	233.550	364.9	0.97	23916.450	37368.2	26666.842	99.03	0.000	0.0	0.000	0.00	24150.000	37733.1
Boron	3.220	25.025	39.1	53.19	22.025	34.4	70.921	46.81	0.000	0.0	0.000	0.00	47.050	73.5
Cadmium	1.142	0.713	1.1	16.96	1.560	2.4	1.782	37.14	1.927	3.0	2.201	45.89	4.200	6.6
Calcium	1.399	433.500	677.3	41.75	604.750	944.9	846.045	58.25	0.000	0.0	0.000	0.00	1038.250	1622.2
Chromium	1.462	151.250	236.3	15.62	806.500	1260.1	1179.103	83.29	10.500	16.4	15.351	1.08	968.250	1512.8
Cobalt	1.407	1.088	1.7	15.66	0.673	1.1	0.947	9.69	5.182	8.1	7.291	74.65	6.943	10.8
Copper	1.252	0.746	1.2	1.44	41.979	65.6	52.558	81.28	8.925	13.9	11.174	17.28	51.850	80.7
Iron	1.430	118.275	184.8	1.07	10901.725	17033.4	15589.467	98.50	47.500	74.2	67.925	0.43	11067.500	17292.4
Lead	1.077	7.723	12.1	10.37	55.078	86.1	59.318	73.95	11.675	18.2	12.574	15.68	74.475	116.4
Magnesium	1.658	16.455	25.7	10.38	142.045	221.9	235.511	89.62	0.000	0.0	0.000	0.00	158.500	247.6
Manganese	1.582	0.984	1.5	1.52	38.766	60.6	61.328	60.06	24.800	38.7	39.234	38.42	64.550	100.9
Nickel	1.409	1.528	2.4	12.49	10.698	16.7	15.073	87.51	NA				12.225	19.1
Phosphate	1.000	14370.000	22452.4	20.40	54705.000	85473.7	54705.000	77.68	1350.000	2109.3	1350.000	1.92	70425.000	110035.4
Potassium	1.000	147.500	230.5	56.14	115.250	180.1	115.250	43.86	NA				262.750	410.5
Silicon	2.139	294.000	459.4	4.33	1371.000	2142.1	2932.569	20.21	5117.500	7995.8	10946.333	75.45	6782.500	10597.3
Silver	1.074	1.020	1.6	17.17	0.000	0.0	0.000	0.00	4.920	7.7	5.284	82.83	5.940	9.3
Sodium	1.000	68100.000	106402.7	67.26	33150.000	51795.2	33150.000	32.74	0.000	0.0	0.000	0.00	101250.000	158197.9
Strontium	1.183	2.455	3.8	1.46	164.045	256.3	194.065	97.36	2.000	3.1	2.366	1.19	168.500	263.3
Zinc	1.245	14.268	22.3	17.11	45.258	70.7	56.346	54.27	23.875	37.3	29.724	28.63	83.400	130.3
Zirconium	1.351	2.488	3.9	1.84	93.688	146.4	126.572	69.12	39.375	61.5	53.196	29.05	135.550	211.8
Uranium (2)	1.202	NR	NR		2267.500	3542.9	2725.535	100.00	>0	>0			2267.500	3542.9
Nitrate	1.000	137500.000	214836.6	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥137500.000	214836.6
Chloride	1.000	1145.000	1789.0	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥1145.000	1789.0
Fluoride	1.000	9078.250	14184.3	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 9078.250	14184.3
Free OH	1.000	NR	NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Carbonate	1.000	5800.000	9062.2	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 5800.000	9062.2
TOC	2.450	1956.325	1247.6	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 798.500	1247.6
Nitrite	1.000	8135.000	12710.5	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 8135.000	12710.5
Sulfate	1.000	13400.000	20936.8	97.85	295.000	460.9	295.000	2.15	0.000	0.0	0.000	0.00	13695.000	21397.7
Total		261071.582			178513.368				12657.054					
		60.35 %total solids in wash			41.27 %total solids in acid				2.93 %total solids in fusion					104.54 % mass balance
Radionuclides		uCi/g	Cl/tank	% dissolved	uCi/g	Cl/tank	% dissolved	uCi/g	Cl/tank	% dissolved	uCi/g	Cl/tank		
Pu-239,240		NR	NR		NA			0.057	89.3	≤ 100.00	0.057	89.3		
C-14		0.00028	0.4	≤ 100.00	NA			NR	NR		≥ 0.00028	0.4		
Sr-90		NR	NR		NA			9.870	15421.4	≤ 100.00	9.870	15421.4		
Tc-99		NR	NR		NA			0.037	57.7	≤ 100.00	0.037	57.7		
Am-241		NR	NR		NA			0.018	28.7	≤ 100.00	0.018	28.7		
Co-60		NR	NR		NA			<0.0068	<10/7	≤ 100.00	<0.0068	<10.7		
Cs-137		NR	NR		NA			17.400	27186.6	≤ 100.00	17.400	27186.6		
I-129		NR	NR		NA			<0.027	<42	≤ 100.00	<0.027	<42		

NOTES:

1. Aluminum oxide factor for acid 2.79 (based on 85% Al(OH)3 and 15% AIOOH)
2. Uranium analysis on fused sample only; uranium assumed to dissolve with acid
3. With the exception of C-14, all radionuclide analyses were performed on fused samples
4. Na7F(PO4)2 has been identified in this waste.

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

C-103 (PUREX, SRS)

Density (g/mL)	1.34
Volume (L)	234670
Mass (kg)	313284
Solids (ug/g)	389000
pH	9.8

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	8.255	2.6	0.08	6435.000	2016.0	12155.715	44.35	8065.000	2526.6	15234.785	55.59	14508.255	4545.2
Barium	1.117	1.835	0.6	0.04	541.500	169.6	604.856	10.91	4420.000	1384.7	4937.140	89.05	4963.335	1554.9
Bismuth	1.115	66.850	20.9	9.26	192.000	60.2	214.080	26.60	463.000	145.1	516.245	64.14	721.850	226.1
Boron	3.220	NR	NR	2.400	0.8	7.728	100.00	NR	0.0	0.000	0.00	2.400	0.8	
Cadmium	1.142	6.900	2.2	1.35	131.950	41.3	150.687	25.91	370.500	116.1	423.111	72.74	509.350	159.6
Calcium	1.399	37.550	11.8	0.34	789.000	247.2	1103.811	7.10	10285.000	3222.1	14388.715	92.56	11111.550	3481.1
Chromium	1.462	17.600	5.5	2.85	208.500	65.3	304.827	33.76	391.500	122.7	572.373	63.39	617.600	193.5
Cobalt	1.407	36.260	11.4	56.84	4.735	1.5	6.662	7.42	22.800	7.1	32.080	35.74	63.795	20.0
Copper	1.252	16.300	5.1	1.91	530.500	168.2	664.186	62.06	308.000	96.5	385.616	36.03	854.800	267.8
Iron	1.430	7.020	2.2	0.01	14835.000	4647.6	21214.050	17.12	71820.000	22500.1	102702.600	82.87	86662.020	27149.9
Lead	1.077	25.900	8.1	0.73	1011.500	316.9	1089.386	28.39	2525.000	791.0	2719.425	70.88	3562.400	1116.0
Magnesium	1.658	9.550	3.0	0.15	183.000	57.3	303.414	2.96	6000.000	1879.7	9948.000	96.89	6192.550	1940.0
Manganese	1.582	11.850	3.7	0.48	746.000	233.7	1180.172	30.11	1720.000	538.8	2721.040	69.42	2477.850	776.3
Nickel	1.409	45.100	14.1	1.58	870.500	272.7	1226.535	30.59	1930.000	604.6	2719.370	67.82	2845.600	891.5
Phosphate	1.000	2290.500	717.6	18.28	459.000	143.8	459.000	3.66	9780.000	3063.9	9780.000	78.06	12529.500	3925.3
Potassium	1.000	171.000	53.6	12.18	147.800	46.3	147.800	10.53	1085.000	339.9	1085.000	77.29	1403.800	439.8
Silicon	2.139	91.700	28.7	0.13	834.500	261.4	1784.996	1.18	69692.000	21833.4	149071.188	98.69	70618.200	22123.6
Silver	1.074	13.300	4.2	6.00	100.400	31.5	107.830	45.32	107.850	33.8	115.831	48.68	221.550	69.4
Sodium	1.000	7311.500	2290.6	14.48	10423.500	3265.5	10423.500	20.64	32770.000	10266.3	32770.000	64.88	50505.000	15822.4
Strontium	1.183	0.000	0.0	0.00	49.700	15.6	58.795	42.39	67.550	21.2	79.912	57.61	117.250	36.7
Zinc	1.245	0.000	0.0	0.00	105.700	33.1	131.597	60.47	69.100	21.6	86.030	39.53	174.800	54.8
Zirconium	1.351	36.650	11.5	0.30	368.310	115.4	497.587	3.02	11805.000	3698.3	15948.555	96.68	12209.960	3825.2
Uranium	1.202	1406.500	440.6	40.83	56.500	17.7	67.913	1.64	1981.400	620.7	2381.643	57.53	3444.400	1079.1
Nitrate	1.000	2810.000	880.3	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 2810.000	880.3
Chloride	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Fluoride	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hydroxide	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Carbonate	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
TOC	2.450	7999.250	1022.9	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 3265.000	1022.9
Nitrite	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sulfate	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Total		22421.370			53905.124				368618.657				114.38 % mass balance	
		5.76 %total solids in wash			13.86 %total solids in acid				94.76 %total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		0.007	2.0	0.05	8.938	2800.0	65.79	4.640	1453.6	34.16	13.584	4255.7		
C-14		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
Sr-90		1.039	325.5	0.04	2140.000	670428.7	78.97	569.000	178258.9	21.00	2710.039	849013.1		
Tc-99		0.017	5.3	6.45	0.111	34.8	42.13	0.136	42.5	51.42	0.264	82.6		
Am-241		0.008	2.5	0.59	1.275	399.4	94.41	0.068	21.1	5.00	1.351	423.1		
Co-60		0.079	24.6	1.99	0.358	112.0	9.06	3.510	1099.6	88.95	3.946	1236.2		
Cs-137		24.400	7644.1	41.08	17.500	5482.5	29.46	17.500	5482.5	29.46	59.400	18609.1		
I-129		0.000011	0.01	≤100.00	NR	NR	NR	NR	NR	NR	≥ 0.000011	0.01		

NOTES:

1. Nitrate on water leach only, would not account for any nitrate associated with cancrinite
2. TOC on water leach only
3. No analyses for nitrite, sulfate, chloride, fluoride, carbonate, total Cs
4. Reported value of 1.1e-5 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

C-104 (CW, POS)

Density (g/mL)	1.21
Volume (L)	1116575
Mass (kg)	1351056
Solids (ug/g)	616000
~pH	11.500

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	541.000	730.9	1.79	8900.000	12024.4	16812.100	29.53	20700.000	27966.9	39102.300	68.68	30141.000	40722.2
Barium	1.117	3.010	4.1	0.08	72.700	98.2	81.206	1.86	3830.000	5174.5	4278.110	98.06	3905.710	5276.8
Bismuth	1.115	60.100	81.2	1.63	3470.000	4688.2	3869.050	93.93	164.000	221.6	182.860	4.44	3694.100	4990.9
Boron	3.220	3.210	4.3	18.76	13.900	18.8	44.758	81.24	0.000	0.0	0.000	0.00	17.110	23.1
Cadmium	1.142	65.500	88.5	5.11	959.000	1295.7	1095.178	74.83	257.000	347.2	293.494	20.05	1281.500	1731.4
Calcium	1.399	21.900	29.6	0.19	1350.000	1823.9	1888.650	11.98	9900.000	13375.5	13850.100	87.83	11271.900	15229.0
Chromium	1.462	45.100	60.9	4.03	746.000	1007.9	1090.652	66.60	329.000	444.5	480.998	29.37	1120.100	1513.3
Cobalt	1.407	0.000	0.0	0.00	9.340	12.6	13.141	57.65	6.860	9.3	9.652	42.35	16.200	21.9
Copper	1.252	3.160	4.3	2.83	74.000	100.0	92.648	66.21	34.600	46.7	43.319	30.96	111.760	151.0
Iron	1.430	6.960	9.4	0.03	19430.000	26251.0	27784.900	74.51	6640.000	8971.0	9495.200	25.46	26076.960	35231.4
Lead	1.077	180.000	243.2	18.05	605.000	817.4	651.585	60.68	212.000	286.4	228.324	21.26	997.000	1347.0
Magnesium	1.658	4.610	6.2	0.08	209.000	282.4	346.522	3.83	5250.000	7093.0	8704.500	96.09	5463.610	7381.6
Manganese	1.582	19.900	26.9	0.60	2450.000	3310.1	3875.900	74.29	828.000	1118.7	1309.896	25.11	3297.900	4455.6
Nickel	1.409	77.500	104.7	4.06	1530.000	2067.1	2155.770	80.08	303.000	409.4	426.927	15.86	1910.500	2581.2
Phosphate	1.000	261.000	352.6	2.78	354.000	478.3	354.000	3.78	8760.000	11835.2	8760.000	93.44	9375.000	12666.1
Potassium	1.000	347.000	468.8	25.76	118.000	159.4	118.000	8.76	882.000	1191.6	882.000	65.48	1347.000	1819.9
Silicon	2.139	2140.000	2891.3	3.79	940.000	1270.0	2010.660	1.67	53310.000	72024.8	114030.090	94.54	56390.000	76186.0
Silver	1.074	1.380	1.9	0.29	293.000	395.9	314.682	62.42	175.000	236.4	187.950	37.28	469.380	634.2
Sodium	1.000	58060.000	78442.3	60.80	9590.000	12956.6	9590.000	10.04	27850.000	37626.9	27850.000	29.16	95500.000	129025.8
Strontium	1.183	0.000	0.0	0.00	29.300	39.6	34.662	36.08	51.900	70.1	61.398	63.92	81.200	109.7
Zinc	1.245	0.000	0.0	0.00	72.100	97.4	89.765	61.52	45.100	60.9	56.150	38.48	117.200	158.3
Zirconium	1.351	9.630	13.0	0.02	6768.000	9143.9	9143.568	10.95	55020.000	74335.1	74332.020	89.03	61797.630	83492.0
Uranium	1.202	30.100	40.7	0.12	23260.000	31425.6	27958.520	93.83	1500.000	2026.6	1803.000	6.05	24790.100	33492.8
Nitrate	1.000	23440.000	31668.7	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 23440.000	31668.7
Chloride	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Fluoride	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hydroxide	1.000	0.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Carbonate	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
TOC	2.450	10804.500	5958.2	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 4410.000	5958.2
Nitrite	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sulfate	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Total		96125.560			109415.917				306368.287				83.10 % mass balance	
		15.60 %total solids in wash			17.76 %total solids in acid				49.74 %total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		0.004	5.4	0.04	8.680	11727.2	89.26	1.040	1405.1	10.70	9.724	13137.7		
C-14		0.001	1.4	≤100.00	NR	NR	NR	NR	NR	NR	≥ 0.001	1.4		
Sr-90		0.029	39.2	0.01	369.000	498539.6	99.70	1.090	1472.7	0.29	370.119	500051.4		
Tc-99		0.023	31.1	0.83	2.370	3202.0	85.65	0.374	505.3	13.52	2.767	3738.4		
Am-241		0.006	8.1	0.19	3.110	4201.8	99.68	0.004	5.4	0.13	3.120	4215.3		
Co-60		0.027	36.5	4.84	0.412	556.6	73.84	0.119	160.8	21.33	0.558	753.9		
Cs-137		4.964	6706.6	15.82	26.300	35532.8	83.81	0.115	155.4	0.37	31.379	42394.8		
I-129		≥0.000	≥0.0	NR	NR	NR	NR	NR	NR	NR	≥0.000	≥0.0		

NOTES:

1. Nitrate on water leach only, would not account for any nitrate associated with cancrinite
2. No analyses for nitrite, sulfate, chloride, fluoride, carbonate, total Cs
3. TOC on water leach only
4. Reported value of 0 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

C-105 (TBP, PSS)

Density (g/mL)	1.55
Volume (L)	567750
Mass (kg)	880013
Solids (ug/g)	623000
-pH	NR

(drainable liquor pH 9.7)

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	102.000	89.8	0.16	37910.000	33361.3	71611.990	61.30	23830.000	20970.7	45014.870	38.53	61842.000	54421.7
Barium	1.117	3.530	3.1	0.14	70.300	61.9	78.525	2.74	2490.000	2191.2	2781.330	97.12	2563.830	2256.2
Bismuth	1.115	70.500	62.0	11.28	480.000	422.4	535.200	76.80	74.500	65.6	83.068	11.92	625.000	550.0
Boron	3.220	3.230	2.8	26.24	9.080	8.0	29.238	73.76	0.000	0.0	0.000	0.00	12.310	10.8
Cadmium	1.142	56.400	49.6	35.63	42.300	37.2	48.307	26.72	59.600	52.4	68.063	37.65	158.300	139.3
Calcium	1.399	71.700	63.1	0.92	798.000	702.2	1116.402	10.23	6930.000	6098.5	9695.070	88.85	7799.700	6863.8
Chromium	1.462	468.000	411.8	49.62	410.000	360.8	599.420	43.47	65.200	57.4	95.322	6.91	943.200	830.0
Cobalt	1.407	0.000	0.0	0.00	10.300	9.1	14.492	100.00	0.000	0.0	0.000	0.00	10.300	9.1
Copper	1.252	0.000	0.0	0.00	64.200	56.5	80.378	41.50	90.500	79.6	113.306	58.50	154.700	136.1
Iron	1.430	5.170	4.5	0.05	6390.000	5623.3	9137.700	60.25	4210.000	3704.9	6020.300	39.70	10605.170	9332.7
Lead	1.077	212.000	186.8	23.61	463.000	407.4	498.651	51.56	223.000	196.2	240.171	24.83	898.000	790.3
Magnesium	1.658	24.400	21.5	0.66	219.000	192.7	363.102	5.93	3450.000	3036.0	5720.100	93.41	3693.400	3250.2
Manganese	1.582	23.300	20.5	0.94	2240.000	1971.2	3543.680	90.60	209.000	183.9	330.638	8.45	2472.300	2175.7
Nickel	1.409	6.000	5.3	0.28	1900.000	1672.0	2677.100	88.74	235.000	206.8	331.115	10.98	2141.000	1884.1
Phosphate	1.000	3960.000	3484.8	52.11	1941.000	1708.1	1941.000	25.54	1698.000	1494.3	1698.000	22.35	7599.000	6687.2
Potassium	1.000	385.000	338.8	34.78	145.000	127.6	145.000	13.10	577.000	507.8	577.000	52.12	1107.000	974.2
Silicon	2.139	49.000	43.1	0.12	343.000	301.8	733.677	0.86	39470.000	34734.1	84426.330	99.02	39862.000	35079.1
Silver	1.074	1.720	1.5	2.57	58.400	51.4	62.722	87.20	6.850	6.0	7.357	10.23	66.970	58.9
Sodium	1.000	34910.000	30721.2	48.64	16570.000	14581.8	16570.000	23.09	20290.000	17855.5	20290.000	28.27	71770.000	63158.5
Strontium	1.183	0.000	0.0	0.00	160.000	140.8	189.280	62.84	94.600	83.2	111.912	37.16	254.600	224.1
Zinc	1.245	0.000	0.0	0.00	59.100	52.0	73.580	7.94	685.000	602.8	852.825	92.06	744.100	654.8
Zirconium	1.351	11.300	9.9	1.53	18.200	16.0	24.588	2.47	707.000	622.2	955.157	95.99	736.500	648.1
Uranium	1.202	642.000	565.0	5.37	11310.000	9952.9	13594.620	94.63	NR	NR	NR	NR	11952.000	10517.9
Nitrate	1.000	10490.000	9231.3	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥10490.000	9231.3
Chloride	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Fluoride	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hydroxide	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Carbonate	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
TOC	2.450	2082.500	748.0	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 850.000	748.0
Nitrite	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sulfate	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Total		53577.750			123668.651				179411.934				57.25 % mass balance	
		8.60 %total solids in wash			19.85 %total solids in acid				28.80 %total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		0.004	3.5	0.13	2.900	2552.0	94.74	0.157	138.2	5.13	3.061	2693.7		
C-14		0.001	0.9	≤100.00	NR	NR	NR	NR	NR	NR	≥ 0.001	0.9		
Sr-90		0.430	378.4	0.05	863.000	759450.8	99.93	0.172	151.4	0.02	863.602	759980.6		
Tc-99		0.068	59.8	64.76	0.032	28.2	30.48	0.005	4.4	4.76	0.105	92.4		
Am-241		1.128	992.7	74.75	0.376	330.9	24.92	0.005	4.4	0.33	1.509	1327.9		
Co-60		0.027	23.8	3.55	0.636	559.7	83.57	0.098	86.2	12.88	0.761	669.7		
Cs-137		12.000	10560.2	8.15	135.000	118801.7	91.71	0.206	181.3	0.14	147.206	129543.1		
I-129		0.000	0.1	≤100.00	NR	NR	NR	NR	NR	NR	≥ 0.000	0.1		

NOTES:

1. Nitrate on water leach only, would not account for any nitrate associated with cancrinite
2. TOC on water leach only
3. No analyses for nitrite, sulfate, chloride, fluoride, carbonate, total Cs
4. Reported value of 1.2e-4 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

C-106 (PUREX, SRS)

Density (g/mL)	1.43
Volume (L)	745645
Mass (kg)	1066272
Solids (ug/g)	475000
pH	10.5

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	21.500	22.9	0.05	32870.000	35048.4	62091.430	80.32	8030.000	8562.2	15168.670	19.62	40921.500	43633.5
Barium	1.117	2.890	3.1	0.06	123.000	131.2	137.391	2.52	4760.000	5075.5	5316.920	97.42	4885.890	5209.7
Bismuth	1.115	15.000	16.0	3.00	52.700	56.2	58.761	10.53	433.000	461.7	482.795	86.48	500.700	533.9
Boron	3.220	4.770	5.1	24.50	14.700	15.7	47.334	75.50	0.000	0.0	0.000	0.00	19.470	20.8
Cadmium	1.142	12.000	12.8	3.24	12.000	12.8	13.704	3.24	346.000	368.9	395.132	93.51	370.000	394.5
Calcium	1.399	45.600	48.6	0.38	739.000	788.0	1033.861	6.20	11140.000	11878.3	15584.860	93.42	11924.600	12714.9
Chromium	1.462	1.420	1.5	0.14	611.000	651.5	893.282	62.07	372.000	396.7	543.864	37.79	984.420	1049.7
Cobalt	1.407	0.000	0.0	0.00	4.810	5.1	6.768	100.00	0.000	0.0	0.000	0.00	4.810	5.1
Copper	1.252	1.520	1.6	1.19	67.500	72.0	84.510	52.73	59.000	62.9	73.868	46.09	128.020	136.5
Iron	1.430	1.110	1.2	0.00	27460.000	29279.8	39267.800	52.75	24600.000	26230.3	35178.000	47.25	52061.110	55511.3
Lead	1.077	44.900	47.9	1.87	1060.000	1130.2	1141.620	44.08	1300.000	1386.2	1400.100	54.06	2404.900	2564.3
Magnesium	1.658	11.400	12.2	0.17	138.000	147.1	228.804	2.10	6410.000	6834.8	10627.780	97.72	6559.400	6994.1
Manganese	1.582	4.940	5.3	0.27	1100.000	1172.9	1740.200	59.75	736.000	784.8	1164.352	39.98	1840.940	1962.9
Nickel	1.409	32.200	34.3	3.31	488.000	520.3	687.592	50.14	453.000	483.0	638.277	46.55	973.200	1037.7
Phosphate	1.000	1320.000	1407.5	15.12	3240.000	3454.7	3240.000	37.11	4170.000	4446.4	4170.000	47.77	8730.000	9308.6
Potassium	1.000	156.000	166.3	10.58	89.000	94.9	89.000	6.03	1230.000	1311.5	1230.000	83.39	1475.000	1572.8
Silicon	2.139	24.700	26.3	0.03	147.000	158.7	314.433	0.21	70840.000	75534.7	151526.760	99.76	71011.700	75717.8
Silver	1.074	1.360	1.5	0.26	349.000	372.1	374.826	66.05	178.000	189.8	191.172	33.69	528.360	563.4
Sodium	1.000	45480.000	48494.1	38.84	36650.000	39078.9	36650.000	31.30	34980.000	37298.2	34980.000	29.87	117110.000	124871.2
Strontium	1.183	0.000	0.0	0.00	42.400	45.2	50.159	41.17	60.600	64.6	71.690	58.83	103.000	109.8
Zinc	1.245	0.000	0.0	0.00	46.300	49.4	57.644	100.00	0.000	0.0	0.000	0.00	46.300	49.4
Zirconium	1.351	113.000	120.5	5.22	3.700	3.9	4.999	0.17	2050.000	2185.9	2769.550	94.61	2166.700	2310.3
Uranium	1.202	9.130	9.7	2.23	2.770	3.0	3.330	0.68	397.000	423.3	477.194	97.09	408.900	436.0
Nitrate	1.000	928.000	989.5	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 928.000	989.5
Chloride	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Fluoride	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hydroxide	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Carbonate	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
TOC	2.450	11319.000	4926.2	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 4620.000	4926.2
Nitrite	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sulfate	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Total		59550.440	12.54 %total solids in wash			148217.446	31.20 %total solids in acid			281990.984	59.37 %total solids in fusion		103.11 % mass balance	
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		0.245	261.2	4.77	2.440	2601.7	47.52	2.450	2612.4	47.71	5.135	5475.3		
C-14		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
Sr-90		0.204	217.5	0.01	1970.000	2100556.5	99.14	16.800	17913.4	0.85	1987.004	2118687.4		
Tc-99		0.035	37.3	16.06	0.103	109.8	47.25	0.080	85.3	36.70	0.218	232.4		
Am-241		0.015	16.0	1.42	0.844	899.9	80.15	0.194	206.9	18.42	1.053	1122.8		
Co-60		0.028	29.9	3.15	0.333	355.1	37.50	0.527	561.9	59.35	0.888	946.8		
Cs-137		62.200	66322.1	18.83	239.000	254839.1	72.36	29.100	31028.5	8.81	330.300	352189.8		
I-129		0.000081	0.1	≤100.00	NR	NR	NR	NR	NR	NR	≥ 0.000081	0.1		

NOTES:

1. Nitrate on water leach only, would not account for any nitrate associated with cancrinite
2. TOC on water leach only
3. No analyses for nitrite, sulfate, chloride, fluoride, carbonate, total Cs
4. Reported value of 8.1e-5 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

C-109 (TBP(F), BiPO4 1C)

Density (g/mL)	1.20
Volume (L)	234670
Mass (kg)	281604
Solids (ug/g)	753500
pH	11-12.3

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum (1)	1.889	258.500	72.8	0.21	78021.000	21971.0	217678.590	64.12	43401.500	12222.0	95483.300	35.67	121681.000	34265.9
Barium	1.117	<DL			45.850	12.9	51.214	71.25	18.500	5.2	20.665	28.75	64.350	18.1
Bismuth (2)	1.115	NR	NR		12300.000	3463.7	13714.500	100.00	NR	NR	NR		12300.000	3463.7
Boron	3.220	21.000	5.9	23.08	70.000	19.7	225.400	76.92	<DL				91.000	25.6
Cadmium	1.142	<DL			10.000	2.8	11.420	100.00	<DL				10.000	2.8
Calcium	1.399	130.500	36.7	0.66	16048.500	4519.3	22451.852	81.22	3581.000	1008.4	5009.819	18.12	19760.000	5564.5
Chromium	1.462	175.000	49.3	71.57	27.500	7.7	40.205	11.25	42.000	11.8	61.404	17.18	244.500	68.9
Cobalt	1.407	<DL			<DL		<DL		<DL		<DL		<DL	
Copper	1.252	<DL			41.500	11.7	51.958	58.45	29.500	8.3	36.934	41.55	71.000	20.0
Iron	1.430	897.000	252.6	4.74	17066.500	4806.0	24405.095	90.10	978.000	275.4	1398.540	5.16	18941.500	5334.0
Lead	1.077	24.000	6.8	0.51	4711.000	1326.8	5073.747	99.49	0.000	0.0	0.000	0.00	4735.000	1333.4
Magnesium	1.658	7.000	2.0	1.43	375.500	105.7	622.579	76.48	108.500	30.6	179.893	22.10	491.000	138.3
Manganese	1.582	<DL			91.000	25.6	143.962	73.68	32.500	9.2	51.415	26.32	123.500	34.8
Nickel	1.409	89.000	25.1	0.59	13204.500	3718.4	18605.141	87.72	1760.000	495.6	2479.840	11.69	15053.500	4239.1
Phosphate	1.000	16815.000	4735.2	28.69	39658.500	11168.0	39658.500	67.66	2142.000	603.2	2142.000	3.65	58615.500	16506.4
Potassium	1.000	491.000	138.3	94.88	26.500	7.5	26.500	5.12	NA				517.500	145.7
Silicon	2.139	93.500	26.3	1.03	1554.500	437.8	3325.076	17.20	7387.500	2080.3	15801.863	81.76	9035.500	2544.4
Silver	1.074	<DL			<DL		<DL		<DL		<DL		<DL	
Sodium	1.000	63845.000	17979.0	75.80	17730.500	4993.0	17730.500	21.05	2650.500	746.4	2650.500	3.15	84226.000	23718.4
Strontium	1.183	1.000	0.3	0.54	170.500	48.0	201.702	91.67	14.500	4.1	17.154	7.80	186.000	52.4
Zinc	1.245	8.000	2.3	2.17	259.000	72.9	322.455	70.19	102.000	28.7	126.990	27.64	369.000	103.9
Zirconium	1.351	<DL			<DL		<DL		<DL		<DL		0.000	0.0
Uranium	1.202	<DL			8485.000	2389.4	10198.970	100.00	0.000	0.0	0.000	0.00	8485.000	2389.4
Nitrate	1.000	36500.000	10278.5	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 36500.000	10278.5
Chloride	1.000	700.000	197.1	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 700.000	197.1
Fluoride	1.000	400.000	112.6	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 400.000	112.6
CN	1.000	815.000	229.5	14.82	NR	NR	NR	NR	4685.000	1319.3	4685.000	85.18	5500.000	1548.8
Carbonate	1.000	25500.000	7180.9	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 25500.000	7180.9
TOC	2.450	5635.000	647.7	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 2300.000	647.7
Nitrite	1.000	39000.000	10982.6	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 39000.000	10982.6
Sulfate	1.000	6950.000	1957.1	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 6950.000	1957.1
Total		198355.500			374539.364		49.71 %total solids in acid		130145.316		17.27 %total solids in fusion		93.30 % mass balance	
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	uCi/g	Ci/tank
Pu-239,240		NR	NR		NA			0.448	126.0	≤100.00	0.448	126.0	0.448	126.0
C-14		0.00002	0.006	≤100.00	NA			NR	NR	NR	≥ 0.00002	0.006	≥ 0.00002	0.006
Sr-90		NR	NR		NA			1055.000	297092.2	≤100.00	1055.000	297092.2	1055.000	297092.2
Tc-99		NR	NR		NA			0.101	28.4	≤100.00	0.101	28.4	0.101	28.4
Am-241		0.004	1.0	1.56	NA			0.222	62.4	98.44	0.225	63.4	0.225	63.4
Co-60		0.001	0.2	4.73	NA			0.014	3.8	95.27	0.014	4.0	0.014	4.0
Cs-137		7.240	2038.8	1.01	NA			708.000	199375.6	98.99	715.240	201414.4	715.240	201414.4
I-129		NR	NR		NA			NR	NR	NR	NR	NR	NR	NR

NOTES:

1. Acid soluble oxide factor 2.79 (85% Al(OH)3, 15% AlOOH); fusion soluble oxide factor 2.22 (AlOOH)

2. Bismuth concentration estimated based on work by Lumetta, et al PNL-9387

3. Nitrate and sulfate on water leach only, would not account for nitrate in cancrinite (I.D.'d by XRD) or water insoluble sulfate

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

C-110 (BiPO4 1C, TBP)

Density (g/mL)	1.20
Volume (L)	707795
Mass (kg)	849354
Solids (ug/g)	401600
pH	11.0

Component	Oxide Factor	WATER			ACID				FUSION			TOTAL		
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum (1)	1.889	1210.000	1027.7	8.31	13350.000	11338.9	37246.500	91.69	0.000	0.0	0.000	0.00	14560.000	12366.6
Barium	1.117	0.880	0.7	11.67	6.658	5.7	7.437	88.33	0.000	0.0	0.000	0.00	7.538	6.4
Bismuth	1.115	117.800	100.1	0.71	16382.200	13914.3	18266.153	99.29	0.000	0.0	0.000	0.00	16500.000	14014.3
Boron	3.220	24.860	21.1	100.00	0.000	0.0	0.000	0.00	0.000	0.0	0.000	0.00	24.860	21.1
Cadmium	1.142	0.812	0.7	15.62	2.116	1.8	2.416	40.71	2.270	1.9	2.592	43.67	5.198	4.4
Calcium	1.399	187.800	159.5	29.54	269.800	229.2	377.450	42.43	178.200	151.4	249.302	28.03	635.800	540.0
Chromium	1.462	259.600	220.5	55.64	207.000	175.8	302.634	44.36	0.000	0.0	0.000	0.00	466.600	396.3
Cobalt	1.407	2.725	2.3	44.58	0.000	0.0	0.000	0.00	3.387	2.9	4.766	55.42	6.112	5.2
Copper	1.252	2.338	2.0	2.84	28.382	24.1	35.535	34.54	51.460	43.7	64.428	62.62	82.180	69.8
Iron	1.430	310.200	263.5	2.83	10641.800	9038.7	15217.774	97.17	0.000	0.0	0.000	0.00	10952.000	9302.1
Lead	1.077	19.828	16.8	7.42	225.572	191.6	242.941	84.42	21.800	18.5	23.479	8.16	267.200	226.9
Magnesium	1.658	14.166	12.0	9.51	134.834	114.5	223.555	90.49	0.000	0.0	0.000	0.00	149.000	126.6
Manganese	1.582	2.078	1.8	3.92	33.442	28.4	52.905	63.05	17.522	14.9	27.720	33.03	53.042	45.1
Nickel	1.409	2.777	2.4	11.48	21.403	18.2	30.157	88.52	NA				24.180	20.5
Phosphate	1.000	24041.400	20419.7	38.86	32958.600	27993.5	32958.600	53.28	4860.000	4127.9	4860.000	7.86	61860.000	52541.0
Potassium	1.000	396.726	337.0	69.92	170.674	145.0	170.674	30.08	NA				567.400	481.9
Silicon	2.139	240.280	204.1	3.41	432.720	367.5	925.588	6.13	6381.000	5419.7	13648.959	90.46	7054.000	5991.3
Silver	1.074	1.148	1.0	23.01	0.000	0.0	0.000	0.00	3.842	3.3	4.126	76.99	4.990	4.2
Sodium	1.000	66168.000	56200.1	79.05	10272.000	8724.6	10272.000	12.27	7260.000	6166.3	7260.000	8.67	83700.000	71090.9
Strontium	1.183	5.534	4.7	4.40	118.786	100.9	140.524	94.41	1.500	1.3	1.775	1.19	125.820	106.9
Zinc	1.245	11.256	9.6	5.14	136.464	115.9	169.898	62.37	71.080	60.4	88.495	32.49	218.800	185.8
Zirconium	1.351	12.442	10.6	7.45	26.598	22.6	35.934	15.93	127.960	108.7	172.874	76.62	167.000	141.8
Uranium (2)	1.202	NR	NR		1508.000	1280.8	1812.616	100.00	>0	>0			1508.000	1280.8
Nitrate	1.000	109080.000	92647.5	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	109080.000	92647.5
Chloride	1.000	1377.000	1169.6	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 1377.000	1169.6
Fluoride	1.000	7520.000	6387.1	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 7520.000	6387.1
Free OH	1.000	NR	NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Carbonate	1.000	10490.000	8909.7	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 10490.000	8909.7
TOC	2.450	2178.867	755.4	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 889.333	755.4
Nitrite	1.000	7264.000	6169.7	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 7264.000	6169.7
Sulfate	1.000	19050.000	16180.2	≤100.00	0.000	0.0	0.000	0.00	0.000	0.0	0.000	0.00	≥ 19050.000	16180.2
Total		249992.516		62.25 %total solids in wash			118491.291				26408.515		98.33 % mass balance	
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		NR	NR		NA			0.080	68.0	≤100.00	0.080	68.0		
C-14		0.005	4.2	≤100.00	NA			NR	NR		≥ 0.005	4.2		
Sr-90		NR	NR		NA			4.980	4229.8	≤ 100.00	4.980	4229.8		
Tc-99		NR	NR		NA			0.035	30.1	≤ 100.00	0.035	30.1		
Am-241		NR	NR		NA			0.005	4.1	≤ 100.00	0.005	4.1		
Co-60		NR	NR		NA			<0.04	<34		<0.04	<34		
Cs-137		NR	NR		NA			19.440	16511.4	≤ 100.00	19.440	16511.4		
I-129		NR	NR		NA			<0.019	<16		<0.019	<16		

NOTES:

1. Aluminum oxide factor for acid 2.79 (based on 85% Al(OH)3 and 15% AlOOH)

2. Uranium analysis on fused sample only; uranium assumed to dissolve in acid

3. With the exception of C-14, all radionuclide analyses were performed on fused samples

4. Na7F(PO4)2 probably exists in this waste.

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

C-112 [TBP(F), BIPO4 1C]

Density (g/mL) 1.50
 Volume (L) 393640
 Mass (kg) 590460
 Solids (ug/g) 585000
 ~pH 11-12.3

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum (1)	1.889	564.500	333.3	3.12	13838.500	8171.1	38609.415	76.45	3697.500	2183.2	6984.578	20.43	18100.500	10687.6
Barium	1.117	<DL	NR	NR	69.950	41.3	78.134	80.49	16.950	10.0	18.933	19.51	86.900	51.3
Bismuth	1.115	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Boron	3.220	34.350	20.3	26.86	93.550	55.2	301.231	73.14	0.000	0.0	0.000	0.00	127.900	75.5
Cadmium	1.142	<DL	NR	NR	5.500	3.2	6.281	100.00	0.000	0.0	0.000	0.00	5.500	3.2
Calcium	1.399	312.500	184.5	1.27	19989.000	11802.7	27964.611	80.98	4383.500	2588.3	6132.517	17.76	24685.000	14575.5
Chromium	1.462	159.000	93.9	63.33	30.300	17.9	44.299	12.07	61.750	36.5	90.279	24.60	251.050	148.2
Cobalt	1.407	<DL	NR	NR	<DL	NR	NR	NR	<DL	NR	NR	NR	<DL	NR
Copper	1.252	<DL	NR	NR	11.850	7.0	14.836	20.70	45.400	26.8	56.841	79.30	57.250	33.8
Iron	1.430	1512.000	892.8	6.19	18251.500	10776.8	26099.645	74.71	4667.000	2755.7	6673.810	19.10	24430.500	14425.2
Lead	1.077	<DL	0.0	0.00	1918.150	1132.6	2065.848	87.60	271.500	160.3	292.406	12.40	2189.650	1292.9
Magnesium	1.658	36.650	21.6	6.51	450.450	266.0	746.846	80.07	75.500	44.6	125.179	13.42	562.600	332.2
Manganese	1.582	1.850	1.1	0.78	175.100	103.4	277.008	74.21	59.000	34.8	93.338	25.01	235.950	139.3
Nickel	1.409	895.500	528.8	5.37	13237.500	7816.2	18651.638	79.44	2530.000	1493.9	3564.770	15.18	16663.000	9838.8
Phosphate	1.000	34245.000	20220.3	38.88	40663.500	24010.2	40663.500	46.17	13171.500	7777.2	13171.500	14.95	88080.000	52007.7
Potassium	1.000	542.500	320.3	86.77	82.700	48.8	82.700	13.23	NA	NA	NA	NA	625.200	369.2
Silicon	2.139	73.100	43.2	2.87	1073.500	633.9	2296.217	42.17	1399.000	826.1	2992.461	54.96	2545.600	1503.1
Silver	1.074	<DL	NR	NR	<DL	NR	NR	NR	<DL	NR	NR	NR	<DL	NR
Sodium	1.000	106648.000	62971.4	90.52	0.000	0.0	0.000	0.00	11167.000	6593.7	11167.000	9.48	117815.000	69565.0
Strontium	1.183	3.650	2.2	1.15	263.500	155.6	311.721	82.71	51.450	30.4	60.865	16.15	318.600	188.1
Zinc	1.245	5.700	3.4	1.59	254.200	150.1	316.479	71.12	97.500	57.6	121.388	27.28	357.400	211.0
Zirconium	1.351	<DL	NR	NR	23.800	14.1	32.154	92.79	1.850	1.1	2.499	7.21	25.650	15.1
Uranium	1.202	2656.000	1568.3	4.45	45343.000	26773.2	54502.286	76.01	11656.500	6882.7	14011.113	19.54	59655.500	35224.2
Nitrate	1.000	75750.000	44727.3	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥75750.000	44727.3
Chloride	1.000	1175.000	693.8	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥1175.000	693.8
Fluoride	1.000	725.000	428.1	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥725.000	428.1
CN	1.000	1682.500	993.4	20.03	NR	NR	NR	NR	6717.500	3966.4	6717.500	79.97	8400.000	4959.8
Carbonate	1.000	31375.000	18525.7	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥31375.000	18525.7
TOC	2.450	7595.000	1830.4	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥3100.000	1830.4
Nitrite	1.000	57250.000	33803.8	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥57250.000	33803.8
Sulfate	1.000	14650.000	8650.2	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥14650.000	8650.2
Total		337892.800			213064.847		36.42 %total solids in acid		72276.975				106.54 % mass balance	
Radionuclides		uCi/g	Cl/tank	% dissolved	uCi/g	Cl/tank	% dissolved	uCi/g	Cl/tank	% dissolved	uCi/g	Cl/tank	uCi/g	Cl/tank
Pu-239,240		NR	NR	NR	NA	NR	NR	0.107	63.2	≤100.00	0.107	63.2	0.107	63.2
C-14		0.00002	0.01	≤100.00	NA	NR	NR	2004.000	1183281.8	≤100.00	≥0.00002	0.01	2004.000	1183281.8
Sr-90		NR	NR	NR	NA	NR	NR	0.124	72.9	≤100.00	0.124	72.9	0.124	72.9
Tc-99		NR	NR	NR	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR
Am-241		0.009	5.3	2.64	NA	NR	NR	0.333	196.3	97.36	0.342	201.6	0.342	201.6
Co-60		0.004	2.4	20.00	NA	NR	NR	0.016	9.4	80.00	0.020	11.8	0.020	11.8
Cs-137		6.160	3637.2	0.77	NA	NR	NR	789.000	465872.9	99.23	795.160	469510.2	795.160	469510.2
I-129		NR	NR	NR	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR

NOTES:

- Acid soluble oxide factor 2.79 (85% Al(OH)3, 15% AlOOH)
- Nitrate on water leach only, would not account for nitrate in cancrinite
- No reported values for I-129

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

S-104 (REDOX)

Density (g/mL)	1.50	
Volume (L)	1109005	estimated
Mass (kg)	1663508	
Solids (ug/g)	652000	
~pH	13.0	

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum (1)	1.889	4731.667	7871.2	4.01	34268.333	57005.6	95608.650	29.04	79000.000	131417.1	173800.000	66.95	118000.000	196293.9
Barium	1.117	0.310	0.5	0.93	21.557	35.9	24.079	64.80	11.400	19.0	12.734	34.27	33.267	55.3
Bismuth	1.115	<DL			<DL		<DL		<DL		<DL		<DL	
Boron	3.220	8.983	14.9	22.94	5.467	9.1	17.603	13.96	24.717	41.1	79.588	63.11	39.167	65.2
Cadmium	1.142	<DL			<DL		<DL		<DL		<DL		<DL	
Calcium	1.399	98.683	164.2	5.16	158.983	264.5	222.418	8.31	1655.667	2754.2	2316.278	86.53	1913.333	3182.8
Chromium	1.462	1914.000	3184.0	44.64	2373.333	3948.1	3469.813	55.36	0.000	0.0	0.000	0.00	4287.333	7132.0
Cobalt	1.407	1.200	2.0	17.82	1.383	2.3	1.946	20.54	4.150	6.9	5.839	61.63	6.733	11.2
Copper	1.252	0.850	1.4	1.64	18.800	31.3	23.538	36.31	32.133	53.5	40.231	62.05	51.783	86.1
Iron	1.430	3.317	5.5	0.13	771.350	1283.1	1103.031	31.03	1711.550	2847.2	2447.516	68.84	2486.217	4135.8
Lead	1.077	8.150	13.6	21.12	18.217	30.3	19.619	47.21	12.217	20.3	13.157	31.66	38.583	64.2
Magnesium	1.658	4.483	7.5	8.39	39.500	65.7	65.491	73.88	9.483	15.8	15.723	17.74	53.467	88.9
Manganese	1.582	0.303	0.5	0.03	934.197	1554.0	1477.899	85.34	160.167	266.4	253.384	14.63	1094.667	1821.0
Nickel	1.409	1.667	2.8	0.03	54.817	91.2	77.237	1.12	4826.850	8029.5	6801.032	98.84	4883.333	8123.5
Phosphate	1.000	27.250	45.3	9.43	32.800	54.6	32.800	11.35	228.950	380.9	228.950	79.22	289.000	480.8
Potassium	1.000	252.833	420.6	84.28	47.167	78.5	47.167	15.72	0.0	0.000	0.00	0.00	300.000	499.1
Silicon	2.139	34.433	57.3	2.36	165.567	275.4	354.147	11.34	1260.000	2096.0	2695.140	86.30	1460.000	2428.7
Silver	1.074	<DL			<DL		<DL		<DL		<DL		<DL	
Sodium	1.000	118250.000	196709.8	99.09	1083.333	1802.1	1083.333	0.91	0.000	0.0	0.000	0.00	119333.333	198511.9
Strontium	1.183	0.635	1.1	0.15	329.698	548.5	390.033	78.78	88.167	146.7	104.301	21.07	418.500	696.2
Zinc	1.245	12.383	20.6	3.81	8.567	14.3	10.665	2.83	304.250	506.1	378.791	93.56	325.200	541.0
Zirconium	1.351	1.020	1.7	0.16	643.547	1070.5	869.432	99.84	0.000	0.0	0.000	0.00	644.567	1072.2
Uranium	1.202	NR	NR		6616.667	11006.9	7953.233	<100.00	0.000	0.0	0.000	0.00	6616.667	11006.9
Nitrate	1.000	185666.667	308857.9	≤100.00	NR	NR			NR	NR			≥185666.667	308857.9
Chloride	1.000	3173.333	5278.9	≤100.00	NR	NR			NR	NR			≥3173.333	5278.9
Fluoride	1.000	145.333	241.8	≤100.00	NR	NR			NR	NR			≥145.333	241.8
Free OH	1.000	NR	NR		NR	NR			NR	NR			NR	NR
Carbonate	1.000	20973.333	34889.3	≤100.00	NR	NR			NR	NR			≥20973.333	34889.3
TOC	2.450	3768.917	2559.0	≤100.00	NR	NR			NR	NR			≥1538.333	2559.0
Nitrite	1.000	20816.667	34628.7	≤100.00	NR	NR			NR	NR			≥20816.667	34628.7
Sulfate	1.000	2365.000	3934.2	100.00	0.000	0.0	0.000	0.00	0.000	0.0	0.000	0.00	2365.000	3934.2
Total		362261.418				112852.134				189192.664				
		55.56 %total solids in wash				17.31 %total solids in acid				29.02 %total solids in fusion				101.89 % mass balance
Radionuclides	uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank		% dissolved	uCi/g	Ci/tank		% dissolved	uCi/g	Ci/tank
Pu-239,240	NR	NR			NA				0.284	473.0		≤100.00	0.284	473.0
C-14	0.001	1.6	≤100.00		NA				NR	NR			≥ 0.001	1.6
Sr-90	NR	NR			NA				303.333	504597.3		≤100.00	303.333	504597.3
Tc-99	NR	NR			NA				0.025	40.8		≤100.00	0.025	40.8
Am-241	NR	NR			NA				0.118	196.3		≤100.00	0.118	196.3
Co-60	NR	NR			NA				<0.033	<55.6		<0.033	<55.6	
Cs-137	NR	NR			NA				63.182	105103.2		≤100.00	63.182	105103.2
I-129	NR	NR			NA				0.013	22.3		≤100.00	0.013	22.3

NOTES:

1. Acid soluble oxide factor 2.79 (85% Al(OH)3, 15% AlOOH); fusion soluble oxide factor 2.22 (AlOOH)

2. Uranium analysis performed on fused sample only; uranium assumed to be acid soluble

3. Radionuclide analyses on fused sample only, with exception of C-14

4. Co-60 value less than

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

T-102 (CW, Mix)

Density (g/mL)	1.79
Volume (L)	71915
Mass (kg)	128728
Solids (ug/g) (1)	985000
pH	12.0

(estimated)

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum (1)	1.889	791.750	101.9	0.26	157322.000	20251.7	438928.380	52.14	143609.750	18486.6	400671.203	47.60	301723.500	38840.2
Barium	1.117	<2	<0.4		12.000	1.5	13.404	100.00	<111	<24			12.000	1.5
Bismuth	1.115	<101	<21.9		<199	<43			<DL				<DL	
Boron	3.220	<4	<0.9		>0	>0			>0	>0			>0	>0
Cadmium	1.142	<1	<0.2		12.750	1.6	14.561	100.00	>0	>0			12.750	1.6
Calcium	1.399	13.500	1.7	1.83	318.000	40.9	444.882	43.03	407.500	52.5	570.093	55.14	739.000	95.1
Chromium	1.462	771.750	99.3	98.12	0.000	0.0	0.000	0.00	14.750	1.9	21.565	1.88	786.500	101.2
Cobalt	1.407	<2	<0.4		<4	<0.9			<111	<24			<DL	
Copper	1.252	<1	<0.2		17.000	2.2	21.284	29.82	40.000	5.1	50.080	70.18	57.000	7.3
Iron	1.430	104.333	13.4	0.52	20095.417	2586.8	28736.446	99.48	0.000	0.0	0.000	0.00	20199.750	2600.3
Lead	1.077	<12	<2.6		421.500	54.3	453.956	100.00	0.000	0.0	0.000	0.00	421.500	54.3
Magnesium	1.658	<20	<4.3		107.000	13.8	177.406	100.00	<DL				107.000	13.8
Manganese	1.582	8.000	1.0	0.82	789.250	101.6	1248.594	81.12	175.750	22.6	278.037	18.06	973.000	125.3
Nickel	1.409	<6	<1.3		73.000	9.4	102.857	100.00	NA				73.000	9.4
Phosphate	1.000	1239.750	159.6	26.95	553.500	71.3	553.500	12.03	2807.250	361.4	2807.250	61.02	4600.500	592.2
Potassium	1.000	<202	<43.8		<399	<86.5			NA				<DL	
Silicon	2.139	46.000	5.9	1.42	807.000	103.9	1726.173	24.91	2386.500	307.2	5104.724	73.67	3239.500	417.0
Silver	1.074	<2	<0.4		15.000	1.9	16.110	10.31	130.500	16.8	140.157	89.69	145.500	18.7
Sodium	1.000	28813.750	3709.1	100.00	0.000	0.0	0.000	0.00	0.000	0.0	0.000	0.00	28813.750	3709.1
Strontium	1.183	<1	<0.2		17.750	2.3	20.998	100.00	<55	<12			17.750	2.3
Zinc	1.245	<4	<0.9		112.500	14.5	140.063	49.78	113.500	14.6	141.308	50.22	226.000	29.1
Zirconium	1.351	<2	<0.4		41.750	5.4	56.404	100.00	<111	<24			41.750	5.4
Uranium	1.202	<403	<87.3		734.000	94.5	882.268	100.00	<DL				734.000	94.5
Nitrate	1.000	35000.000	4505.5	≤100.00	NR	NR			NR	NR			≥35000.000	4505.5
Chloride	1.000	300.000	38.6	≤100.00	NR	NR			NR	NR			≥300.000	38.6
Fluoride	1.000	220.000	28.3	≤100.00	NR	NR			NR	NR			≥220.000	28.3
Free OH	1.000	NR	NR		NR	NR			NR	NR			NR	NR
Carbonate	1.000	12350.000	1589.8	≤100.00	0.000	0.0	0.000	0.00	NR	NR			≥12350.000	1589.8
TOC	2.450	1604.750	84.3	≤100.00	NR	NR			NR	NR			≥655.000	84.3
Nitrite	1.000	8000.000	1029.8	≤100.00	NR	NR			NR	NR			≥8000.000	1029.8
Sulfate	1.000	1670.000	215.0	≤100.00	NR	NR			NR	NR			≥1670.000	215.0
Total		90933.583			473537.284				409784.414				98.91 % mass balance	
		9.23 % total solids in wash			48.07 % total solids in acid				41.60 % total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank
Pu-239,240		NR	NR		NA				0.061	7.9			0.061	7.9
C-14		0.031	4.0	≤100.00	NA				NR	NR			≥ 0.031	4.0
Sr-90		NR	NR		NA				238.000	30637.2			238.000	30637.2
Tc-99		NR	NR		NA				0.018	2.3			0.018	2.3
Am-241		NR	NR		NA				0.257	33.0			0.257	33.0
Co-60		0.001	0.1	3.06	NA				0.026948	3.5			0.028	3.6
Cs-137		26.400	3398.4	83.02	NA				5.400	695.1			31.800	4093.5
I-129		NR	NR		NA				NR	NR			NR	NR

NOTES:

1. % Solids as received was 723,000 ug/g sludge; however, samples were stored in hot cell for four months prior to analysis. % Solids was determined to be 985,000 ug/g at time of analysis.

2. Oxide factor 2.79 (85% Al(OH)₃, 15% AlOOH))

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

T-104 (B/PO4 1C)

Density (g/mL)	1.15	estimated
Volume (L)	1672970	
Mass (kg)	1923916	
Solids (ug/g)	293500	
~pH	10.0	

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	155.000	298.2	0.98	16045.000	30869.2	30309.005	99.04	0.000	0.0	0.000	0.00	16200.000	31167.4
Barium	1.117	0.308	0.6	3.49	7.468	14.4	8.341	84.86	1.025	2.0	1.145	11.65	8.800	16.9
Bismuth	1.115	166.750	320.8	0.88	18708.250	35993.1	20859.699	99.12	0.000	0.0	0.000	0.00	18875.000	36313.9
Boron	3.220	11.600	22.3	83.15	2.350	4.5	7.567	16.85	<DL				13.950	26.8
Cadmium	1.142	<DL			1.725	3.3	1.970	31.22	3.800	7.3	4.340	68.78	5.525	10.6
Calcium	1.399	183.500	353.0	27.65	98.250	189.0	137.452	14.80	382.000	734.9	534.418	57.55	663.750	1277.0
Chromium	1.462	144.750	278.5	15.80	771.250	1483.8	1127.568	84.20	0.000	0.0	0.000	0.00	916.000	1762.3
Cobalt	1.407	<DL			1.625	3.1	2.286	14.84	9.325	17.9	13.120	85.16	10.950	21.1
Copper	1.252	<DL			12.675	24.4	15.869	27.01	34.250	65.9	42.881	72.99	46.925	90.3
Iron	1.430	79.550	153.0	0.88	8935.450	17191.1	12777.694	99.12	0.000	0.0	0.000	0.00	9015.000	17344.1
Lead	1.077	<DL			61.175	117.7	65.885	100.00	0.000	0.0	0.000	0.00	61.175	117.7
Magnesium	1.658	6.425	12.4	4.03	97.550	187.7	161.738	61.16	55.525	106.8	92.060	34.81	159.500	306.9
Manganese	1.582	0.410	0.8	0.69	31.190	60.0	49.343	52.33	28.000	53.9	44.296	46.98	59.600	114.7
Nickel	1.409	<DL			12.675	24.4	17.859	100.00	NA				12.675	24.4
Phosphate	1.000	19215.000	36968.0	25.98	52710.000	101409.6	52710.000	71.28	2025.000	3895.9	2025.000	2.74	73950.000	142273.6
Potassium	1.000	37.350	71.9	43.59	48.325	93.0	48.325	56.41	NA				85.675	164.8
Silicon	2.139	172.000	330.9	2.67	851.000	1637.3	1820.289	13.21	5417.000	10421.9	11586.963	84.11	6440.000	12390.0
Silver	1.074	<DL			<DL				<DL				<DL	
Sodium	1.000	46500.000	89462.1	72.12	17975.000	34582.4	17975.000	27.88	0.000	0.0	0.000	0.00	64475.000	124044.5
Strontrium	1.183	1.230	2.4	1.25	97.495	187.6	115.337	98.75	0.000	0.0	0.000	0.00	98.725	189.9
Zinc	1.245	4.325	8.3	2.84	20.575	39.6	25.616	13.53	127.175	244.7	158.333	83.63	152.075	292.6
Zirconium	1.351	2.550	4.9	3.69	66.525	128.0	89.875	96.31	0.000	0.0	0.000	0.00	69.075	132.9
Uranium (1)	1.202	NR	NR		866.750	1667.6	1041.834	<100.00	0.000	0.0	0.000	0.00	866.750	1667.6
Nitrate	1.000	58025.000	111635.2	≤100.00	NR	NR			NR	NR			≥ 58025.000	111635.2
Chloride	1.000	670.250	1289.5	≤100.00	NR	NR			NR	NR			≥ 670.250	1289.5
Fluoride	1.000	8582.500	16512.0	≤100.00	NR	NR			NR	NR			≥ 8582.500	16512.0
Free OH	1.000	NR	NR		NR	NR			NR	NR			NR	NR
Carbonate (3)	1.000	<2750	<5330		NR	NR			NR	NR			<2750	<5330
TOC (3)	2.450	<1220	<969		NR	NR			NR	NR			<1220	<969
Nitrite	1.000	4067.500	7825.5	≤100.00	NR	NR			NR	NR			≥ 4067.500	7825.5
Sulfate	1.000	3857.500	7421.5	99.29	27.500	52.9	27.500	0.71	0.000	0.0			3885.000	7474.4
Total		141883.498				139396.050				14502.556				
		48.34 %total solids in wash				47.49 %total solids in acid				4.94 %total solids in fusion				100.78 % mass balance

Radionuclides	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved
Pu-239,240	NA			<0.018	<34.9		<0.018	<34.9	
C-14	<DL			NR	NR		≥0.000	≥0.0	
Sr-90	NA			2.608	5016.6		≤100.00	2.608	5016.6
Tc-99	NA			0.001	1.2		≤100.00	0.001	1.2
Am-241	NA			0.017	32.5		≤100.00	0.017	32.5
Co-60	NA			<0.0003	<0.6		<0.0003	<0.6	
Cs-137	NA			<0.2	<386		<0.2	<386	
I-129	NA			<0.020	<38.7		<0.02	<38.7	

NOTES:

1. Uranium analysis performed on fused sample only; uranium assumed to be acid soluble

2. Radionuclide analyses on fused sample only, with exception of C-14

3. TOC and Carbonate values less than

4. Cs-137, Co-60, I-129 and Pu239,240 values are less than

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

T-107 [TBP(F), BiPO4 1C]

Density (g/mL)	1.50
Volume (L)	647235
Mass (kg)	970853
Solids (ug/g)	501750
~pH	11.500

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum(1)	1.889	651.000	632.0	3.98	13719.000	13319.1	38276.010	83.96	1970.000	1912.6	3721.330	12.06	16340.000	15863.7
Barium	1.117	NR	NR		NR	NR			NR	NR			NR	
Bismuth	1.115	243.375	236.3	2.03	10611.625	10302.3	11831.962	88.45	1142.500	1109.2	1273.888	9.52	11997.500	11647.8
Boron	3.220	12.970	12.6	100.00	0.000	0.0	0.000	0.00	0.000	0.0	0.000	0.00	12.970	12.6
Cadmium	1.142	NR	NR		NR	NR			NR	NR			NR	
Calcium	1.399	270.500	262.6	35.57	452.000	438.8	632.348	59.43	38.000	36.9	53.162	5.00	760.500	738.3
Chromium	1.462	210.750	204.6	58.54	143.000	138.8	209.066	39.72	6.250	6.1	9.138	1.74	360.000	349.5
Cobalt	1.407	NR	NR		NR	NR			NR	0.0			NR	
Copper	1.252	NR	NR		NR	NR			NR	0.0			NR	
Iron	1.430	355.500	345.1	1.13	31119.500	30212.4	44500.885	98.87	0.000	0.0	0.000	0.00	31475.000	30557.6
Lead	1.077	41.500	40.3	5.21	754.750	732.8	812.866	94.79	0.000	0.0	0.000	0.00	796.250	773.0
Magnesium	1.658	31.950	31.0	14.12	181.550	176.3	301.010	80.24	12.750	12.4	21.140	5.64	226.250	219.7
Manganese	1.582	2.558	2.5	1.15	218.943	212.6	346.367	98.85	0.000	0.0	0.000	0.00	221.500	215.0
Nickel	1.409	8.843	8.6	0.34	283.158	274.9	398.969	10.74	2345.500	2277.1	3304.810	88.93	2637.500	2560.6
Phosphate	1.000	71175.000	69100.4	73.97	18825.000	18276.3	18825.000	19.56	6225.000	6043.6	6225.000	6.47	96225.000	93420.3
Potassium	1.000	315.500	306.3	100.00	0.000	0.0	0.000	0.00	NA				315.500	306.3
Silicon	2.139	1980.600	1922.9	32.70	0.000	0.0	0.000	0.00	4076.900	3958.1	8720.489	67.30	6057.500	5880.9
Silver	1.074	NR	NR		NR	NR			NR	NR			NR	
Sodium	1.000	107900.000	104755.0	82.84	22350.000	21698.6	22350.000	17.16	0.000	0.0	0.000	0.00	130250.000	126453.5
Strontium	1.183	5.530	5.4	0.57	956.720	928.8	1131.800	99.43	0.000	0.0	0.000	0.00	962.250	934.2
Zinc	1.245	NR	NR		NR	NR			NR	NR			NR	
Zirconium	1.351	6.323	6.1	6.79	65.228	63.3	88.122	70.01	21.625	21.0	29.215	23.21	93.175	90.5
Uranium	1.202	NR	NR		25425.000	24683.9	30560.850	100.00	0.000	0.0	0.000	0.00	25425.000	24683.9
Nitrate	1.000	74525.000	72352.8	≤100.00	NR	NR			NR	NR			≥74525.000	72352.8
Chloride	1.000	540.500	524.7	≤100.00	NR	NR			NR	NR			≥540.500	524.7
Fluoride	1.000	11412.500	11079.9	≤100.00	NR	NR			NR	NR			≥11412.500	11079.9
CN	1.000	76.075	73.9	≤100.00	NR	NR			NR	NR			≥76.075	73.9
Carbonate	1.000	4225.000	4101.9	≤100.00	NR	NR			NR	NR			≥4225.000	4101.9
TOC	2.450	4158.875	1648.0	≤100.00	NR	NR			NR	NR			≥1697.500	1648.0
Nitrite	1.000	11717.500	11376.0	≤100.00	NR	NR			NR	NR			≥11717.500	11376.0
Sulfate	1.000	10620.000	10310.5	100.00	0.000	0.0	0.000	0.00	0.000	0.0	0.000	0.00	10620.000	10310.5
Total		300487.348		59.89 % total solids in wash		170265.255		33.93 % total solids in acid		23358.170		4.66 % total solids in fusion		98.48 % mass balance
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		NR	NR		NA			0.152	147.8	≤100.00	0.152	147.8		
C-14		0.000144	0.1	≤100.00	NA			NR	NR		≥ 0.000144	0.1		
Sr-90		NR	NR		NA			108.700	105531.7	≤100.00	108.700	105531.7		
Tc-99		NR	NR		NA			0.051	49.0	≤100.00	0.051	49.0		
Am-241		NR	NR		NA			0.014	13.6	≤100.00	0.014	13.6		
Co-60		0.005	5.0	35.76	NA			0.009	9.1	64.24	0.015	14.1		
Cs-137		9.245	8975.5	43.01	NA			12.250	11892.9	56.99	21.495	20868.5		
I-129		NR	NR		NA			NR	NR		NR	NR		

NOTES:

1. Aluminum oxide factor for acid 2.79 [based on 85% Al(OH)3 and 15% AlOOH]
2. Nitrate on water leach only, would not account for any nitrate associated with cancrinite
3. Sulfur analyses were performed on water, acid, and fusion analyses
4. Co-60 value is less than

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

T-111 (BiPO4 2C, BiPO4 224)

Density (g/mL)	1.10
Volume (L)	1714605
Mass (kg)	1886066
Solids (ug/g)	239800
~pH	10.0

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	10.878	20.5	1.91	530.623	1000.8	1002.346	93.09	28.500	53.8	53.837	5.00	570.000	1075.1
Barium	1.117	0.446	0.8	0.65	68.554	129.3	76.575	99.35	0.000	0.0	0.000	0.00	69.000	130.1
Bismuth	1.115	201.750	380.5	0.78	25748.250	48562.9	28709.299	99.22	0.000	0.0	0.000	0.00	25950.000	48943.4
Boron	3.220	4.073	7.7	12.69	28.025	52.9	90.241	87.31	0.000	0.0	0.000	0.00	32.098	60.5
Cadmium	1.142	0.400	0.8	4.91	5.401	10.2	6.167	66.39	2.335	4.4	2.667	28.70	8.135	15.3
Calcium	1.399	61.575	116.1	2.54	1818.425	3429.7	2543.977	75.06	542.500	1023.2	758.958	22.39	2422.500	4569.0
Chromium	1.462	218.250	411.6	11.05	1756.750	3313.3	2568.369	88.95	0.000	0.0	0.000	0.00	1975.000	3725.0
Cobalt	1.407	0.818	1.5	7.11	3.482	6.6	4.900	30.28	7.200	13.6	10.130	62.61	11.500	21.7
Copper	1.252	0.400	0.8	1.19	33.151	62.5	41.504	98.81	0.000	0.0	0.000	0.00	33.550	63.3
Iron	1.430	127.650	240.8	0.69	18372.350	34651.5	26272.461	99.31	0.000	0.0	0.000	0.00	18500.000	34892.2
Lead	1.077	6.853	12.9	1.88	339.898	641.1	366.070	93.12	18.250	34.4	19.655	5.00	365.000	688.4
Magnesium	1.658	3.640	6.9	0.96	373.610	704.7	619.445	99.04	0.000	0.0	0.000	0.00	377.250	711.5
Manganese	1.582	24.750	46.7	0.39	6305.250	11892.1	9974.906	99.61	0.000	0.0	0.000	0.00	6330.000	11938.8
Nickel	1.409	1.700	3.2	1.29	129.800	244.8	182.888	98.71	0.0	0.000	0.000	0.00	131.500	248.0
Phosphate	1.000	17040.000	32138.6	54.51	13875.000	26169.2	13875.000	44.39	345.000	650.7	345.000	1.10	31260.000	58958.4
Potassium	1.000	719.250	1356.6	63.37	415.750	784.1	415.750	36.63	0.000	0.0	0.000	0.00	1135.000	2140.7
Silicon	2.139	571.750	1078.4	10.09	0.000	0.0	0.000	0.00	5095.750	9610.9	10899.809	89.91	5667.500	10689.3
Silver	1.074	0.713	1.3	0.56	125.362	236.4	134.639	98.02	1.825	3.4	1.960	1.43	127.900	241.2
Sodium	1.000	32950.000	62145.9	89.11	3950.000	7450.0	3950.000	10.68	75.000	141.5	75.000	0.20	36975.000	69737.3
Strontium	1.183	1.965	3.7	0.66	285.785	539.0	338.084	95.98	10.000	18.9	11.830	3.36	297.750	561.6
Zinc	1.245	0.300	0.6	0.28	64.600	121.8	80.427	60.80	41.350	78.0	51.481	38.92	106.250	200.4
Zirconium	1.351	0.800	1.5	20.00	0.037	0.1	0.050	0.92	3.163	6.0	4.274	79.08	4.000	7.5
Uranium (1)	1.202	NR	NR		2797.500	5276.3	3362.595	100.00	0.000	0.0	0.000	0.00	2797.500	5276.3
Nitrate	1.000	41275.000	77847.4	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥41275.000	77847.4
Chloride	1.000	450.000	848.7	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥450.000	848.7
Fluoride	1.000	2310.000	4356.8	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥2310.000	4356.8
Lanthanum	1.430	11.035	20.8	0.26	4206.465	7933.7	6015.245	99.82	0.000	0.0	0.000	0.00	4214.182	7948.2
Carbonate	1.000	4058.750	7655.1	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥4058.750	7655.1
TOC	2.450	7644.000	5884.5	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥3120.000	5884.5
Nitrite	1.000	793.000	1495.6	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥793.000	1495.6
Sulfate	1.000	3547.500	6690.8	96.53	90.000	169.7	90.000	2.45	37.500	70.7	37.500	1.02	3675.000	6931.3
Total		112037.243			100720.935				12272.100				93.84 % mass balance	
		46.72 %total solids in wash			42.00 %total solids in acid				5.12 %total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		NR	NR		NA			0.139	261.7	≤100.00	0.139	261.7		
C-14		<0.000225	<0.4		NA			NR	NR		<0.000225	<0.4		
Sr-90		NR	NR		NA			5.418	10217.8	≤100.00	5.418	10217.8		
Tc-99		NR	NR		NA			0.007	12.7	≤100.00	0.007	12.7		
Am-241		NR	NR		NA			0.043	80.4	≤100.00	0.043	80.4		
Co-60		NR	NR		NA			<0.000421	<0.8	≤100.00	<0.000421	<0.8		
Cs-137		NR	NR		NA			0.166	313.6	≤100.00	0.166	313.6		
I-129		NR	NR		NA			<0.02	<38	≤100.00	<0.02	<38		

NOTES:

1. Uranium analysis performed on fused sample only; uranium assumed to be acid soluble

2. Radionuclide analyses on fused sample only, with exception of C-14

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

TY-101 (B1P04 1C, EB)

Density (g/mL)	1.64
Volume (L)	446630
Mass (kg)	732473
Solids (ug/g)	565000
~pH	NR

(drainable liquor pH 9.9)

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL		
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide) % element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide) % element dissolved	ug/g sludge (element)	kg/tank (element)	
Aluminum	1.889	39.000	28.6	0.13	13400.000	9815.1	25312.600 46.14	15600.000	11426.6	29468.400 53.72	29039.000	21270.3	
Barium	1.117	0.392	0.3	0.02	16.700	12.2	18.654 0.87	1910.000	1399.0	2133.470 99.11	1927.092	1411.5	
Bismuth	1.115	8.630	6.3	0.03	26500.000	19410.5	29547.500 97.33	717.000	525.2	799.455 2.63	27225.630	19942.0	
Boron	3.220	NR	NR		NR	NR		NR	NR		NR	NR	
Cadmium	1.142	1.960	1.4	18.48	3.140	2.3	3.586 29.57	5.520	4.0	6.304 51.98	10.620	7.8	
Calcium	1.399	NR	NR		NR	NR		NR	NR		NR	NR	
Chromium	1.462	424.000	310.6	5.05	500.000	366.2	731.000 5.95	7480.000	5478.9	10935.780 89.01	8404.000	6155.7	
Cobalt	1.407	NR	NR		NR	NR		NR	NR		NR	NR	
Copper	1.252	NR	NR		NR	NR		NR	NR		NR	NR	
Iron	1.430	53.100	38.9	0.13	13000.000	9522.2	18590.000 32.38	27100.000	19850.0	38753.000 67.49	40153.100	29411.1	
Lead	1.077	6.360	4.7	2.84	157.000	115.0	169.089 70.04	60.800	44.5	65.482 27.12	224.160	164.2	
Magnesium	1.658	NR	NR		NR	NR		NR	NR		NR	NR	
Manganese	1.582	15.700	11.5	2.81	38.300	28.1	60.591 6.86	504.000	369.2	797.328 90.32	558.000	408.7	
Nickel	1.409	76.700	56.2	1.51	895.000	655.6	1261.055 17.58	4120.000	3017.8	5805.080 80.92	5091.700	3729.5	
Phosphate	1.000	16170.000	11844.1	21.78	57300.000	41970.7	57300.000 77.20	756.000	553.7	756.000 1.02	74226.000	54368.6	
Potassium	1.000	NR	NR		NR	NR		NR	NR		NR	NR	
Silicon	2.139	322.000	235.9	0.83	657.000	481.2	1405.323 1.70	37700.000	27614.2	80640.300 97.47	38679.000	28331.3	
Silver	1.074	0.785	0.6	20.41	0.981	0.7	1.054 25.51	2.080	1.5	2.234 54.08	3.846	2.8	
Sodium	1.000	75000.000	54935.5	61.83	33300.000	24391.4	33300.000 27.45	13000.000	9522.2	13000.000 10.72	121300.000	88849.0	
Strontium	1.183	NR	NR		NR	NR		NR	NR		NR	NR	
Zinc	1.245	NR	NR		NR	NR		NR	NR		NR	NR	
Zirconium	1.351	3.610	2.6	0.94	4.510	3.3	6.093 1.17	377.000	276.1	509.327 97.89	385.120	282.1	
Uranium	1.202	11.200	8.2	0.48	2290.000	1677.4	2752.580 97.92	37.500	27.5	45.075 1.60	2338.700	1713.0	
Nitrate	1.000	145000.000	106208.6	≤100.00	NR	NR		NR	NR		≥145000.000	106208.6	
Chloride	1.000	757.000	554.5	≤100.00	NR	NR		NR	NR		≥757.000	554.5	
Fluoride	1.000	3370.000	2468.4	≤100.00	NR	NR		NR	NR		≥3370.000	2468.4	
Free OH	1.000	0.212	0.2	≤100.00	NR	NR		NR	NR		≥ 0.212	0.2	
Carbonate	1.000	NR	NR		NR	NR		NR	NR		NR	NR	
TOC	2.450	619.850	185.3	38.16	410.000	300.3	1004.500 61.84	NR	NR		663.000	485.6	
Nitrite	1.000	NR	NR		NR	NR		NR	NR		NR	NR	
Sulfate	1.000	5490.000	4021.3	≤100.00	NR	NR		NR	NR		≥ 5490.000	4021.3	
Total		247370.499			171463.624			183717.214			106.65 % mass balance		
		43.78 % total solids in wash			30.35 % total solids in acid			32.52 % total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	
Pu-239,240		0.001	0.7	0.52	0.119	87.2	61.98	0.072	52.7	37.50	0.192	140.6	
C-14		0.000	0.2	42.86	0.000	0.3	57.14	NR	NR		0.001	0.5	
Sr-90		0.000	0.0	0.00	12.200	8936.2	97.76	0.279	204.4	2.24	12.479	9140.5	
Tc-99		0.004	2.9	57.14	0.003	2.2	42.86	0.000	0.0	0.00	0.007	5.1	
Am-241		0.000	0.0	0.00	0.002	1.5	15.38	0.011	8.1	84.62	0.013	9.5	
Co-60		0.000	0.0	0.00	0.005	3.7	50.00	0.005	3.7	50.00	0.010	7.3	
Cs-137		0.000	0.0	0.00	0.163	119.4	57.39	0.121	88.6	42.61	0.284	208.0	
I-129		0.000047	0.03	≤100.00	NR	NR	0.00	NR	NR		≥ 0.000047	0.03	

NOTES:

1. Nitrate on water leach only, would not account for any nitrate associated with cancrinite
2. No analyses for Ca, B, total Co, Cu, Mg, K, total Sr, total Cs, Zn
3. Reported value of 4.7e-5 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

TY-103 (TBP, BiPO4 1C-F)

Density (g/mL) 1.70
 Volume (L) 613170
 Mass (kg) 1042389
 Solids (ug/g) 475000
 ~pH NR

(drainable liquor pH 9.5 - 12.2)

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	4.240	4.4	0.05	7780.000	8109.8	14696.420	94.74	428.000	446.1	808.492	5.21	8212.240	8560.3
Barium	1.117	7.070	7.4	1.41	41.300	43.1	46.132	8.25	452.000	471.2	504.884	90.33	500.370	521.6
Bismuth	1.115	7.040	7.3	0.03	27400.000	28561.5	30551.000	99.95	5.510	5.7	6.144	0.02	27412.550	28574.5
Boron	3.220	NR	NR		NR	NR			NR	NR			NR	NR
Cadmium	1.142	1.610	1.7	21.10	4.870	5.1	5.562	63.83	1.150	1.2	1.313	15.07	7.630	8.0
Calcium	1.399	NR	NR		NR	NR			NR	NR			NR	NR
Chromium	1.462	406.000	423.2	40.49	588.000	612.9	859.656	58.64	8.730	9.1	12.763	0.87	1002.730	1045.2
Cobalt	1.407	NR	NR		NR	NR			NR	NR			NR	NR
Copper	1.252	NR	NR		NR	NR			NR	NR			NR	NR
Iron	1.430	156.000	162.6	0.66	22600.000	23558.0	32318.000	94.93	1050.000	1094.5	1501.500	4.41	23806.000	24815.1
Lead	1.077	5.210	5.4	1.11	441.000	459.7	474.957	94.13	22.300	23.2	24.017	4.76	468.510	488.4
Magnesium	1.658	NR	NR		NR	NR			NR	NR			NR	NR
Manganese	1.582	12.900	13.4	8.06	138.000	143.8	218.316	86.21	9.180	9.6	14.523	5.73	160.080	166.9
Nickel	1.409	63.600	66.3	2.51	1350.000	1407.2	1902.150	53.28	1120.000	1167.5	1578.080	44.21	2533.600	2641.0
Phosphate	1.000	18930.000	19732.4	30.10	43800.000	45856.6	43800.000	69.65	158.400	165.1	158.400	0.25	62888.400	65554.2
Potassium	1.000	NR	NR		NR	NR			NR	NR			NR	NR
Silicon	2.139	72.600	75.7	0.77	514.000	535.8	1099.446	5.46	8820.000	9193.9	18865.980	93.76	9406.600	9805.3
Silver	1.074	0.643	0.7	7.14	7.440	7.8	7.991	82.66	0.918	1.0	0.986	10.20	9.001	9.4
Sodium	1.000	73900.000	77032.5	69.77	28600.000	29812.3	28600.000	27.00	3420.000	3565.0	3420.000	3.23	105920.000	110409.8
Strontium	1.183	NR	NR		NR	NR			NR	NR			NR	NR
Zinc	1.245	NR	NR		NR	NR			NR	NR			NR	NR
Zirconium	1.351	2.960	3.1	5.73	4.220	4.4	5.701	8.17	44.500	46.4	60.120	86.11	51.680	53.9
Uranium	1.202	41.400	43.2	0.25	16200.000	16886.7	19472.400	99.71	6.060	6.3	7.284	0.04	16247.460	16936.2
Nitrate	1.000	149000.000	155316.0	95.54	6950.000	7244.6	6950.000	4.46	NR	NR			155950.000	162560.6
Chloride	1.000	1200.000	1250.9	≤100.00	NR	NR			NR	NR			≥ 1200.000	1250.9
Fluoride	1.000	860.000	896.5	≤100.00	NR	NR			NR	NR			≥ 860.000	896.5
Free OH	1.000	86.800	90.5	≤100.00	NR	NR			NR	NR			≥ 86.800	90.5
Carbonate	1.000	4780.000	4982.6	≤100.00	NR	NR			NR	NR			≥ 4780.000	4982.6
TOC	2.450	2425.500	1032.0	66.40	501.000	522.2	1227.450	33.60	NR	NR			1491.000	1554.2
Nitrite	1.000	8100.000	8443.4	≤100.00	NR	NR			NR	NR			≥ 8100.000	8443.4
Sulfate	1.000	9260.000	9652.5	94.56	533.000	555.6	533.000	5.44	NR	NR			9793.000	10208.1
Total		269323.573				182768.180				26964.486				
		56.70 %total solids in wash				38.48 %total solids in acid				5.68 %total solids in fusion			100.85 % mass balance	
Radionuclides		uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank	% dissolved		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank
Pu-239,240		0.000	0.2	0.10		0.175	182.4	99.34	0.001	1.0		0.57	0.176	183.6
C-14		0.001	1.0	71.43		0.0004	0.4	28.57	NR	NR			0.001	1.5
Sr-90		0.009	9.4	0.01		105.000	109450.8	99.97	0.024	25.0		0.02	105.033	109485.2
Tc-99		0.011	11.5	68.75		0.005	5.2	31.25	0.000	0.0		0.00	0.016	16.7
Am-241		0.001	1.0	3.70		0.025	26.1	92.59	0.001	1.0		3.70	0.027	28.1
Co-60		0.001	1.0	20.00		0.003	3.1	60.00	0.001	1.0		20.00	0.005	5.2
Cs-137		0.001	1.0	0.00		2.000	2084.8	8.10	22.700	23662.2		91.90	24.701	25748.1
I-129		0.003	2.8	≤100.00		NR	NR		NR	NR			≥ 0.003	2.8

NOTES:

- No analyses for Ca, B, total Co, Cu, Mg, K, total Sr, total Cs, Zn
- Reported value of <2.7e-3 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

TY-104 (TBP,BIP04 1C-F)

Density (g/mL)	1.69
Volume (L)	162755
Mass (kg)	275056
Solids (ug/g)	430250
~pH	NR

(drainable liquor pH 12.1)

Component	Oxide Factor	WATER			ACID				FUSION				TOTAL	
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	414.500	114.0	4.56	6957.500	1913.7	13142.718	76.54	1718.500	472.7	3246.247	18.90	9090.500	2500.4
Barium	1.117	0.948	0.3	0.21	52.950	14.6	59.145	11.96	389.000	107.0	434.513	87.83	442.898	121.8
Bismuth	1.115	10.055	2.8	0.06	17650.000	4854.7	19679.750	99.42	92.758	25.5	103.425	0.52	17752.813	4883.0
Boron	3.220	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Cadmium	1.142	3.140	0.9	24.48	8.398	2.3	9.590	65.48	1.288	0.4	1.470	10.04	12.825	3.5
Calcium	1.399	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Chromium	1.462	1794.000	493.5	77.63	509.250	140.1	744.524	22.04	7.813	2.1	11.422	0.34	2311.063	635.7
Cobalt	1.407	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Copper	1.252	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Iron	1.430	85.775	23.6	0.26	31325.000	8616.1	44794.750	96.18	1159.750	319.0	1658.443	3.56	32570.525	8958.7
Lead	1.077	10.263	2.8	1.77	558.500	153.1	599.351	96.02	12.818	3.5	13.804	2.21	579.580	159.4
Magnesium	1.658	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Manganese	1.582	15.018	4.1	0.72	2060.000	566.6	3258.920	98.63	13.645	3.8	21.586	0.65	2088.663	574.5
Nickel	1.409	16.650	4.6	1.07	1440.000	396.1	2028.960	92.69	96.985	26.7	136.652	6.24	1553.635	427.3
Phosphate	1.000	53332.500	14669.4	67.87	24825.000	6828.3	24825.000	31.59	422.775	116.3	422.775	0.54	78580.275	21614.0
Potassium	1.000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Silicon	2.139	162.650	44.7	2.01	229.750	63.2	491.435	2.84	7700.000	2117.9	16470.300	95.15	8092.400	2225.9
Silver	1.074	2.785	0.8	22.48	8.818	2.4	9.470	71.17	0.788	0.2	0.846	6.36	12.390	3.4
Sodium	1.000	86150.000	23696.1	76.15	24025.000	6608.2	24025.000	21.24	2962.500	814.9	2962.500	2.62	113137.500	31119.1
Strontium	1.183	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Zinc	1.245	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Zirconium	1.351	4.710	1.3	2.59	5.300	1.5	7.160	2.92	171.500	47.2	231.697	94.49	181.510	49.9
Uranium	1.202	37.950	10.4	0.19	19300.000	5308.6	23198.600	99.16	124.708	34.3	149.899	0.64	19462.658	5353.3
Nitrate	1.000	44675.000	12288.1	95.87	1922.500	528.8	1922.500	4.13	NR	NR	NR	NR	46597.500	12816.9
Chloride	1.000	598.000	164.5	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 598.000	164.5
Fluoride	1.000	5352.500	1472.2	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 5352.500	1472.2
Free OH	1.000	1289.500	354.7	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 1289.500	354.7
Carbonate	1.000	18250.000	5019.8	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 18250.000	5019.8
TOC	2.450	4012.488	450.5	84.54	299.500	82.4	733.775	15.46	NR	NR	NR	NR	1937.250	532.9
Nitrite	1.000	12217.500	3360.5	≤100.00	NR	NR	NR	NR	NR	NR	NR	NR	≥ 12217.500	3360.5
Sulfate	1.000	4047.500	1113.3	77.46	1177.500	323.9	1177.500	22.54	NR	NR	NR	NR	5225.000	1437.2
Total		232483.431			160708.147				25865.578					
		54.03 %total solids in wash			37.35 %total solids in acid				6.01 %total solids in fusion				97.40 % mass balance	
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		0.001	0.2	0.47	0.173	47.6	95.66	0.007	1.9	3.87	0.181	49.7		
C-14		0.002	0.6	64.52	0.001	0.3	35.48	0.000	0.0	0.00	0.003	0.9		
Sr-90		0.039	10.8	0.03	131.250	36101.1	99.69	0.368	100.5	0.28	131.655	36212.4		
Tc-99		0.024	6.6	73.28	0.007	1.9	20.61	0.002	0.6	6.11	0.033	9.0		
Am-241		0.002	0.6	5.97	0.029	7.8	85.07	0.003	0.8	8.96	0.034	9.2		
Co-60		0.003	0.8	12.17	0.018	5.0	80.75	0.002	0.4	7.08	0.023	6.2		
Cs-137		16.455	4526.0	36.26	10.195	2804.2	22.47	18.727	5151.0	41.27	45.377	12481.2		
I-129		0.0000335	0.01	≤100.00	NR	NR	NR	NR	NR	NR	≥0.0000335	0.01		

NOTES:

- No analyses for Ca, B, total Co, Cu, Mg, K, total Sr, total Cs, Zn
- Reported value of 3.35e-5 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

TY-105 (TBP)

Density (g/mL)	1.53
Volume (L)	874335
Mass (kg)	1337733
Solids (ug/g)	606000
~pH	NR

(drainable liquor pH 8.7)

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	2.220	3.0	0.12	1910.000	2555.1	3607.990	99.88	NR				1912.220	2558.0
Barium	1.117	3.180	4.3	6.38	46.700	62.5	52.164	93.62	NA				49.880	66.7
Bismuth	1.115	7.190	9.6	1.84	383.000	512.4	427.045	98.16	NA				390.190	522.0
Boron	3.220	NR	NR		NR	NR			NA				NR	NR
Cadmium	1.142	1.640	2.2	29.98	3.830	5.1	4.374	70.02	NA				5.470	7.3
Calcium	1.399	NR	NR		NR	NR			NA				NR	NR
Chromium	1.462	23.400	31.3	17.67	109.000	145.8	159.358	82.33	NA				132.400	177.1
Cobalt	1.407	NR	NR		NR	NR			NA				NR	NR
Copper	1.252	NR	NR		NR	NR			NA				NR	NR
Iron	1.430	0.589	0.8	0.00	20900.000	27958.6	29887.000	100.00	NA				20900.589	27959.4
Lead	1.077	5.300	7.1	1.36	383.000	512.4	412.491	98.64	NA				388.300	519.4
Magnesium	1.658	NR	NR		NR	NR			NA				NR	NR
Manganese	1.582	13.100	17.5	8.03	150.000	200.7	237.300	91.97	NA				163.100	218.2
Nickel	1.409	1.050	1.4	1.23	84.100	112.5	118.497	98.77	NA				85.150	113.9
Phosphate	1.000	7860.000	10514.6	6.75	108600.000	145277.8	108600.000	93.25	NA				116460.000	155792.3
Potassium	1.000	NR	0.0		NR	NR			NA				NR	NR
Silicon	2.139	68.700	91.9	18.68	299.000	400.0	639.561	81.32	NA				367.700	491.9
Silver	1.074	0.654	0.9	41.18	0.934	1.2	1.003	58.82	NA				1.588	2.1
Sodium	1.000	81800.000	109426.5	70.95	33500.000	44814.0	33500.000	29.05	NA				115300.000	154240.6
Strontium	1.183	NR	NR		NR	NR			NA				NR	NR
Zinc	1.245	NR	NR		NR	NR			NA				NR	NR
Zirconium	1.351	3.010	4.0	41.18	4.300	5.8	5.809	58.82	NA				7.310	9.8
Uranium	1.202	14.100	18.9	0.26	5380.000	7197.0	6466.760	99.74	NA				5394.100	7215.9
Nitrate	1.000	178000.000	238116.4	≤100.00	NR	NR			NA				≥178000.000	238116.4
Chloride	1.000	NR	NR		NR	NR			NA				NR	NR
Fluoride	1.000	NR	NR		NR	NR			NA				NR	NR
Free OH	1.000	0.533	0.7	≤100.00	NR	NR			NA				≥ 0.533	0.7
Carbonate	1.000	NR	NR		NR	NR			NA				NR	NR
TOC	2.450	1153.950	630.1	58.44	335.000	448.1	820.750	41.56	NA				806.000	1078.2
Nitrite	1.000	NR	NR		NR	NR			NA				NR	NR
Sulfate	1.000	NR	NR		NR	NR			NA				NR	NR
Total		268958.616				184940.102			0.000				74.90 % mass balance	
		44.38 %total solids in wash				30.52 %total solids in acid			0.00 %total solids in fusion					
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		
Pu-239,240		0.001	1.3	4.00	0.024	32.1	96.00	NA			0.025	33.4		
C-14		0.000	0.4	41.18	0.000	0.5	58.82	NA			0.001	0.9		
Sr-90		0.020	26.8	0.01	229.000	306340.8	99.99	NA			229.020	306367.5		
Tc-99		0.026	34.8	78.79	0.007	9.4	21.21	NA			0.033	44.1		
Am-241		0.002	2.7	6.25	0.030	40.1	93.75	NA			0.032	42.8		
Co-60		0.001	1.3	6.67	0.014	18.7	93.33	NA			0.015	20.1		
Cs-137		6.460	8641.8	67.93	3.050	4080.1	32.07	NA			9.510	12721.8		
I-129		0.0000344	0.05	≤100.00	NR	NR					≥ 0.0000344	0.05		

NOTES:

- No analyses for Ca, B, total Co, Cu, Mg, K, total Sr, total Cs, Zn
- Reported value of 4.7e-5 uCi/g for I is direct report value for total sample

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

TY-106 (TBP, 27t diatomaceous earth)

Density (g/mL)	1.37
Volume (L)	64345
Mass (kg)	88153
Solids (ug/g)	638500
~pH	NR (drainable liquor pH ~9)

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum	1.889	3.075	0.3	0.04	1241.000	109.4	2344.249	18.12	5605.000	494.1	10587.845	81.84	6849.075	603.8
Barium	1.117	7.879	0.7	0.60	570.500	50.3	637.249	43.55	731.500	64.5	817.086	55.84	1309.879	115.5
Bismuth	1.115	9.840	0.9	1.88	425.000	37.5	473.875	81.12	89.050	7.8	99.291	17.00	523.890	46.2
Boron	3.220	NR	NR		NR	NR			NR	NR			NR	NR
Cadmium	1.142	2.260	0.2	7.94	5.865	0.5	6.698	20.60	20.350	1.8	23.240	71.47	28.475	2.5
Calcium	1.399	NR	NR		NR	NR			NR	NR			NR	NR
Chromium	1.462	1.505	0.1	1.06	112.450	9.9	164.402	79.05	28.300	2.5	41.375	19.89	142.255	12.5
Cobalt	1.407	NR	NR		NR	NR			NR	NR			NR	NR
Copper	1.252	NR	NR		NR	NR			NR	NR			NR	NR
Iron	1.430	4.363	0.4	0.01	24200.000	2133.3	34606.000	52.84	21590.000	1903.2	30873.700	47.15	45794.363	4036.9
Lead	1.077	7.330	0.8	1.91	280.000	24.7	301.560	73.02	96.150	8.5	103.554	25.07	383.480	33.8
Magnesium	1.658	NR	NR		NR	NR			NR	NR			NR	NR
Manganese	1.582	18.100	1.6	3.27	181.000	16.0	286.342	32.67	355.000	31.3	561.610	64.07	554.100	48.8
Nickel	1.409	1.450	0.1	2.12	48.050	4.2	67.702	70.40	18.750	1.7	26.419	27.47	68.250	6.0
Phosphate	1.000	12555.000	1106.8	21.71	43800.000	3861.1	43800.000	75.72	1488.000	131.2	1488.000	2.57	57843.000	5099.0
Potassium	1.000	NR	NR		NR	NR			NR	NR			NR	NR
Silicon	2.139	55.900	4.9	0.06	632.000	55.7	1351.848	0.71	88250.000	7779.5	188766.750	99.23	88937.900	7840.1
Silver	1.074	0.906	0.1	3.27	21.523	1.9	23.115	77.73	5.260	0.5	5.649	19.00	27.689	2.4
Sodium	1.000	79600.000	7017.0	75.32	17950.000	1582.3	17950.000	16.99	8130.000	716.7	8130.000	7.69	105680.000	9316.0
Strontium	1.183	NR	NR		NR	NR			NR	NR			NR	NR
Zinc	1.245	NR	NR		NR	NR			NR	NR			NR	NR
Zirconium	1.351	4.160	0.4	0.64	9.625	0.8	13.003	1.49	633.500	55.8	855.859	97.87	647.285	57.1
Uranium	1.202	2.801	0.2	0.03	8125.000	716.2	9766.250	97.31	222.000	19.6	266.844	2.66	8349.801	736.1
Nitrate	1.000	166500.000	14677.4	97.28	4662.000	411.0	4662.000	2.72	NR	NR			171162.000	15088.4
Chloride	1.000	1232.100	108.6	≤100.00	NR	NR			NR	NR			≥ 1232.100	108.6
Fluoride	1.000	699.300	61.6	≤100.00	NR	NR			NR	NR			≥ 699.300	61.6
Free OH	1.000	1.049	0.1	≤100.00	NR	NR			NR	NR			≥ 1.049	0.1
Carbonate	1.000	1015.650	89.5	≤100.00	NR	NR			NR	NR			≥ 1015.650	89.5
TOC	2.450	3797.500	136.6	67.94	731.500	64.5	1792.175	32.06	NR	NR			2281.500	201.1
Nitrite	1.000	5661.000	499.0	≤100.00	NR	NR			NR	NR			≥ 5661.000	499.0
Sulfate	1.000	11988.000	1056.8	86.01	1950.000	171.9	1950.000	13.99	NR	NR			13938.000	1228.7
Total		283169.166			120196.468					242647.220				
		44.35 %total solids in wash			18.82 %total solids in acid				38.00 %total solids in fusion				101.18 % mass balance	
Radionuclides		uCi/g	Ci/tank	% dissolved	uCi/g	Ci/tank		% dissolved	uCi/g	Ci/tank		% dissolved	uCi/g	Ci/tank
Pu-239,240		0.001	0.1	1.72	0.033	2.9		81.08	0.007	0.6		17.20	0.041	3.6
C-14		0.001	0.0	40.00	0.001	0.1		60.00	0.000	0.0		0.00	0.001	0.1
Sr-90		0.058	5.1	0.04	133.500	11768.4		98.34	2.195	193.5		1.62	135.752	11966.9
Tc-99		0.105	9.3	86.42	0.017	1.5		13.58	0.000	0.0		0.00	0.122	10.7
Am-241		0.006	0.5	12.37	0.025	2.2		50.52	0.018	1.6		37.11	0.049	4.3
Co-60		0.001	0.1	3.69	0.007	0.6		20.87	0.024	2.1		75.44	0.031	2.7
Cs-137		4.930	434.6	20.77	9.705	855.5		40.89	9.100	802.2		38.34	23.735	2092.3
I-129		0.001	0.1	≤100.00	NR	NR			NR	NR			≥ 0.001	0.1

NOTES:

1. No analyses for Ca, B, total Co, Cu, Mg, K, total Sr, total Cs, Zn

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

U-110 (BiPO4 1C, CW) (1)

Density (g/mL)	1.50
Volume (L)	704010
Mass (kg)	1056015
Solids (ug/g)	741700
-pH	12.6-13

Component	Oxide Factor	WATER			ACID			FUSION			TOTAL			
		ug/g sludge (element)	kg/tank (element)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)	ug/g sludge (oxide)	% element dissolved	ug/g sludge (element)	kg/tank (element)
Aluminum (2)	1.889	2666.000	2815.3	1.59	116874.500	123421.2	326079.855	69.51	48606.000	51328.7	106933.200	28.91	168146.500	177565.2
Barium	1.117	5.500	5.8	10.58	23.000	24.3	25.691	44.23	23.500	24.8	26.250	45.19	52.000	54.9
Bismuth	1.115	<DL			9421.500	9949.2	10504.973	67.54	4528.500	4782.2	5049.278	32.46	13950.000	14731.4
Boron	3.220	285.500	301.5	100.00	0.000	0.0	0.000	0.00	0.000	0.0	0.000	0.00	285.500	301.5
Cadmium	1.142	<DL			16.000	16.9	18.272	100.00	<40	0.0	0.000	0.00	16.000	16.9
Calcium	1.399	109.000	115.1	3.83	206.500	218.1	288.894	7.26	2530.500	2672.2	3540.170	88.91	2846.000	3005.4
Chromium	1.462	232.500	245.5	59.39	159.000	167.9	232.458	40.61	0.000	0.0	0.000	0.00	391.500	413.4
Cobalt	1.407	117.000	123.6	100.00	NR	NR			<250	<264			117.000	123.6
Copper	1.252	<DL			184.500	194.8	230.994	64.06	103.500	109.3	129.582	35.94	288.000	304.1
Iron	1.430	32.000	33.8	0.32	7603.000	8028.9	10872.290	75.44	2443.500	2580.4	3494.205	24.24	10078.500	10643.0
Lead	1.077	57.000	60.2	11.60	434.500	458.8	467.957	88.40	0.000	0.0	0.000	0.00	491.500	519.0
Magnesium	1.658	317.000	334.8	23.31	0.000	0.0	0.000	0.00	1043.000	1101.4	1729.294	76.69	1360.000	1436.2
Manganese	1.582	<DL			2357.500	2489.6	3729.565	100.00	0.000	0.0	0.000	0.00	2357.500	2489.6
Nickel	1.409	<DL			93.500	98.7	131.742	2.62	3473.000	3667.5	4893.457	97.38	3566.500	3766.3
Phosphate (3)	1.000	43880.000	46337.9	100.00	0.000	0.0	0.000	0.00	NR	NR			43880.000	46337.9
Potassium	1.000	<600	<633		1210.000	1277.8	1210.000	100.00	NA				1210.000	1277.8
Silicon	2.139	822.500	868.6	7.53	NR	NR			10097.500	10663.1	21598.553	92.47	10920.000	11531.7
Silver	1.074	<DL			67.500	71.3	72.495	100.00	<122	<130			67.500	71.3
Sodium	1.000	65779.500	69464.1	60.61	11697.000	12352.2	11697.000	10.78	31059.500	32799.3	31059.500	28.62	108536.000	114615.6
Strontium	1.183	3.500	3.7	0.87	294.000	310.5	347.802	73.13	104.500	110.4	123.624	26.00	402.000	424.5
Zinc	1.245	25.500	26.9	13.97	113.500	119.9	141.308	62.19	43.500	45.9	54.158	23.84	182.500	192.7
Zirconium	1.351	<DL			141.500	149.4	191.167	64.46	78.000	82.4	105.378	35.54	219.500	231.8
Uranium	1.202	<3000	<3170		8519.000	8996.2	10239.838	100.00	0.000	0.0	0.000	0.00	8519.000	8996.2
Nitrate	1.000	31750.000	33528.5	<100.00	NR	NR			NR	NR			≥ 31750.000	33528.5
Chloride	1.000	975.000	1029.6	≤100.00	NR	NR			NR	NR			≥ 975.000	1029.6
Fluoride	1.000	7427.500	7843.6	≤100.00	NR	NR			NR	NR			≥ 7427.500	7843.6
Free OH (4)	1.000	5000.000	5280.1	≤100.00	NR	NR			NR	NR			≥ 5000.000	5280.1
Carbonate	1.000	16025.000	16922.6	≤100.00	NR	NR			NR	NR			≥ 16025.000	16922.6
TOC	2.450	3317.300	1429.8	≤100.00	NR	NR			NR	NR			≥ 1354.000	1429.8
Nitrite	1.000	6620.000	6990.8	≤100.00	NR	NR			NR	NR			≥ 6620.000	6990.8
Sulfate	1.000	1210.000	1277.8	93.80	0.000	0.0	0.000	0.00	80.000	84.5	80.000	6.20	1290.000	1362.3
Total		186657.300			376482.298				178816.646					
		25.17 %total solids in wash			50.76 %total solids in acid				24.11 %total solids in fusion				100.03 % mass balance	
Radionuclides	uCi/g	Cl/tank	% dissolved		uCi/g	Cl/tank		% dissolved	uCi/g	Cl/tank		% dissolved	uCi/g	Cl/tank
Pu-239,240	0.001	1.2	0.65		NA				0.171	180.5		99.35	0.172	181.6
C-14	0.000128	0.1	100.00		NA				NR	NR			0.000	0.1
Sr-90	0.231	243.9	0.09		NA				260.500	275091.9		99.91	260.731	275335.8
Tc-99	0.003	3.6	68.20		NA				0.002	1.7		31.80	0.005	<5.3
Am-241	<0.002	<2.1	0.00		NA				0.064	67.6		100.00	0.064	67.6
Co-60	NR	NR			NA				NR	NR			NR	NR
Cs-137	4.003	4226.7	22.55		NA				13.748	14517.6		77.45	17.750	18744.3
I-129	<0.005	<5.3			NA				<0.003	<3.2			<0.003	<3.2

NOTES:

1. Core Composites 7 and 14 had good segment recovery and were chosen to represent U-110

2. Acid soluble oxide factor 2.79 (85% Al(OH)3, 15% AlOOH); fusion soluble oxide factor 2.22 (AlOOH)

3. Na7F(PO4)2 has been I.D'd (XRD); this salt dissolves in water, however dissolution decreases as [NaOH] increases

4. Free OH estimated based on concentration of Al in water wash

NR - Not Reported

NA - No Analysis Performed

<DL - Less than Detection Limit

2.2 Data References

Tank I.D.

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- B-110 Jones, T. E., S. G. McKinley, J. M. Tingey, T. M. Longaker, J. A. Gibson. 1990. *SST Waste Characterization Project: (241-B-110) Cores 1 - 4 Data Reports*.
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- C-109 Simpson, B. C., G. L. Borsheim, L. Jensen. 1993. *Tank Characterization Report: Tank 241-C-109*, WHC-EP-0668.
- C-110 1993. *Westinghouse 222-S Analytical Laboratory Single-Shell Tank Waste Characterization Tank C-110 Cores 37, 38 and 39*, WHC-SD-WM-DP-027, Addendum 1, Rev. 0.
- C-112 Simpson, B. C., G. L. Borsheim, L. Jensen. 1993. *Tank Characterization Data Report: Tank 241-C-112*, WHC-EP-0640.
- S-104 Kocher, K. L. 1993. *Single-Shell Tank Waste Characterization Tank 241-S-104 Data Package*, "222-S Laboratory Single-Shell Tank Waste Characterization, Tank S-104 Cores 42, 43 and 44 Validation Summary," WHC-SD-WM-DP-031, Addendum 2 Rev. 0.
- T-102 1993. *PNL 325 Laboratory Single-Shell Tank Waste Characterization Tank T-102, Cores 55 and 56 Validation Summary*, WHC-SD-WM-DP-052, Addendum 1, Rev. 0.
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- T-107 1993. *Westinghouse 222-S Laboratory Single-Shell Tank Waste Characterization, Tank T-107 Cores 50, 51, and 52 Validation Summary*, WHC-SD-WM-042, Addendum 1A, Rev. 1.
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3.0 Sludge Wash Factors Evaluation

3.0 Sludge Wash Factors Evaluation

The analytical water wash data, contained in the "WATER" column of the characterization worksheets, provided tank-specific information about the fraction of each component that dissolves with water, *i.e.*, an estimate of tank-specific wash factors for evaluating tank-by-tank processing. The wash factors tend to vary from tank to tank, a reflection of the differences in elemental inventories as well the differences in chemical species. An important point to note is that wash factors derived from the analytical data may be misleading for some components. When analyses are performed solely on the water-digested portion of the sludge, as is the case with many anions, the wash factors for these components appear as 100%. However, qualitative analysis by scanning electron microscopy indicates fluorine and sulfur may be present in some washed sludge samples. Because of their potential impact on HLW vitrification, the partitioning behavior of anions, such as F^- , SO_4^{2-} , and Cl^- , needs to be better established.

The characterization wash data can be used collectively to evaluate some of the wash factors that are assumed for the overall SST waste inventory; specifically, wash factors for elements that would be found primarily in sludges. For example, tank wastes listed in Table 2.1 represent approximately 40% of the SST sludge-type wastes. If the bulk of an element is expected to be in sludge-type wastes, *e.g.*, bismuth, then a wash factor based on this 40% sludge inventory might be expected to be similar to the wash factor assumed for the overall SST waste inventory. As shown in Table 3.1, which contains wash factors calculated from sludge characterization data, the calculated wash factor for bismuth shows that less than 1% of the bismuth inventory is removed with washing. The currently assumed wash factor for bismuth for the overall SST inventory is 25% (see Table 3.2). Table 3.2 provides calculated wash factors, for selected elements, as compared with current wash factors assumed for systems engineering studies.

Table 3.1. Calculated Sludge Wash Factors Based on Characterization Data

Tank ID	Al Total (kg)	Al Wash (kg)	Ba Total (kg)	Ba Wash (kg)	Bl Total (kg)	Bl Wash (kg)	B Total (kg)	B Wash (kg)	Cd Total (kg)	Cd Wash (kg)	Ca Total (kg)	Ca Wash (kg)	Cr Total (kg)	Cr Wash (kg)
A-102	5181	2661	196	1	387	15	3	3	14	3	577	19	1290	29
A-103	30874	27669	1072	8	329	161	41	41	169	129	3196	262	2852	85
A-106	16713	7561	1578	2	171	36	14	14	28	8	3864	47	3713	303
B-110	1535	0	31	<DL	25190	53	43	5	38	8	1211	42	1217	88
B-111	1519	0	47	<DL	22544	54	76	16	22	<DL	762	10	1279	298
B-201	643	7	53	0.1	13700	2	9	1	5	0.1	1824	5	443	114
BX-104	31085	784	1079	1	919	7	7	4	16	2	3178	39	2484	388
BX-105	9940	419	938	1	228	4	2	2	13	1	1823	26	2537	44
BX-107	22382	209	14	1	37733	365	73	39	7	1	1622	677	1513	236
C-103	4545	3	1555	1	226	21	1	0	160	2	3481	12	193	5
C-104	40722	731	5277	4	4991	81	23	4	1731	89	15229	30	1513	61
C-105	54422	90	2256	3	550	62	11	3	139	50	6864	63	830	412
C-106	43633	23	5210	3	534	16	21	5	395	13	12715	49	1050	2
C-109	34266	73	18	<DL			26	6	3	<DL	5565	37	69	49
C-110	12367	1028	6	1	14014	100	21	21	4	1	540	159	396	221
C-112	10688	333	51	<DL			75	20	3	<DL	14575	185	148	94
S-104	196294	7871	55	1	<DL	<DL	65	15	<DL		3183	164	7132	3184
T-102	38840	102	2	<DL			2	<DL	95	2	101	2	101	99
T-104	34467	298	17	1	36314	321	27	22	11	<DL	1277	353	1762	278
T-107	15864	632			11648	237	13	13			738	263	349	205
T-111	1075	21	130	1	48943	381	61	8	15	1	4569	116	3725	412
TY-101	21270	29	1411	0.3	19942	6			8	1			6156	311
TY-103	8560	4	522	7.4	28575	7			8	2			1045	423
TY-104	2500	114	122	0.3	4883	3			3	1			636	493
TY-105	2558	3	67	4	522	10			7	2			177	31
TY-106	604	0.3	115	1	46	1			3	0.2			13	0.1
U-110	177565	2815	55	6	14731	<DL	301	301	17	<DL	3005	115	413	245
	820112	53480.3	21877	48.1	287120	1943	913	543	2821	314.3	89893	2675	43036	8110.1
% SST Inv (a)	31				110				73		70		45	
Wash Factor	6.52		0.22		0.68		59.47		11.14		2.98		18.84	

Table 3.1. Contd.

Tank ID	Co Total (kg)	Co Wash (kg)	Cu Total (kg)	Cu Wash (kg)	Fe Total (kg)	Fe Wash (kg)	La Total (kg)	La Wash (kg)	Pb Total (kg)	Pb Wash (kg)	Mg Total (kg)	Mg Wash (kg)	Mn Total (kg)	Mn Wash (kg)
A-102	6	1	19	1	3103	1			264	11	308	0.3	479	27
A-103	3	0	25	6	661	12			678	482	1482	5	232	53
A-106	10	3	61	3	19326	3			791	27	2079	0.4	1103	66
B-110	<DL		74	35	24181	149			823	<DL	239	5	113	<DL
B-111	18	<DL	247	5	18267	91			2062	<DL	824	<DL	124	<DL
B-201	9	0.1	16	0.1	2001	1	2040	3	200	1	452	2	3058	0.5
BX-104	8	0	63	5	4697	1			375	7	1621	1	643	14
BX-105	0.2	0.2	8	1	1834	1			165	13	955	1	438	8
BX-107	11	2	81	1	17292	185			116	12	248	26	101	1
C-103	20	11	268	5	27150	2			1116	8	1940	3	776	4
C-104	22	0	151	4	25231	9			1347	243	7382	6	4456	27
C-105	9	0	136	0	10605	5			790	187	3250	21	2176	21
C-106	5	0	137	2	55511	1			2564	48	6994	12	1963	5
C-109	<DL		20	<DL	5334	253			1333	7	138	2	35	<DL
C-110	5	2	70	2	9302	263			227	17	127	12	45	2
C-112	<DL		34	<DL	14425	893			1293	<DL	332	22	139	1
S-104	11	2	86	1	4136	5			64	14	89	7	1821	0.5
T-102	<DL		7	<DL	2600	13			54	<DL	14	<DL	125	1
T-104	21	<DL	90	<DL	17344	153			118	<DL	307	12	115	1
T-107					30558	345			773	40	220	31	215	3
T-111	22	2	63	1	34892	241	7948	21	688	13	711	7	11939	47
TY-101					29411	39			164	5			409	11
TY-103					24815	163			488	5			167	13
TY-104					8959	24			159	3			575	4
TY-105					27959	1			519	7				
TY-106					4037	0.4			34	1			49	2
U-110			304	<DL	10643	34			519	60	1436	335	2490	<DL
	180.2	23.3	1960	72.1	434274	2888.4	9988	24	17724	1211	31148	510.7	33786	312
% SST Inv (a)					59				4				28	
Wash Factor	12.93		3.68		0.67		0.24			6.83		1.84		0.92

Table 3.1. Contd.

Tank ID	NI Total (kg)	NI Wash (kg)	PO4 Total (kg)	PO4 Wash (kg)	K Total (kg)	K Wash (kg)	Si Total (kg)	Si Wash (kg)	Ag Total (kg)	Ag Wash (kg)	Na Total (kg)	Na Wash (kg)	Sr Total (kg)	Sr Wash (kg)
A-102	117	3	3499	2979	627	542	3681	29	55	1	41650	38411	22	0.1
A-103	174	69	12132	11906	4721	4397	20585	714	46	4	388682	380101	22	0
A-106	458	9	38532	36521	1647	1243	28143	56	207	3	89321	74911	39	0.3
B-110	111	<DL	65417	29369	585	388	12337	471	109	10	125366	113717	271	<DL
B-111	21	<DL	50891	25187	685	685	10763	730	109	<DL	97648	89737	247	1
B-201	99	0.4	2408	171	793	603	3222	88	8	0.1	5502	4062	123	0.1
BX-104	102	11	7521	6287	692	329	21238	86	59	1	45025	32301	41	0
BX-105	43	8	17529	13545	422	230	12165	210	8	0.4	32286	23265	17	0.2
BX-107	19	1	110035	22452	411	231	10597	459	9	2	158198	106403	263	4
C-103	891	14	3925	718	440	54	22124	29	69	4	15822	2291	37	0
C-104	2581	105	12666	353	1820	469	76186	2891	634	2	129026	78442	110	0
C-105	1884	5	6687	3485	974	339	35079	43	59	1	63159	30721	224	0
C-106	1038	34	9309	1407	1573	166	75718	26	564	1	124871	48494	110	0
C-109	4239	25	16506	4735	146	138	2544	26	<DL		23718	17979	52	0.3
C-110	21	2	52541	20420	482	337	5991	204	4	1	71091	56200	107	5
C-112	9839	529	52008	20220	369	320	1503	43	<DL		69565	62971	188	2
S-104	8123	3	481	45	499	421	2429	57	<DL		198512	151185	696	1
T-102	9	<DL	592	160	<DL		417	6	19	<DL	3709	3709	2	<DL
T-104	24	<DL	142274	36968	165	72	12390	331	<DL		124045	89462	190	2
T-107	2561	9	93420	69100	306	306	5881	1923			126454	104755	934	5
T-111	248	3	58958	32139	2141	1357	10689	1078	241	1	69737	62146	562	4
TY-101	3729	56	54369	11844			28331	236	3	1	88849	54935		
TY-103	2641	66	65554	19732			9805	76	9	1	110410	77033		
TY-104	427	5	21614	14669			2226	45	3	1	31119	23696		
TY-105	114	1	155792	10515			492	92	2	1	154241	109427		
TY-106	6	0.1	5099	1107			7840	5	2	0.1	9316	7017		
U-110	3766	<DL	46338	46338	1278	600	11532	869	71	<DL	114616	69464	425	4
	43285	958.5	1106097	442372	20776	13227	433908	10823	2290	35.6	2511938	1912835	4682	29
% SST Inv (a)	24		24		35		97				4		13	
Wash Factor	2.21		39.99		63.66		2.49				1.55		76.15	0.62

Table 3.1. Contd.

Tank ID	Zn Total (kg)	Zn Wash (kg)	Zr Total (kg)	Zr Wash (kg)	U Total (kg)	U Wash (kg)				
A-102			321	8	2124	1				
A-103	29	0	389	26	2673	18				
A-106	1	1	898	15	588	7				
B-110	630	28	4	<DL	506	<DL				
B-111	193	<DL	23	<DL	251	217				
B-201	37	0.2	8	0.1	85	12				
BX-104	73	0	820	3	16005	2				
BX-105	42	0	98	2	1293	1				
BX-107	130	22	212	4						
C-103	55	0	3825	11	1079	441				
C-104	158	0	83492	13	33493	41				
C-105	655	0	648	10	10518	565				
C-106	49	0	2310	121	436	10				
C-109	104	2	<DL		2389	<DL				
C-110	186	10	142	11						
C-112	211	3	15	<DL	35224	1568				
S-104	541	21	1072	2						
T-102	29	<DL	5	<DL						
T-104	293	8	133	5						
T-107			91	6						
T-111	200	1	7	1						
TY-101		282	3		1713	8				
TY-103		54	3		16936	43				
TY-104		50	1		5353	10				
TY-105		10	4		7216	19				
TY-106		57	0.4		736	0.2				
U-110	193	27	232	<DL						
% SST Inv (a)			39							
Wash Factor	3.23		0.26		2.14					

(a) Chemical inventories based on Stordeur (1986). Reported inventories for Al, Cr, and PO4 are being investigated by WHC Systems Engineering group.

Table 3.2. Calculated vs. Assumed Wash Factors (percent soluble in wash)

	Assumed ^(a)	Calculated	% SST Inv ^(b) Calculation Based On
Ag ⁺	0	2	
*Al ⁺³	25	7	31
B ⁺³	0	59	
Ba ⁺²	0	<1	
Bi ⁺³	25	<1	110
Ca ⁺²	5	3	70
Cd ⁺²	50	11	73
Co ⁺³	0	13	
*Cr ^{+3/+6}	10	19	45
Cu ⁺²	0	4	
Fe ⁺³	1	<1	59
K ⁺	0	64	35
La ⁺³	1	<1	
Mg ⁺²	0	2	
Mn ^{+2/+3/+4}	5	<1	28
Ni ⁺³	0	2	24
Pb ⁺²	0	7	4
*PO ₄ ⁻³ /P ₂ O ₇ ⁻⁴	50	40	24
Si ⁺⁴	0	2	97
Sr ⁺²	1	<1	13
UO ₂ ⁺²	5	2	
Zn ⁺²	0	3	
Zr ⁺⁴	0	<1	39

* Note that these may be primary constituents in salt cake- as well as sludge-type wastes.

(a) Boomer, et al. (1993).

(b) Stordeur, et al. (1986).

4.0 Spreadsheet Evaluation of the Enhanced Sludge Wash Process

4.0 Spreadsheet Evaluation of the Enhanced Sludge Wash Process

A spreadsheet was developed to evaluate the effect of enhanced sludge washing on tank-specific sludges and different waste types. Input to the spreadsheet originated from the characterization data and consisted of 1) component concentrations prior to any treatment and 2) component concentrations that were reported to be removed with water washes. Output from the spreadsheet consisted of the estimated mass and percentage of each element that would be removed with washing and leaching and the estimated compositions, both in terms of concentration and dry weight percent, of the final wash and leach streams and the residual solids.

4.1 Assumptions

For this evaluation, enhanced sludge washing was defined as a 0.1M NaOH wash followed by a 3M NaOH leach, and the following assumptions were made:

- Cation-to-anion ratios are balanced within experimental error. (Note, this is not necessarily true for all characterized wastes; *e.g.*, in C-106, the sodium concentration appears too high. This excess sodium shows up in the wash and is reflected in the sodium wash factor).
- Separation of liquid and solid phases is ideal.
- Mass of water removed from sludge at a particular step is proportional to mass of solids removed from sludge at that step.
- Volume wash or leachate out = volume wash or leachate in + water removed from sludge.
- Sodium from the wash or leachate remains in the wash or leachate.
- Calcium and magnesium not removed in the wash are tied to phosphorus in a 3:2 mole ratio and will not leach with caustic.
- 4 volumes dilute caustic wash:1 volume sludge.
- With the exception of anions, tank-specific characterization wash factors provide a reasonable estimate of pretreatment wash factors. When anion inventories are based solely on analyses performed on the water-digested portion of the sludge, wash factors for these components are assumed to be $\leq 100\%$. In cases where characterization wash data were reported as "less than detection limit," wash factors are assumed to be $\geq 0\%$.
- Only aluminum, chromium, and phosphorus leach with caustic:
 - Water-insoluble phosphorus that is not tied to calcium will leach with caustic.
 - Aluminum and silicon not removed in the wash are tied up at a 1:1 mole ratio; 85% of excess aluminum will leach with caustic.
 - 75% of water-insoluble chromium will leach with caustic.

These leaching assumptions are consistent with current systems engineering assumptions. To date, no assumptions have been made as to the leaching behavior of components such as sodium, silicon, zinc, chloride, fluoride, sulfate, and the radionuclides.

- Calculated volume of caustic leach is based on enough NaOH (up to 3M free hydroxide) to provide:

3 moles OH⁻:1 mole PO₄³⁻ (after wash)

1 mole OH⁻:1 mole Cr [after wash, assumes Cr exists as Cr(OH)₃]

1 mole OH⁻:1 mole Al [after wash, assumes Al exists as Al(OH)₃].

4.2 Verification

Characterization data for five core composites were evaluated with the enhanced sludge washing spreadsheet to verify spreadsheet performance. The results from these evaluations were compared with results from recent washing and leaching experiments performed with samples from these same core composites. Selected results, in terms of percent element removed, are summarized in Table 4.1. The data summaries from the spreadsheet evaluation of the five core composites are provided at the back of this section.

Table 4.1. Calculated vs. Experimental Enhanced Sludge Washing Results

% Component Dissolved with Enhanced Sludge Washing										
	B-110 Core 1		C-109 Core 47		C-112 Core 36		U-110 Core 14		B-201 Core 27	
	exp ^(a)	cal	exp ^(a)	cal	exp ^(a)	cal	exp ^(a,b)	cal	exp ^(c)	cal
Al	<53	0	81	74	85	63	79	80	18-41	1
Ca	19	9	1	1	1	2	52	3	0	0
Cr	64	77	84-75	91	88	90	74-47	94	48-65	82
Fe	0	1	5	3	5	5	1	0	1	0
P	97	97	42	35	84	70	49(51) ^(d)	100	16-39	44
Si	74	4	16	1	11	4	8	15 ^(e)	36-55	3

(a) Lumetta, et al. (1994).

(b) Experimental results for U-110 are for a sample treated with a 5M NaOH leach followed a K₂CO₃ wash.

(c) Lumetta and Rapko (1994).

(d) 49% of the phosphate was removed with 5M NaOH; 51% of the phosphate was subsequently removed with a K₂CO₃ wash.

(e) No reported value for total silicon in Core 14; total silicon estimated based on Core 7.

The information provided by the comparison of spreadsheet calculations and experimental data is discussed below for several individual elements.

Aluminum. Calculated dissolution values, based on the assumption that 85% of excess aluminum will leach with caustic, compare favorably with experimental values. In most cases, the estimated values appear to be more conservative than the experimental values. In the experimental studies, some of the aluminum that is tied to silicon may have dissolved with caustic leaching, and/or some of these species may have been in the form of colloids that did not readily settle out of solution. The spreadsheet evaluation assumes ideal separation of liquid and solid phases and does not account for dissolution of any aluminum that is tied to silicon.

Calcium. Calculated dissolution values, based on the assumption that calcium not removed in the wash is tied to phosphorus in a 3:2 mole ratio and will not leach, compare favorably with experimental values for wastes from Tanks C-109, C-112, and B-201. The differences between the calculated and experimental values for wastes from B-110 and U-110 may occur because some of the calcium species in these wastes may have been in the form of colloids that did not settle out of solution in experimental studies. Also, the total concentrations for sludge samples in earlier experimental studies were obtained by summing the fractions of the wash, leach, and residual solids portions. If reported analytical concentrations for any fraction were less than or greater than actual concentrations, the percent dissolved values would reflect these discrepancies. Also, wastes from B-110 and U-110 contained lower calcium concentrations per gram of sludge than the other wastes.

Chromium. Calculated dissolution values, based on the assumption that 75% of water-insoluble chromium will leach with caustic, compare reasonably (within a factor of 1.1 - 1.2) with experimental values. However, in most cases, the calculated dissolution value is greater than the experimental.

Iron. Calculated dissolution values compare favorably with experimental values.

Phosphorus. Calculated dissolution values, based on the assumption that water-insoluble phosphorus not tied to calcium will leach with caustic, compare favorably with experimental values. However, several important points should be noted. First, some phosphorus that may be tied to bismuth may metathesize with the 0.1M NaOH wash. Bismuth phosphate has been identified in Tank B-110 by X-ray diffraction analysis, and experimental studies showed that approximately 84% of the phosphate in this waste was removed with the dilute caustic wash and an additional 13% of the phosphate was removed with the caustic leach. On the other hand, wash factors for the spreadsheet are based on water wash characterization data, and water does not metathesize bismuth phosphate. Therefore, the spreadsheet shows only 45% of the phosphate is removed with the wash, and an additional 52% of the phosphate is removed with the alkaline leach. As a result, the calculated volume of leachate on the spreadsheet is higher than will actually be needed to pretreat this waste.

Note that all tanks that contain bismuth and phosphate do not necessarily contain bismuth phosphate. In tanks where the pH was originally high, e.g., pH of 13, the bismuth may have already metathesized to a bismuth oxide species. Also, wastes that contain significant concentrations of fluoride, e.g., 7000 µg F/g sludge as in waste from Tank U-110, may contain the double salt sodium fluoride phosphate $[Na_3F(PO_4)_2 \cdot xH_2O]$. Because of the seven sodiums, the solubility of this salt may decrease with increased sodium concentrations. The results in Table 4.1 show that only half of the

phosphate was removed from U-110 sludge with 5M NaOH, while almost all the phosphate was removed with water.

Silicon. Calculated dissolution values, based on the assumption that no silicon leaches with caustic, do not compare favorably with experimental results. The discrepancies most likely occur because some silicon leaches with caustic, and some of the silicon may be in the form of colloids that do not readily settle out of solution.

4.3 Results

After the spreadsheet results were compared with experimental results, the spreadsheet was used to evaluate the effect of enhanced sludge washing on individual tank sludges, as well as for groups of sludges that may be representative of different waste types.

4.3.1 Specific Tank Sludges

Only sludges with ≥ 90 dry weight percent solids identified (refer to Table 2.1) were included in this evaluation, and tank compositions were derived by averaging core composites for a particular tank. The data summaries from these evaluations are provided at the end of this section. These summaries provide the estimated mass and cumulative percentage of each element that would be removed with washing and leaching and the estimated compositions, both in terms of concentration and dry weight percent, of the final wash and leach streams and the residual solids. The residual solids information may be used to evaluate the impact of not blending any tank sludges during pretreatment processing and to assess which tank sludges might be blended together. Note that wash factors based on averaged core composites may differ from wash factors for a specific core.

4.3.2 Different Waste Types

In this evaluation, sludges were grouped according to waste type. This classification method is based on the assumption that the primary and secondary solids-forming waste types in a tank are responsible for the bulk chemical composition and physical properties of the sludge contained in that tank. Waste types for each tank were identified by Hill and Simpson (1994) with the Sort On Radioactive Waste Type (SORWT) model. Table 4.2 lists, for each sludge group, the primary and secondary waste types; the specific tanks that comprise a group; and the total volume of waste. Available tank-specific compositional data for each group were averaged (mass-weighted basis) to form a representative composition for that particular group, and the representative sludges were evaluated with the spreadsheet.

Data summaries that include wash factors are provided at the end of this section for the waste types listed on the following page. Note that these waste-type wash factors based on mass-weighted-averaged tank compositions may differ slightly from wash factors for individual tanks that belong to a waste-type group.

<u>Waste Type</u>	<u>Tanks Providing Compositional Data</u>
Aluminum Cladding Waste	(U-110 Core 8 Composite)
Aluminum Cladding Waste - Mix	(T-102)
1 st Cycle BiPO ₄	(T-104)
1 st Cycle BiPO ₄ - Aluminum Cladding Waste	(U-110)
1 st Cycle BiPO ₄ - Uranium Recovery	(BX-107, C-110)
1 st Cycle BiPO ₄ - Evaporator Bottoms	(TY-101)
2 nd Cycle BiPO ₄ - Tank 5-6, B-Plant	(B-110, B-111)
2 nd Cycle BiPO ₄ - Concentration Cycle BiPO ₄	(T-111)
Concentration Cycle BiPO ₄	(B-201)
PUREX - PUREX Sludge Supernatant	(C-103, C-106)
Uranium Recovery - Diatomaceous Earth	(TY-106)
Uranium Recovery - Cladding Waste - Portland Cement	(BX-105)
Uranium Recovery - 1 st Cycle BiPO ₄ (ferrocyanide scavenged)	(TY-103, TY-104)
Uranium Recovery (ferrocyanide scavenged) - 1 st Cycle BiPO ₄	(C-109, C-112, T-107)
REDOX	(S-104)

Table 4.2. Single-shell Tanks Containing Predominantly Sludge-type Wastes

KEY:	CC	Complexed Concentrate Waste	POS	Purex Organic Solvent
	CW	Cladding Waste	PSS	Purex Sludge Supernatant
	DSSF	Double-shell Slurry Feed	SRS	Strontium Recovery Sludge
	EB	Evaporator Bottom	TBP	Uranium Recovery
	Evap	Evaporator Feed	1C	1st Cycle, BiPO ₄
	F	Ferrocyanide scavenged	2C	2nd Cycle, BiPO ₄
	HS	Hot Semi Works	224	Concentration Cycle, BiPO ₄
	IX	Ion exchange Waste	5-6	Tank 5-6, B Plant
	NC	Non-complexed Waste	*	Enhanced Sludge Washing Data Summary Available for this Group

Cladding Waste			2nd Cycle BiPO₄		
kgal	(CW)	2nd Waste	kgal	(2C)	2nd Waste
13*	U-201		511*	B-110	5-6
	U-202			B-111	5-6
	U-203			B-112	5-6
200	B-101	EB	370	B-104	EB
	B-102	EB			
	B-103	EB	889*	T-111	224
				T-110	224
423	C-102	TBP		T-112	224
295	C-104	POS			
143*	T-101	Mix	276*		
	T-102	Mix		B-201	
	T-103	Mix		B-202	
				B-203	
				B-204	
				T-201	
				T-202	
				T-203	
				T-204	
1st Cycle BiPO₄			PUREX		
kgal	(1C)	2nd Waste	kgal	PUREX	2nd Waste
442*	T-104		11	C-201 (HS)	
				C-202 (HS)	
303*	U-110	CW		C-203 (HS)	
	T-105	CW		C-204 (HS)	
	T-106	CW			
691*	BX-107	TBP	259*	C-103 (SRS)	PSS
	C-110	TBP		C-106 (SRS)	PSS
	B-106	TBP			
	T-108	TBP			
701*	B-107	EB	28	A-104 (PSS)	Purex
	B-108	EB			
	B-109	EB			
	BX-110	EB	19	A-105	IX
	TY-101(F)	EB			
275	C-107	Purex (SRS)			

Table 4.2. Contd.

<u>Uranium Recovery (TBP)</u>		<u>2nd Waste</u>	<u>kgal</u>	<u>REDOX</u>	<u>2nd Waste</u>
<u>kgal</u>	<u>TY-105</u>		<u>694*</u>		
231				S-104 SX-107	
17*	TY-106	dia-earth		SX-108 SX-112	
538	BX-104 BX-101 BX-103 BX-106 BX-108 BX-109 C-101	CW CW CW CW CW CW CW		SX-115 TX-101 U-101	
96	BX-102	CW, dia-earth	368	SX-110 SX-111 SX-114	Redox IX Redox IX Redox IX
46*	BX-105	CW, cement		S-101 S-107	EB EB
205*	TY-103 TY-104	1C-F 1C-F	148	SX-113 U-104	dia-earth dia-earth
			2	U-204	2C
460*	C-109(F) C-112(F) C-108(F) C-111(F) T-107(F)	1C 1C 1C 1C 1C	403	A-102 A-103	DSSF DSSF
443	BY-108(F) T-109 TX-103	EB EB EB	125	A-106	CC,NC,EB,B-Plant
443			7	AX-104	Evap, NC, Purex
			45	U-112	Unknown
150	C-105	PSS			

Enhanced Sludge Washing Spreadsheet Evaluation

Data Summaries for 5 Core Composites

B-110 Core 1

Density (kg/L)	1.36
Volume (L)/tank	927325
Mass (kg)/tank	1261162
Solids (mg/kg)	408000
Water (mg/kg)	592000

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	3709300
Mass removed (kg)/tank	932249

3M NaOH Leach

Volume leachate (L)/tank	396753
Mass removed (kg)/tank	63328
Vol leachate (L)/kg sludge (after wash)	1.21

Residual Solids

Residual solids/tank (kg)	271289
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Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS			
	ug/g sludge (element)	kg/tank (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION	removed kg/tank	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)	FINAL COMPOSITION
Aluminum	1158.000	1460	>0	>0	mg/L (element)	dry wt % (element)	>0	0	1460	10169 (oxide) 2.42
Barium	19.500	25	>0	>0					25	101 0.02
Bismuth	17620.000	22222	>0	>0					22222	91331 21.72
Boron	<DL								>0	
Cadmium	<DL								996	5138 1.22
Calcium	869.000	1096	100	9.09	23	0.03			239	1290 0.31
Chromium	824.000	1039	82	7.89	19	0.02			>0	
Cobalt	<DL								43	198 0.05
Copper	70.000	88	45	51.43	11	0.01			24301	128095 30.47
Iron	19430.000	24504	203	0.83	48	0.05			1425	5658 1.35
Lead	1130.000	1425	0	0.00	0	0.00			243	1488 0.35
Magnesium	203.000	256	13	4.93	3	0.00			129	750 0.18
Manganese	102.000	129	>0	>0					>0	
Nickel	<DL								2212	6090 1.45
Phosphate	50760.000	64017	28621	44.71	6717	7.24			11390	89802 21.36
Potassium	<DL								33	130 0.03
Silicon	9420.000	11880	491	4.13	115	0.12			14326	71182 16.93
Silver	26.000	33	>0	>0					262	1144 0.27
Sodium	97950.000	123531	109205	88.40	27630	29.79			1718	7883 1.87
Strontium	208.000	262	>0	>0					>0	>0.00
Zinc	1370.000	1728	10	0.58	2	0.00			>0	>0.00
Zirconium	<DL								>0	>0.00
Uranium	<DL								>0	>0.00
Nitrate	2161500.000	203678	203678	≤100.00	47798	51.54			>0	>0.00
Chloride	≥1020.000	1286	1286	≤100.00	302	0.33			>0	>0.00
Fluoride	≥1650.000	2081	2081	≤100.00	488	0.53			>0	>0.00
Free OH	NR				1480	1.60			7194	>0.00
Carbonate	≥ 6000.000	7567	7567	≤100.00	1776	1.91			>0	>0.00
Organic Salts	≥ 1030.000	1299	1299	≤100.00	305	0.33			>0	>0.00
Nitrite	≥ 9860.000	12435	12435	≤100.00	2918	3.15			>0	>0.00
Sulfate	≥ 10500.000	13242	13242	≤100.00	3108	3.35			>0	>0.00
Water	592000.000	746608	551891	73.92			37490	5.02	157226	579552 20.00
					100.00					1000000 100.00
Radionuclides	uCi/g	Ci/tank	Ci/tank							
Pu-239,240	0.109	137.467	1.261	0.92						
C-14	≥ 0.024	30.268	30.268	≤ 100.00						
Sr-90	217	273672.154	277.456	0.10						
Tc-99	0.021	26.484	22.701	85.71						
Am-241	0.135	170.257	6.306	3.70						
Co-60	NR				NR					
Cs-137	14.6	18412.965	10618.984	57.67						
I-129	0.000022	0.028	0.001	4.50						

C-109 Core 47

Density (kg/L)	1.2
Volume (L)/tank	234670
Mass (kg)/tank	281604
Solids (mg/kg)	785000
Water (mg/kg)	215000

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	938680
Mass removed (kg)/tank	75934

3M NaOH Leach

Volume leachate (L)/tank	520655
Mass removed (kg)/tank	86221
Vol leachate (L)/kg sludge (after wash)	2.53

Residual Solids

Residual solids/tank (kg)	108413
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Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS		
	ug/g sludge (element)	kg/tank (element)	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)
Aluminum	116800.000	32891	116	0.35	121	0.18	24248	73.72	44972
Barium	81.000	23	≥0	≥0					8527
Bismuth	12300.000	3464	≥0	≥0					174609
Boron	127.000	36	6	15.75	6	0.01			22.88
Cadmium	12.000	3	≥0	≥0					23
Calcium	24660.000	6944	52	0.74	54	0.08			35624
Chromium	273.000	77	49	63.74	51	0.08			4.67
Cobalt	<DL								30
Copper	85.000	24	≥0	≥0					895
Iron	28780.000	8105	247	3.05	259	0.39			36
Lead	8600.000	2422	14	0.56	14	0.02			0.00
Magnesium	647.000	182	2	1.24	2	0.00			11.66
Manganese	160.000	45	≥0	≥0					6893
Nickel	14720.000	4145	35	0.85	37	0.06			88948
Phosphate	59610.000	16786	5781	34.44	6054	9.12			11.66
Potassium	587.000	165	150	90.97	157	0.24			2.53
Silicon	15760.000	4438	33	0.74	34	0.05			0.01
CN	5500.000	1549	230	14.82	240	0.36			20
Sodium	87160.000	24545	19090	77.78	22250	33.54			24
Strontium	204.000	57	0.3	0.49	0.3	0.0005			276
Zinc	350.000	99	3	2.57	3	0.00			0.03
Zirconium	<DL								108413
Uranium	10700.000	3013	≥0	≥0					13.58
Nitrate	≥ 37000.000	10419	10419	≤100	10910	16.44			23
Chloride	≥ 700.000	197	197	≤100	206	0.31			3464
Fluoride	≥ 400.000	113	113	≤100	118	0.18			30
Free OH	NR				1671	2.52			0.12
Carbonate	≥ 29000.000	8167	8167	≤100	8551	12.89			0.15
Organic Salts	≥ 6630.000	1867	1867	≤100	1955	2.95			0.36
Nitrite	≥ 39000.000	10983	10983	≤100	11500	17.33			0.45
Sulfate	≥ 7300.000	2056	2056	≤100	2153	3.24			657
Water	215000.000	60545	16326	26.96					9.4
					100.00				0.01
Radionuclides	uCi/g	Ci/tank	Ci/tank						22.88
Pu-239,240	0.82	230.915	NR						0.03
C-14	NR	NR	NR						4.67
Sr-90	1180	332292.720	NR						0.12
Tc-99	0.108	30.413	NR						0.00
Am-241	0.32	90.113	1.126	1.25					0.00
Co-60	0.014	3.942	0.282	7.14					0.00
Cs-137	870	244995.480	2599.205	1.06					20.00
I-129	NR	NR	NR						≥0.00

C-112 Core 36

Density (kg/L)	1.4
Volume (L)/tank	393640
Mass (kg)/tank	551096
Solids (mg/kg)	550000
Water (mg/kg)	450000

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	1574560
Mass removed (kg)/tank	333925

3M NaOH Leach

Volume leachate (L)/tank	397745
Mass removed (kg)/tank	30631
Vol leachate (L)/kg sludge (after wash)	1.83

Residual Solids

Residual solids/tank (kg)	163668
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Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS		
	ug/g sludge (element)	kg/tank (element)	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)
Aluminum	6400.000	3527	449	12.72	260	0.24	1776	50.37	4317
Barium	76.800	42	≥0	≥0					1302
Bismuth	NR	NR							42
Boron	143.000	79	16	20.77	9	0.01			289
Cadmium	23.200	13	≥0	≥0					0.06
Calcium	20390.000	11237	212	1.89	123	0.11			≥0
Chromium	182.000	100	61	60.99	35	0.03			62
Cobalt	<DL								1228
Copper	50.100	28	≥0	≥0					13
Iron	26010.000	14334	768	5.36	445	0.40			89
Lead	1050.000	579	≥0	≥0					0.02
Magnesium	610.000	336	16	4.70	9	0.01			11025
Manganese	268.000	147	2	1.17	1	0.00			94236
Nickel	10570.000	5825	436	7.49	253	0.23			10
Phosphate	110280.000	60775	26623	43.81	15435	14.02			87
Potassium	645.000	355	277	77.98	161	0.15			0.02
Silicon	1930.000	1064	38	3.62	22	0.02			1302
CN	7100.000	3913	725	18.52	420	0.38			17661
Sodium	120700.000	66517	59715	89.77	36721	33.34			3.63
Strontium	396.000	218	3	1.52	2	0.00			42
Zinc	370.000	204	3	1.57	2	0.00			289
Zirconium	33.600	19	≥0	≥0					0.06
Uranium	10490.000	5781	2533	43.82	1469	1.33			≥0
Nitrate	≥71500.000	39403	39403	≤100	22845	20.74			≥0
Chloride	≥1050.000	579	579	≤100	335	0.30			≥0
Fluoride	≥450.000	248	248	≤100	144	0.13			≥0
Free OH	NR	NR			1552	1.41			≥0
Carbonate	≥19750.000	10884	10884	≤100	6310	5.73			≥0
Organic Salts	≥7590.000	4183	4183	≤100	2425	2.20			≥0
Nitrite	≥52500.000	28933	28933	≤100	16774	15.23			≥0
Sulfate	≥13700.000	7550	7550	≤100	4377	3.97			≥0
Water	450000.000	247993	150266	60.59					≥0
					100.00				≥0
Radionuclides	uCi/g	Ci/tank	Ci/tank						1000000
Pu-239,240	0.059	32,515	NR						100.00
C-14	0.004	2.204	NR						100.00
Sr-90	507	279405.672	NR						
Tc-99	0.107	58.967	NR						
Am-241	0.061	33,617	NR						
Co-60	0.006	3.307	NR						
Cs-137	792	436468.032	NR						
I-129			NR						

U-110 Core 14

Density (kg/L)	1.5
Volume (L)/tank	704010
Mass (kg)/tank	1056015
Solids (mg/kg)	739500
Water (mg/kg)	260500

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	2816040
Mass removed (kg)/tank	289858

3M NaOH Leach

Volume leachate (L)/tank	2145942
Mass removed (kg)/tank	527187
Vol leachate (L)/kg sludge (after wash)	2.80

Residual Solids

Residual solids tank (kg) 253724

B-201 Core 27

Density (kg/L)	1.25
Volume (L)/tank	105980
Mass (kg)/tank	132475
Solids (mg/kg)	373000
Water (mg/kg)	627000

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	423920
Mass removed (kg)/tank	37376

3M NaOH Leach

Volume leachate (L)/tank	21769
Mass removed (kg)/tank	1850
Vol leachate (L)/kg sludge (after wash)	0.23

Residual Solids

Residual solids/tank (kg)	84580
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Component	UNTREATED		0.1M NaOH WASH				3M NaOH LEACH				RESIDUAL SOLIDS			
	ug/g sludge (element)	kg/tank (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION		removed kg/tank	% removed (element)	FINAL COMPOSITION		remaining kg/tank	mg/kg res (oxide)	dry wt% (oxide)	
Aluminum	1130.000	150	3	2.17	7	0.02	≥ 0	≥ 0.00	0	0.00	146	3271	1.06	
Barium	68.500	9	≥ 0	≥ 0							9	120	0.04	
Bismuth	95590.000	12663	2	0.02	5	0.01					12661	166910	54.06	
Boron	95.200	13	2	12.61	4	0.01					11	420	0.14	
Cadmium	<DL													
Calcium	5130.000	680	2	0.33	5	0.01					677	11204	3.63	
Chromium	3670.000	486	116	23.95	260	0.74	277	57.04	12094	14.93	92	1598	0.52	
Cobalt	<DL													
Copper	42.700	6	≥ 0	≥ 0							6	84	0.03	
Iron	11640.000	1542	1	0.05	2	0.005					1541	26059	8.44	
Lead	3150.000	417	≥ 0	≥ 0							417	5314	1.72	
Magnesium	631.000	84	≥ 0	≥ 0							84	1639	0.53	
Manganese	2530.000	335	1	0.16	1	0.003					335	6259	2.03	
Nickel	491.000	65	1	0.81	1	0.003					65	1075	0.35	
Phosphate	14090.000	1867	195	10.47	437	1.25	381	20.40	16610	10.48	1290	11396	3.69	
Potassium	5070.000	672	575	85.66	1286	3.68					96	1139	0.37	
Silicon	7420.000	983	107	10.89	239	0.68					876	22152	7.18	
Lanthanum	14590.000	1933	4	0.22	9	0.03					1929	26746	8.66	
Sodium	38430.000	5091	3975	78.08	11066	31.66					1116	17782	5.76	
Strontium	953.000	126	0.1	0.10	0.3	0.0009					126	1764	0.57	
Zinc	236.000	31	≥ 0	≥ 0							31	460	0.15	
Zirconium	<DL										≥ 0	≥ 0	≥ 0.00	
Uranium	<DL										≥ 0	≥ 0	≥ 0.00	
Nitrate	≥ 49250.000	6524	6524	≤ 100	14584	41.72					≥ 0	≥ 0	≥ 0.00	
Chloride	≥ 1525.000	202	202	≤ 100	452	1.29					≥ 0	≥ 0	≥ 0.00	
Fluoride	≥ 5900.000	782	782	≤ 100	1747	5.00					≥ 0	≥ 0	≥ 0.00	
Free OH	NR	NR			1611	4.61					≥ 0	≥ 0	≥ 0.00	
Carbonate	10650.000	1411	1159	82.16	2591	7.41					51365			
Organic Salts	1460.000	193	162	83.90	363	1.04					252	2976	0.96	
Nitrite	≥ 763.000	101	101	≤ 100	226	0.65					31	368	0.12	
Sulfate	≥ 195.000	26	26	≤ 100	58	0.17					≥ 0	≥ 0	≥ 0.00	
Water	627000.000	83062	23435	28.21			1160	1.40			58467	691267		
					100.00						1000000		100.00	
Radionuclides	uCi/g	Ci/tank	Ci/tank											
Pu-239,240	1.47	194.738	NR											
C-14	≥ 0.000037	0.005	0.005	≤ 100										
Sr-90	1.03	136.449	NR											
Tc-99	<0.002	<0.3	NR											
Am-241	0.031	4.107	NR											
Co-60	0.00039	0.052	NR											
Cs-137	0.583	77.233	NR											
I-129	NR	NR	NR											

Enhanced Sludge Washing Spreadsheet Evaluation

Data Summaries for 20 Specific Tank Sludges

B-110

Density (kg/L)	1.35
Volume (L)/tank	927325
Mass (kg)/tank	1251889
Solids (mg/kg)	430000
Water (mg/kg)	570000

0.1 M NaOH Wash

Volume wash (L)/tank	3709300
(4 volume wash:1 volume sludge)	
Mass removed (kg)/tank	952011

3M NaOH Leach

Volume leachate (L)/tank	405633
Mass removed (kg)/tank	61214
Vol leachate (L)/kg sludge (after wash)	1.35

Residual Solids

Residual solids/tank (kg)	250074
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Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS		
	ug/g sludge (element)	kg/tank (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION	removed kg/tank	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)
Aluminum	1230.000	1540	≥0	≥0		≥0	≥0.00	0	0.00
Barium	24.600	31	≥0	≥0				1540	11631
Bismuth	20120.000	25188	54	0.21	13	0.01		31	138
Boron	34.500	43	5	10.87	1	0.001		25134	112066
Cadmium	30.000	38	8	20.83	2	0.002		38	496
Calcium	967.000	1211	42	3.44	10	0.01		30	136
Chromium	972.000	1217	88	7.25	21	0.02		1169	6539
Cobalt	<DL					846	69.56	1921	1.93
Copper	59.300	74	35	47.22	8	0.01		39	196
Iron	19320.000	24186	149	0.62	35	0.04		24038	137454
Lead	657.000	822	≥0	≥0				822	3542
Magnesium	191.000	239	5	1.96	1	0.001		234	1554
Manganese	90.300	113	≥0	≥0				113	715
Nickel	88.500	111	≥0	≥0				111	624
Phosphate	52250.000	65411	29369	44.90	6907	6.92		2462	7353
Potassium	467.000	585	387	66.17	91	0.09		198	791
Silicon	9850.000	12331	471	3.82	111	0.11		11860	101447
Silver	86.700	109	10	8.94	2	0.003		99	424
Sodium	100100.000	125314	113717	90.75	28751	28.82		11597	62515
Strontium	217.000	272	≥0	≥0				272	1285
Zinc	503.000	630	28	4.47	7	0.01		602	2995
Zirconium	3.500	4	≥0	≥0				4	24
Uranium	404.000	506	≥0	≥0				506	2431
Nitrate	181100.000	226717	226717	≤100	53321	53.45		≥0	≥0
Chloride	≥1150.000	1440	1440	≤100	339	0.34		≥0	≥0
Fluoride	≥1780.000	2228	2228	≤100	524	0.53		≥0	≥0
Free OH	NR	NR			1483	1.49		7923	
Carbonate	≥5050.000	6322	6322	≤100	1487	1.49		≥0	≥0
Organic Salts	≥919.000	1150	1150	≤100	271	0.27		≥0	≥0
Nitrite	≥10430.000	13057	13057	≤100	3071	3.08		≥0	≥0
Sulfate	≥11250.000	14084	14084	≤100	3312	3.32		≥0	≥0
Water	570000.000	713577	542646	76.05			34892	4.89	136039
					100.00			100.00	1000000
									100.00
Radionuclides	uCi/g	Ci/tank	Ci/tank						
Pu-239,240	0.116	145.219	2.504	1.72					
C-14	≥ 0.002	2.504	2.504	≤100					
Sr-90	169	211569.199	212.821	0.10					
Tc-99	0.02	25.038	23.786	95.00					
Am-241	0.082	102.655	3.756	3.66					
Co-60	≥ 0.0004	0.501	0.501	≤100					
Cs-137	15.1	18903.520	10753.724	56.89					
I-129	<0.00002	<0.025	<0.00002						

B-111	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L)	1.25		
Volume (L)/tank	893260		
Mass (kg)/tank	1116575		
Solids (mg/kg)	363000		
Water (mg/kg)	637000		
Volume wash (L)/tank (4 volume wash:1 volume sludge)	3573040		
Mass removed (kg)/tank	834993		
Volume leachate (L)/tank	295662		
Mass removed (kg)/tank	49009		
Vol leachate (L)/kg sludge (after wash)	1.05		
Residual solids/tank (kg)	243251		

B-201	0.1 M NaOH Wash
Density (kg/L)	1.25
Volume (L)/tank	105980
Mass (kg)/tank	132475
Solids (mg/kg)	396000
Water (mg/kg)	604000
Volume wash (L)/tank (4 volume wash:1 volume sludge)	423920
Mass removed (kg)/tank	36736

3M NaOH Leach

Residual Solids

Residual solids/tank (kg)	101118
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BX-105	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L)	1.69		
Volume (L)/tank	174110	696440	
Mass (kg)/tank	294246	(4 volume wash:1 volume sludge)	
Solids (mg/kg)	430000	Mass removed (kg)/tank	118006
Water (min/kg)	570000	Volume leachate (L)/tank	175971
		Mass removed (kg)/tank	6377
		Vol leachate (L)/kg sludge (after wash)	1.00
			Residual solids/tank (kg) 167500

C-103

Density (kg/L)	1.34
Volume (L)/tank	234670
Mass (kg)/tank	314458
Solids (mg/kg)	389000
Water (mg/kg)	611000

0.1 M NaOH Wash

Volume wash (L)/tank	938680
(4 volume wash:1 volume sludge)	
Mass removed (kg)/tank	18124

3M NaOH Leach

Volume leachate (L)/tank	91404
Mass removed (kg)/tank	532
Vol leachate (L)/kg sludge (after wash)	0.31

Residual Solids

Residual solids/tank (kg)	317302
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Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS			
	ug/g sludge (element)	kg/tank (element)	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)	FINAL COMPOSITION
Aluminum	14510.000	4563	3	0.06	3	0.02	≥ 0	≥ 0.00	0	0.00
Barium	4960.000	1560	1	0.04	1	0.01			4560	27148
Bismuth	722.000	227	21	9.26	22	0.19			1559	5489
Boron	2.400	1	≥ 0	≥ 0					206	724
Cadmium	509.000	160	2	1.36	2	0.02			1	8
Calcium	11110.000	3494	12	0.34	12	0.11			158	568
Chromium	618.000	194	6	2.85	6	0.05			3482	15351
Cobalt	63.800	20	11	56.90	12	0.11			47	217
Copper	855.000	269	5	1.91	5	0.05			9	38
Iron	86660.000	27251	2	0.01	2	0.02			264	1041
Lead	3560.000	1119	8	0.73	9	0.08			27249	122803
Magnesium	6190.000	1946	3	0.15	3	0.03			1111	3772
Manganese	2480.000	780	4	0.48	4	0.03			1943	10155
Nickel	2850.000	896	14	1.58	15	0.13			776	3870
Phosphate	12530.000	3940	720	18.28	758	6.66	≥ 0	≥ 0.00	882	3917
Potassium	1400.000	440	54	12.21	57	0.50			3220	7581
Silicon	70620.000	22207	29	0.13	30	0.27			386	1218
Silver	222.000	70	4	5.99	4	0.04			22178	149508
Sodium	50500.000	15880	2299	14.48	4693	41.26			66	222
Strontium	117.000	37	≥ 0	≥ 0					13581	57698
Zinc	175.000	55	≥ 0	≥ 0					37	137
Zirconium	12210.000	3840	12	0.30	12	0.11			55	216
Uranium	3440.000	1082	442	40.89	466	4.09			3828	16299
Nitrate	≥ 2810.000	884	884	≤ 100	930	8.18			639	2422
Chloride	NR						≥ 0	≥ 0	≥ 0	≥ 0.00
Fluoride	NR						≥ 0	≥ 0	≥ 0	≥ 0.00
Free OH	NR				1680	14.77			≥ 0	≥ 0
Carbonate	NR								≥ 0	≥ 0
Organic Salts	≥ 8000.000	2516	2516	≤ 100	2649	23.28			≥ 0	≥ 0
Nitrite	NR								≥ 0	≥ 0
Sulfate	NR								≥ 0	≥ 0
Water	611000.000	192134	11074	5.76			325	0.17	180735	569598
					100.00				1000000	100.00
Radionuclides	uCi/g	Ci/tank	Ci/tank							
Pu-239,240	13.6	4276.626	2.201	0.05						
C-14	≥ 0	≥ 0								
Sr-90	2710	852180.638	326.722	0.04						
Tc-99	0.264	83.017	5.346	6.44						
Am-241	1.35	424.518	2.516	0.59						
Co-60	3.95	1242.108	24.842	2.00						
Cs-137	59.4	18678.793	7672.770	41.08						
I-129	≥ 0.000011	0.003	0.003	≤ 100.00						

C-106

Density (kg/L)	1.43
Volume (L)/tank	745645
Mass (kg)/tank	1066272
Solids (mg/kg)	475000
Water (mg/kg)	525000

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	2982580
Mass removed (kg)/tank	133635

3M NaOH Leach

Volume leachate (L)/tank	628267
Mass removed (kg)/tank	2419
Vol leachate (L)/kg sludge (after wash)	0.67

Residual Solids

Residual solids/tank (kg)	972019
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Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS			
	ug/g sludge (element)	kg/tank (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION	removed kg/tank	% removed (element)	FINAL COMPOSITION	remaining kg/tank	FINAL COMPOSITION
Aluminum	40920.000	43632	23	0.05	8	0.03	≥ 0	≥ 0.00	0	0.00
Barium	4890.000	5214	3	0.06	1	0.004			43609	84749
Bismuth	501.000	534	16	2.99	5	0.02			5211	5988
Boron	19.500	21	5	24.46	2	0.01			518	594
Cadmium	370.000	395	13	3.24	4	0.02			16	52
Calcium	11920.000	12710	49	0.38	16	0.06			382	448
Chromium	984.000	1049	2	0.14	0.5	0.002	786	74.89	1248	1.93
Cobalt	4.810	5	≥ 0	≥ 0					12661	18223
Copper	128.000	136	2	1.19	1	0.002			262	394
Iron	53060.000	56576	1	0.002	0.4	0.002			5	7
Lead	2400.000	2559	48	1.87	16	0.06			135	174
Magnesium	6560.000	6995	12	0.17	4	0.02			56575	83232
Manganese	1840.000	1962	5	0.27	2	0.01			2511	2782
Nickel	973.000	1037	34	3.31	11	0.05			6983	11910
Phosphate	8730.000	9309	1407	15.12	461	1.87	≥ 0	≥ 0.00	1957	3185
Potassium	1480.000	1578	166	10.54	54	0.22			1003	1454
Silicon	71010.000	75716	26	0.03	9	0.03			7901	6072
Silver	528.000	563	1	0.26	0.5	0.002			1412	1452
Sodium	117100.000	124860	48494	38.84	18133	73.41			75690	166561
Strontium	103.000	110	≥ 0	≥ 0					562	620
Zinc	46.300	49	≥ 0	≥ 0					76366	105905
Zirconium	2170.000	2314	120	5.21	39	0.16			110	134
Uranium	409.000	436	10	2.23	3	0.01			49	63
Nitrate	≥ 928.000	990	990	≤ 100	324	1.31			2193	3048
Chloride	NR								426	527
Fluoride	NR								≥ 0	≥ 0
Free OH	NR				1661	6.72			≥ 0	≥ 0
Carbonate	NR						52121		≥ 0	≥ 0
Organic Salts	≥ 11300.000	12049	12049	≤ 100	3947	15.98			≥ 0	≥ 0
Nitrite	NR								≥ 0	≥ 0
Sulfate	NR								≥ 0	≥ 0
Water	525000.000	559793	70158	12.53			1270	0.23	488365	502423
					100.00				1000000	100.00
Radionuclides	uCi/g	Ci/tank	Ci/tank							
Pu-239,240	5.14	5480.640	261.237	4.77						
C-14	≥ 0	≥ 0								
Sr-90	1990	2121881.976	217.520	0.01						
Tc-99	0.218	232.447	37.320	16.06						
Am-241	1.05	1119.586	15.994	1.43						
Co-60	0.888	946.850	29.856	3.15						
Cs-137	330	351869.876	66322.140	18.85						
I-129	≥ 0.000081	0.086	0.086	≤ 100						

C-109	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L)	1.2		
Volume (L)/tank	234670		
Mass (kg)/tank	281604		
Solids (mg/kg)	753500		
Water (mg/kg)	246500		
Volume wash (L)/tank (4 volume wash:1 volume sludge)	938680		
Mass removed (kg)/tank	74503		
Volume leachate (L)/tank	165458		
Mass removed (kg)/tank	5581		
Vol leachate (L)/kg sludge (after wash)	0.80		
Residual solids/tank (kg)	106466		

C-110

Density (kg/L)	1.2
Volume (L)/tank	707795
Mass (kg/tank)	849354
Solids (mg/kg)	401600
Water (mg/kg)	598400

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	2831180
Mass removed (kg/tank)	528716

3M NaOH Leach

Volume leachate (L)/tank	479235
Mass removed (kg/tank)	92575
Vol leachate (L)/kg sludge (after wash)	1.49

Residual Solids

Residual solids/tank (kg)	213608
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Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS		
	ug/g sludge (element)	kg/tank (element)	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)
Aluminum	14560.000	12367	1028	8.31	327	0.46	4897	39.60	9160
Barium	7.540	6	1	11.67	0.2	0.0003			6442
Bismuth	16500.000	14014	100	0.71	32	0.04			56964
Boron	24.900	21	21	99.84	7	0.01			15.77
Cadmium	5.200	4	1	15.62	0.02	0.0003			6
Calcium	636.000	540	160	29.53	51	0.07			30
Chromium	467.000	397	220	55.59	70	0.10			0.01
Cobalt	4.110	3	2	66.91	1	0.001			13914
Copper	82.200	70	2	2.84	1	0.0009			20.11
Iron	10950.000	9300	263	2.83	84	0.12			0.03
Lead	267.000	227	17	7.43	5	0.01			1
Magnesium	149.000	127	12	9.51	4	0.01			0.0001
Manganese	53.000	45	2	3.92	1	0.0008			4
Nickel	24.200	21	2	11.48	1	0.001			20
Phosphate	61860.000	52541	20420	38.86	6487	9.13			0.01
Potassium	567.000	482	337	69.97	107	0.15			0.69
Silicon	7050.000	5988	204	3.41	65	0.09			44
Silver	4.990	4	1	23.01	0.3	0.0004			301
Sodium	83700.000	71091	56200	79.05	19924	28.04			0.08
Strontium	126.000	107	5	4.39	1	0.002			8
Zinc	219.000	186	10	5.14	3	0.004			0.002
Zirconium	167.000	142	11	7.45	3	0.005			0.001
Uranium	1510.000	1283	≥0	≥0					14.21
Nitrate	≥109080.000	92648	92648	≤100	29435	41.42			2.00
Chloride	≥1380.000	1172	1172	≤100	372	0.52			>0
Fluoride	≥7520.000	6387	6387	≤100	2029	2.86			>0
Free OH	NR				1529	2.15			>0
Carbonate	≥10490.000	8910	8910	≤100	2831	3.98			>0
Organic Salts	≥2180.000	1852	1852	≤100	588	0.83			>0
Nitrite	≥7260.000	6166	6166	≤100	1959	2.76			>0
Sulfate	≥19050.000	16180	16180	≤100	5141	7.23			>0
Water	598400.000	508253	316384	62.25			55397	10.90	≥0
					100.00				100.00000
									100.00
Radionuclides	uCi/g	Ci/tank	Ci/tank						
Pu-239,240	0.08	67.948	NR						
C-14	≥ 0.005	4.247	4.247	≤ 100.00					
Sr-90	4.98	4229.783	NR						
Tc-99	0.035	29.727	NR						
Am-241	0.005	4.247	NR						
Co-60	<0.04	<34	NR						
Cs-137	19.4	16477.468	NR						
I-129	<0.019	<16	NR						

C-112

Density (kg/L)	1.5
Volume (L)/tank	393640
Mass (kg)/tank	590460
Solids (mg/kg)	585000
Water (mg/kg)	415000

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	1574560
Mass removed (kg)/tank	341049

3M NaOH Leach

Volume leachate (L)/tank	462776
Mass removed (kg)/tank	35104
Vol leachate (L)/kg sludge (after wash)	1.86

Residual Solids

Residual solids/tank (kg) 223771

S-104	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L)	1.5		
Volume (L)/tank	1109005		
Mass (kg)/tank	1663508		
Solids (mg/kg)	652000		
Water (mg/kg)	348000		
	Volume wash (L)/tank (4 volume wash:1 volume sludge)	4436020	Residual solids/tank (kg)
	Mass removed (kg)/tank	854513	222507
	Volume leachate (L)/tank	2356119	
	Mass removed (kg)/tank	683672	
	Vol leachate (L)/kg sludge (after wash)	2.91	

T-102

Density (kg/L)	1.79
Volume (L)/tank	71915
Mass (kg)/tank	128728
Solids (mg/kg)	723000
Water (mg/kg)	277000

0.1 M NaOH Wash

Volume wash (L)/tank	287660
(4 volume wash:1 volume sludge)	
Mass removed (kg)/tank	11886

3M NaOH Leach

Volume leachate (L)/tank	354448
Mass removed (kg)/tank	62705
Vol leachate (L)/kg sludge (after wash)	3.03

Residual Solids

Residual solids/tank (kg)	27430
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Component	---- UNTREATED ----		0.1M NaOH WASH				3M NaOH LEACH				RESIDUAL SOLIDS		
	ug/g sludge (element)	kg/tank (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION		removed kg/tank	% removed (element)	FINAL COMPOSITION		remaining kg/tank	mg/kg res (oxide)	dry wt% (oxide)
Aluminum	221500.000	28513	75	0.26	257	0.77	23926	83.91	64350	57.72	4512	310727	68.55
Barium	8.810	1	≥0	≥0							1	46	0.01
Bismuth	<DL												
Boron	≥0	≥0											
Cadmium	9.360	1	≥0	≥0									
Calcium	542.000	70	1	1.83	4	0.01					68	3493	0.77
Chromium	577.000	74	73	98.17	251	0.75					0	18	0.00
Cobalt	<DL												
Copper	41.800	5	≥0	≥0							5	246	0.05
Iron	14830.000	1909	10	0.52	34	0.10					1899	99009	21.84
Lead	309.000	40	≥0	≥0							40	1562	0.34
Magnesium	78.500	10	≥0	≥0							10	611	0.13
Manganese	714.000	92	1	0.82	3	0.01					91	5257	1.16
Nickel	53.600	7	≥0	≥0							7	354	0.08
Phosphate	3380.000	435	117	26.92	403	1.20					135	3671	0.81
Potassium	<DL												
Silicon	2380.000	306	6	1.93	20	0.06					300	23429	5.17
Silver	107.000	14	≥0	≥0							14	539	0.12
Sodium	21150.000	2723	2723	100.00	11631	34.73					0.1	4	0.001
Strontium	13.000	2	≥0	≥0							2	72	0.02
Zinc	166.000	21	≥0	≥0							21	970	0.21
Zirconium	30.600	4	≥0	≥0							4	194	0.04
Uranium	539.000	69	≥0	≥0							69	3040	0.67
Nitrate	≥ 25690.000	3307	3307	≤ 100	11366	33.94					≥0	≥0	≥ 0.00
Chloride	≥ 220.000	28	28	≤ 100	97	0.29					≥0	≥0	≥ 0.00
Fluoride	≥ 162.000	21	21	≤ 100	72	0.21					≥0	≥0	≥ 0.00
Free OH	NR				1681	5.02					≥0	≥0	≥ 0.00
Carbonate	≥ 9060.000	1166	1166	≤ 100	4008	11.97					≥0	≥0	≥ 0.00
Organic Salts	≥ 1180.000	152	152	≤ 100	522	1.56					≥0	≥0	≥ 0.00
Nitrite	≥ 5870.000	756	756	≤ 100	2597	7.75					≥0	≥0	≥ 0.00
Sulfate	≥ 1230.000	158	158	≤ 100	544	1.62					≥0	≥0	≥ 0.00
Water	277000.000	35658	3292	9.23							14996	546705	
					100.00						1000000		100.00
Radionuclides	uCi/g	Ci/tank	Ci/tank										
Pu-239,240	0.045	5.793	NR										
C-14	≥ 0.023	2.961	2.961	≤ 100.00									
Sr-90	175	22527.374	NR										
Tc-99	0.013	1.673	NR										
Am-241	0.19	24.458	NR										
Co-60	0.02	2.575	NR										
Cs-137	23.3	2999.359	NR										
I-129	NR												

T-10

Density (kg/L)	1.15
Volume (L)/tank	1672970
Mass (kg)/tank	1923916
Solids (mg/kg)	293500
Water (mg/kg)	706500

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	6691880
Mass removed (kg)/tank	930086

3M NaOH Leach

Volume leachate (L)/tank	1499092
Mass removed (kg)/tank	373149
Vol leachate (L)/kg sludge (after wash)	1.51

Residual Solids

Residual solids/tank (kg) 610519

T-107

Density (kg/L)	1.5
Volume (L)/tank	647235
Mass (kg)/tank	970853
Solids (mg/kg)	501750
Water (mg/kg)	498250

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	2588940
Mass removed (kg)/tank	581443

3M NaOH Leach

Volume leachate (L)/tank	445023
Mass removed (kg)/tank	88617
Vol leachate (L)/kg sludge (after wash)	1.14

Residual Solids

Residual solids/tank (kg) 291580

T-111	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L) 1.1	Volume wash (L)/tank 6858420 (4 volume wash:1 volume sludge)		Residual solids/tank (kg) 899789
Volume (L)/tank 1714605	Mass removed (kg)/tank 881201		
Mass (kg)/tank 1886066		Volume leachate (L)/tank 316515	
Solids (mg/kg) 239800		Mass removed (kg)/tank 70999	
Water (mo/kg) 760200		Vol leachate (L)/kg sludge (after wash) 0.31	

TY-101

Density (kg/L)	1.64
Volume (L)/tank	446630
Mass (kg)/tank	732473
Solids (mg/kg)	565000
Water (mg/kg)	435000

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	1786520
Mass removed (kg)/tank	320696

3M NaOH Leach

Volume leachate (L)/tank	752055
Mass removed (kg)/tank	68986
Vol leachate (L)/kg sludge (after wash)	1.83

Residual Solids

Residual solids/tank (kg)	372418
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Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS		
	ug/g sludge (element)	kg/tank (element)	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)
Aluminum	29040.000	21271	29	0.13	15	0.02	≥ 0	≥ 0.00	0
Barium	1930.000	1414	0.3	0.02	0.1	0.0001			
Bismuth	27230.000	19945	6	0.03	3	0.003			
Boron	NR								
Cadmium	10.600	8	1	18.49	1	0.0008			
Calcium	NR								
Chromium	9400.000	6885	311	4.51	161	0.16	4931	71.62	6305
Cobalt	NR								
Copper	NR								
Iron	40150.000	29409	39	0.13	20	0.02			
Lead	224.000	164	5	2.84	2	0.002			
Magnesium	NR								
Manganese	558.000	409	11	2.81	6	0.01			
Nickel	5090.000	3728	56	1.51	29	0.03			
Phosphate	74230.000	54371	11844	21.78	6150	6.29	42527	78.22	54378
Potassium	NR								
Silicon	38680.000	28332	236	0.83	122	0.13			
Silver	3.850	3	1	20.39	0.3	0.0003			
Sodium	121300.000	88849	54935	61.83	30656	31.35			
Strontium	NR								
Zinc	NR								
Zirconium	385.000	282	3	0.94	1	0.001			
Uranium	2340.000	1714	8	0.48	4	0.004			
Nitrate	≥145000.000	106209	106209	≤100	55144	56.39			
Chloride	≥ 757.000	554	554	≤100	288	0.29			
Fluoride	≥ 3370.000	2468	2468	≤100	1282	1.31			
Free OH	≥ 0.212	0.2	0.2	≤100	1577	1.61			
Carbonate	NR								
Organic Salts	1630.000	1194	455	38.10	236	0.24			
Nitrite	NR								
Sulfate	≥ 5490.000	4021	4021	≤100	2088	2.14	30009	9.42	
Water	435000.000	318626	139503	43.78					
					100.00				
Radionuclides	uCi/g	Ci/tank	Ci/tank						
Pu-239,240	0.192	140.635	0.732	0.52					
C-14	0.001	0.732	0.293	40.00					
Sr-90	12.5	9155.915	≥0	≥0					
Tc-99	0.007	5.127	2.930	57.14					
Am-241	0.013	9.522	>0	≥0					
Co-60	0.01	7.325	>0	≥0					
Cs-137	0.294	215.347	>0	≥0					
I-129	≥ 0.000047	0.034	0.034	≤ 100.00					
					100.00				
									100.00

TY-103

Density (kg/L)	1.7
Volume (L)/tank	613170
Mass (kg)/tank	1042389
Solids (mg/kg)	475000
Water (mg/kg)	525000

0.1 M NaOH Wash

Volume wash (L)/tank
(4 volume wash:1 volume sludge)
Mass removed (kg)/tank

2452680
591029

3M NaOH Leach

Volume leachate (L)/tank
Mass removed (kg)/tank
Vol leachate (L)/kg sludge (after wash)

Residual Solids

Residual solids/tank (kg)

382033

Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS				
	ug/g sludge (element)	kg/tank (element)	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)	mg/kg res (oxide)	dry wt% (oxide)
Aluminum	8212.000	8560		4	0.05	2	0.002				
Barium	500.000	521		0.3	1.41	3	0.003				
Bismuth	27410.000	28572		7	0.03	3	0.003				
Boron	NR										
Cadmium	7.630	8		2	21.10	1	0.0006				
Calcium	NR										
Chromium	1000.000	1042		423	40.60	153	0.15				
Cobalt	NR										
Copper	NR										
Iron	23806.000	24815		163	0.66	59	0.06				
Lead	468.000	488		5	1.11	2	0.002				
Magnesium	NR										
Manganese	160.000	167		13	8.06	5	0.005				
Nickel	2530.000	2637		66	2.51	24	0.02				
Phosphate	62890.000	65556		19732	30.10	7142	6.79				
Potassium	NR										
Silicon	9410.000	9809		76	0.77	27	0.03				
Silver	9.000	9		1	7.14	0.2	0.0002				
Sodium	105900.000	110389		77033	69.78	27880	28.45				
Strontium	NR										
Zinc	NR										
Zirconium	51.700	54		3	5.73	1	0.001				
Uranium	16250.000	16939		43	0.25	16	0.01				
Nitrate	155900.000	162508		155316	95.57	56213	53.46				
Chloride	≥ 1200.000	1251		1251	≤100	453	0.43				
Fluoride	≥ 860.000	896		896	≤100	324	0.31				
Free OH	≥ 86.800	0.2		0.2	≤100	1542	1.47				
Carbonate	≥ 4780.000	4983		4983	≤100	1803	1.71				
Organic Salts	3650.000	3805		2527	66.42	915	0.87				
Nitrite	≥ 8100.000	8443		8443	≤100	3056	2.91				
Sulfate	9793.000	10208		9653	94.56	3494	3.32				
Water	525000.000	547254		310290	56.70			38584	7.05		
Radionuclides	uCi/g	Ci/tank				100.00					
Pu-239,240	0.176	183.460		0.417	0.23						
C-14	0.0014	1.459		1.042	71.43						
Sr-90	105	109450.845		9.382	0.01						
Tc-99	0.016	16.678		11.466	68.75						
Am-241	0.027	28.145		1.042	3.70						
Co-60	0.005	5.212		1.042	20.00						
Cs-137	24.7	25747.008		1.042	0.004						
I-129	>0.003	>3		<3							

4-29

TY-104

Density (kg/L)	1.69
Volume (L)/tank	162755
Mass (kg)/tank	294246
Solids (mg/kg)	430250
Water (mg/kg)	569750

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	651020
Mass removed (kg)/tank	158999

3M NaOH Leach

Volume leachate (L)/tank	110686
Mass removed (kg)/tank	14417
Vol leachate (L)/kg sludge (after wash)	0.82

Residual Solids

Residual solids/tank (kg)	118397
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Component	UNTREATED		0.1M NaOH WASH				3M NaOH LEACH				RESIDUAL SOLIDS				
	ug/g sludge (element)	kg/tank (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION	mg/L	dry wt % (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION	mg/L	dry wt% (oxide)	remaining kg/tank	FINAL COMPOSITION	mg/kg res (oxide)
Aluminum	9090.000	2675	122	4.57	155	0.17	258	9.64	2168	2.95	2295	36613	8.75		
Barium	423.000	124	0.3	0.22	0.4	0.0004					124	1172	0.28		
Bismuth	17750.000	5223	3	0.06	4	0.004					5220	49158	11.75		
Boron	NR														
Cadmium	12.800	4	1	24.53	1	0.001									
Calcium	NR														
Chromium	2310.000	680	528	77.66	671	0.74	114	16.75	958	1.01	38	469	0.11		
Cobalt	NR														
Copper	NR														
Iron	32570.000	9584	25	0.26	32	0.04					9558	115446	27.58		
Lead	580.000	171	3	1.77	4	0.004					168	1525	0.36		
Magnesium	NR														
Manganese	2090.000	615	4	0.72	6	0.01					611	8158	1.95		
Nickel	1550.000	456	5	1.07	6	0.01					451	5369	1.28		
Phosphate	78580.000	23122	15693	67.87	19939	22.04	7429	32.13	62481	33.64	-0	-0	-0.00		
Potassium	NR										2333	42141	10.07		
Silicon	8090.000	2380	48	2.01	61	0.07					3	26	0.01		
Silver	12.400	4	1	22.46	1	0.001					7930	90286	21.57		
Sodium	113100.000	33279	25349	76.17	34244	37.86									
Strontium	NR														
Zinc	NR														
Zirconium	181.000	53	1	2.60	2	0.002					52	592	0.14		
Uranium	19460.000	5726	11	0.20	14	0.02					5715	58019	13.86		
Nitrate	46600.000	13712	13145	95.87	16703	18.46					566	4784	1.14		
Chloride	> 598.000	176	176	≤100	224	0.25					≥0	>0	≥0.00		
Fluoride	> 5350.000	1574	1574	≤100	2000	2.21					≥0	>0	≥0.00		
Free OH	> 1290.000	380	380	≤100	1987	2.20					≥0	>0	≥0.00		
Carbonate	> 18250.000	5370	5370	≤100	6823	7.54					≥0	>0	≥0.00		
Organic Salts	4750.000	1398	1182	84.55	1501	1.66					216	1824	0.44		
Nitrite	> 12220.000	3596	3596	≤100	4569	5.05					≥0	>0	≥0.00		
Sulfate	5230.000	1539	1192	77.44	1514	1.67					347	2933	0.70		
Water	569750.000	167647	90590	54.04			8214	4.90			68843	581458			
					100.00				100.00			1000000		100.00	
Radionuclides	uCi/g	Ci/tank	Ci/tank												
Pu-239,240	0.181	53.259	0.294	0.55											
C-14	0.003	0.883	0.588	66.67											
Si-90	132	38840.472	11.476	0.03											
Tc-99	0.033	9.710	7.062	72.73											
Am-241	0.034	10.004	0.588	5.88											
Co-60	0.023	6.768	0.883	13.04											
Cs-137	45.4	13358.768	4855.059	36.34											
I-129	>0.0000335	>0.010	<0.010	≤100											

TY-106

Density (kg/L)	1.37
Volume (L)/tank	64345
Mass (kg)/tank	88153
Solids (mg/kg)	638500
Water (mg/kg)	361500

0.1 M NaOH Wash

Volume wash (L)/tank	257380
(4 volume wash:1 volume sludge)	
Mass removed (kg)/tank	39095

3M NaOH Leach

Volume leachate (L)/tank	49552
Mass removed (kg)/tank	4692
Vol leachate (L)/kg sludge (after wash)	1.01

Residual Solids

Residual solids/tank (kg)	44824
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Component	UNTREATED		0.1M NaOH WASH				3M NaOH LEACH				RESIDUAL SOLIDS				
	ug/g sludge (element)	kg/tank (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION		removed kg/tank	% removed (element)	FINAL COMPOSITION		remaining kg/tank	mg/kg res (oxide)	dry wt% (oxide)		
Aluminum	6850.000	604		0.3	0.04	1	0.001		0	0	604	25436	3.96		
Barium	1310.000	115		1	0.60	3	0.003		0	0	115	2860	0.45		
Bismuth	524.000	46		1	1.88	3	0.003		0	0	45	1127	0.18		
Boron	NR										2	59	0.01		
Cadmium	28.500	3		0.2	7.93	1	0.0008		9	74.20	181	0.18	3	101	0.02
Calcium	NR										4036	128762	20.05		
Chromium	142.000	13		0.1	1.06	0.5	0.005		3992	78.29	77896	39.21	33	796	0.12
Cobalt	NR										47	1667	0.26		
Copper	NR										6	185	0.03		
Iron	45790.000	4037		0.4	0.01	1	0.001				0	0	0.00		
Lead	383.000	34		1	1.91	2	0.003				7835	373901	58.22		
Magnesium	NR										2	57	0.01		
Manganese	554.000	49		2	3.27	6	0.01				2301	69191	10.77		
Nickel	68.300	6		0.1	2.12	0.5	0.0005				57	1708	0.27		
Phosphate	57840.000	5099		1107	21.71	4076	4.26				736	19732	3.07		
Potassium	NR										414	9243	1.44		
Silicon	88940.000	7840		5	0.06	18	0.02				20	>0	>0.00		
Silver	27.700	2		0.08	3.27	0.3	0.0003				20	>0	>0.00		
Sodium	105700.000	9318		7017	75.31	28024	29.27				20	>0	>0.00		
Strontium	NR										158	3529	0.55		
Zinc	NR										20	>0	>0.00		
Zirconium	647.000	57		0.04	0.64	1	0.001				172	3839	0.60		
Uranium	8350.000	736		0.2	0.03	1	0.001				16038	357806	1000000		
Nitrate	171200.000	15092		14677	97.25	54058	56.47				100.00	100.00			
Chloride	≥1230.000	108		108	≤100	399	0.42				100.00	100.00			
Fluoride	≥699.000	62		62	≤100	227	0.24				100.00	100.00			
Free OH	≥1.050	0.1		0	≤100	1612	1.68				100.00	100.00			
Carbonate	≥1020.000	90		90	≤100	331	0.35				100.00	100.00			
Organic Salts	5590.000	493		335	67.89	1232	1.29				100.00	100.00			
Nitrite	≥5660.000	499		499	≤100	1838	1.92				100.00	100.00			
Sulfate	13940.000	1229		1057	86.00	3892	4.07				100.00	100.00			
Water	361500.000	31867		14133	44.35										
Radionuclides	uCi/g	Ci/tank				100.00									
Pu-239,240	0.041	3.614		0.062	1.71										
C-14	0.001	0.088		0.035	40.00										
Sr-90	136	11988.760		5.113	0.04										
Tc-99	0.122	10.755		9.256	86.07										
Am-241	0.049	4.319		0.529	12.24										
Co-60	0.031	2.733		0.088	3.23										
Cs-137	23.7	2089.218		434.593	20.80										
I-129	>0.001	>0.088		<0.088											

U-110

Density (kg/L)	1.5
Volume (L)/tank	704010
Mass (kg)/tank	1056015
Solids (mg/kg)	741700
Water (mg/kg)	258300

0.1 M NaOH Wash

Volume wash (L)/tank	2816040
(4 volume wash:1 volume sludge)	
Mass removed (kg)/tank	265774

3M NaOH Leach

Volume leachate (L)/tank	2158521
Mass removed (kg)/tank	356299
Vol leachate (L)/kg sludge (after wash)	2.73

Residual Solids

Residual solids/tank (kg)	322799
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Component	UNTREATED		0.1M NaOH WASH				3M NaOH LEACH				RESIDUAL SOLIDS				
	ug/g sludge (element)	kg/tank (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION	mg/L	dry wt % (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION	mg/L	dry wt % (oxide)	remaining kg/tank (element)	FINAL COMPOSITION mg/kg res (oxide)	dry wt % (oxide)
Aluminum	168150.000	177569	2815	1.59	976	1.35		139801	78.73	62119	56.79		34953	204540	31.33
Barium	52.000	55	6	10.58	2	0.003							49	170	0.03
Bismuth	13950.000	14731	>0	>0									14731	50885	7.80
Boron	285.000	301	301	100.00	104	0.14							0	0	0.00
Cadmium	16.000	17	>0	>0									17	60	0.01
Calcium	2850.000	3010	115	3.82	40	0.06							2895	12545	1.92
Chromium	391.000	413	246	59.59	85	0.12							42	189	0.03
Cobalt	117.000	124	124	100.00	43	0.06							0	0	0.00
Copper	288.000	304	>0	>0									304	1180	0.18
Iron	10080.000	10645	34	0.32	12	0.02							10611	47006	7.20
Lead	491.000	519	60	11.61	21	0.03							458	1529	0.23
Magnesium	1360.000	1436	335	23.31	116	0.16							1101	5657	0.87
Manganese	2360.000	2492	>0	>0									2492	12214	1.87
Nickel	3570.000	3770	>0	>0									3770	16456	2.52
Phosphate	43880.000	46338	46338	≤100	16063	22.24							0	0	0.00
Potassium	1210.000	1278	<600										1278	3958	0.61
Silicon	10920.000	11532	869	7.54	301	0.42							10663	70655	10.82
Silver	67.500	71	>0	>0									71	237	0.04
Sodium	108540.000	114620	69464	60.60	26326	36.44							45156	188569	28.89
Strontrium	402.000	425	4	0.87	1	0.002							421	1542	0.24
Zinc	183.000	193	27	13.93	9	0.01							166	641	0.10
Zirconium	219.000	231	>0	>0									231	968	0.15
Uranium	8520.000	8997	<3200										8997	33503	5.13
Nitrate	≥ 31750.000	33528	33528	≤100	11623	16.09							≥0	≥0	≥0.00
Chloride	≥ 975.000	1030	1030	≤100	357	0.49							≥0	≥0	≥0.00
Fluoride	≥ 7430.000	7846	7846	≤100	2720	3.77							≥0	≥0	≥0.00
Free OH	≥ 5000.000	5280	5280	≤100	3490	4.83							≥0	≥0	≥0.00
Carbonate	≥ 16030.000	16928	16928	≤100	5868	8.12							≥0	≥0	≥0.00
Organic Salts	≥ 3320.000	3506	3506	≤100	1215	1.68							≥0	≥0	≥0.00
Nitrite	≥ 6620.000	6991	6991	≤100	2423	3.35							≥0	≥0	≥0.00
Sulfate	1290.000	1362	1278	93.80	443	0.61							84	262	0.04
Water	258300.000	272769	68649	25.17									112087	347235	
					100.00								1000000		100.00
Radionuclides	uCi/g	Ci/tank													
Pu-239,240	0.172	181.635			1.056	0.58									
C-14	≥ 0.0001	0.106			0.106	≤100									
Sr-90	261	275619.915			243.939	0.09									
Tc-99	0.005	5.280			3.168	60.00									
Am-241	0.064	67.585			<2										
Co-60	NR														
Cs-137	17.7	18691.466			4224.060	22.60									
I-129	<0.003	<3.2													

Enhanced Sludge Washing Spreadsheet Evaluation

Data Summaries for 15 Different Waste Types

Aluminum Cladding Waste	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L)	1.8		
Volume (L)/tank	49205		
Mass (kg)/tank	88569		
Solids (mg/kg)	740000		
Water (mg/kg)	260000		
	Volume wash (L)/tank (4 volume wash:1 volume sludge)	196820	Residual solids/tank (kg)
	Mass removed (kg)/tank	2327	19067
	Volume leachate (L)/tank	300933	
	Mass removed (kg)/tank	49906	
	Vol leachate (L)/kg sludge (after wash)	3.49	

Aluminum Cladding Waste - Mix		0.1 M NaOH Wash		3M NaOH Leach		Residual Solids							
Density (kg/L)	1.79	Volume wash (L)/tank	2165020 <th>Volume leachate (L)/tank</th> <td>2667688<th>Residual solids/tank (kg)</th><td>206446</td></td>	Volume leachate (L)/tank	2667688 <th>Residual solids/tank (kg)</th> <td>206446</td>	Residual solids/tank (kg)	206446						
Volume (L)/tank	541255	(4 volume wash:1 volume sludge)		Mass removed (kg)/tank	89456 <th></th> <td></td>								
Mass (kg)/tank	968846	Vol leachate (L)/kg sludge (after wash)		Vol leachate (L)/kg sludge (after wash)	3.03								
Solids (mg/kg)	723000												
Water (mg/kg)	277000												
UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS							
Component	ug/g sludge (element)	kg/tank (element)	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)	mg/kg res (oxide)	dry wt% (oxide)		
Aluminum	221500.000	214599	563	0.26	257	0.77	180078	83.91	64350	57.72	33959	310727	68.55
Barium	8.810	9	≥0	≥0							9	46	0.01
Bismuth	<DL												
Boron	>0	>0											
Cadmium	9.360	9	≥0	≥0									
Calcium	542.000	525	10	1.83	4	0.01							
Chromium	577.000	559	549	98.17	251	0.75	8	1.37	3	0.002			
Cobalt	<DL												
Copper	41.800	40	≥0	≥0									
Iron	14830.000	14368	74	0.52	34	0.10							
Lead	309.000	299	≥0	≥0									
Magnesium	78.500	76	≥0	≥0									
Manganese	714.000	692	6	0.82	3	0.01							
Nickel	53.600	52	≥0	≥0									
Phosphate	3380.000	3275	882	26.92	403	1.20	1379	42.10	493	0.17	1014	3671	0.81
Potassium	<DL												
Silicon	2380.000	2306	45	1.93	20	0.06							
Silver	107.000	104	≥0	≥0									
Sodium	21150.000	20491	20490	100.00	11631	34.73							
Strontium	13.000	13	≥0	≥0									
Zinc	166.000	161	≥0	≥0									
Zirconium	30.600	30	≥0	≥0									
Uranium	539.000	522	≥0	≥0									
Nitrate	≥25690.000	24890	24890	≤100	11366	33.94							
Chloride	≥220.000	213	213	≤100	97	0.29							
Fluoride	≥162.000	157	157	≤100	72	0.21							
Free OH	NR				1681	5.02							
Carbonate	≥9060.000	8778	8778	≤100	4008	11.97							
Organic Salts	≥1180.000	1143	1143	≤100	522	1.56							
Nitrite	≥5870.000	5687	5687	≤100	2597	7.75							
Sulfate	≥1230.000	1192	1192	≤100	544	1.62							
Water	277000.000	268370	24779	9.23			130726	48.71			112865	546705	1000000
						100.00				100.00		100.00	
Radionuclides		uCi/g	Ci/tank	Ci/tank		100.00		100.00		100.00		100.00	
Pu-239,240	0.045	43.598	NR	NR		100.00		100.00		100.00		100.00	
C-14	≥ 0.023	22.283	22.283	≤ 100.00		100.00		100.00		100.00		100.00	
Sr-90	175	169548.129	NR	NR		100.00		100.00		100.00		100.00	
Tc-99	0.013	12.595	NR	NR		100.00		100.00		100.00		100.00	
Am-241	0.19	184.081	NR	NR		100.00		100.00		100.00		100.00	
Co-60	0.02	19.377	NR	NR		100.00		100.00		100.00		100.00	
Cs-137	23.3	22574.122	NR	NR		100.00		100.00		100.00		100.00	
I-129			NR	NR		100.00		100.00		100.00		100.00	

1st Cycle Bismuth Phosphate

Density (kg/L)	1.15
Volume (L)/tank	1672970
Mass (kg/tank)	1923916
Solids (mg/kg)	293500
Water (mg/kg)	706500

0.1 M NaOH Wash

Volume wash (L)/tank	6691880
(4 volume wash:1 volume sludge)	
Mass removed (kg/tank)	930086

3M NaOH Leach

Volume leachate (L)/tank	1499092
Mass removed (kg/tank)	373149
Vol leachate (L)/kg sludge (after wash)	1.51

Residual Solids

Residual solids/tank (kg)	610519
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Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS		
	ug/g sludge (element)	kg/tank (element)	removed kg/tank	% removed (element)	FINAL COMPOSITION	removed kg/tank	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)
Aluminum	16200.000	31167	298	0.96	41	0.10	16355	52.47	9278
Barium	8.800	17	1	3.50	0.09	0.002			14515
Bismuth	18880.000	36324	321	0.88	44	0.11			44909
Boron	13.900	27	22	83.45	3	0.01			16
Cadmium	5.530	11	≥0	≥0					30
Calcium	664.000	1277	353	27.64	48	0.12			0.01
Chromium	916.000	1762	278	15.80	38	0.09	1113	63.15	631
Cobalt	10.900	21	≥0	≥0					0.11
Copper	46.900	90	≥0	≥0					20
Iron	9020.000	17354	153	0.88	21	0.05			0.01
Lead	61.200	118	≥0	≥0					0.01
Magnesium	159.000	306	12	4.04	2	0.004			0.01
Manganese	59.600	115	1	0.69	0.1	0.003			0.01
Nickel	12.700	24	≥0	≥0					0.01
Phosphate	73950.000	142274	36968	25.98	5030	12.33	103077	72.45	58476
Potassium	85.700	165	72	43.64	10	0.02			30.93
Silicon	6440.000	12390	331	2.67	45	0.11			
Silver	<DL								
Sodium	64480.000	124054	89462	72.12	14268	34.98			58680
Strontium	98.800	190	2	1.24	0.3	0.0008			56.01
Zinc	152.000	292	8	2.85	1	0.003			34592
Zirconium	69.100	133	5	3.69	1	0.002			76378
Uranium	867.000	1668	≥0	≥0					27.11
Nitrate	≥ 58030.000	111645	111645	≤100	15192	37.25			188
Chloride	≥ 670.000	1289	1289	≤100	175	0.43			364
Fluoride	≥ 8580.000	16507	16507	≤100	2246	5.51			0.13
Free OH	NR				1548	3.80			284
Carbonate	<2750	≥0	≥0	≥0					128
Organic Salts	<1220	≥0	≥0	≥0					1668
Nitrite	≥ 4070.000	7830	7830	≤100	1065	2.61			3284
Sulfate	3890.000	7484	7421	99.15	1010	2.48			1.17
Water	706500.000	1359246	657106	48.34			263630	19.40	
					100.01				1000000
									100.00
Radionuclides	uCi/g	Ci/tank							
Pu-239,240	<0.018	<35							
C-14	<DL								
Sr-90	2.61	5021.419							
Tc-99	0.001	1.924							
Am-241	0.017	32.707							
Co-60	<0.0003	<0.6							
Cs-137	<0.2	<385							
I-129	<0.02	<39							
					NR				

1st Cycle BiPO4 - Al Cladding Waste

Density (kg/L)	1.5
Volume (L)/tank	1146855
Mass (kg)/tank	1720283
Solids (mg/kg)	741700
Water (mg/kg)	258300

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	4587420
Mass removed (kg)/tank	432954

3M NaOH Leach

Volume leachate (L)/tank	3516301
Mass removed (kg)/tank	580423
Vol leachate (L)/kg sludge (after wash)	2.73

Residual Solids

Residual solids/tank (kg) 525851

1st Cycle BiPO4 - Uranium Recovery	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L)	1.2		
Volume (L)/tank	2615435	10461740	
Mass (kg)/tank	3138522		
Solids (mg/kg)	421750		
Water (mg/kg)	578250		
	Volume wash (L)/tank (4 volume wash:1 volume sludge)	1913960	
	Mass removed (kg)/tank		
		Volume leachate (L)/tank	2191832
		Mass removed (kg)/tank	364288
		Vol leachate (L)/kg sludge (after wash)	1.79
			Residual solids/tank (kg) 847848

1st Cycle BiPO4 - Evaporator Bottoms		0.1 M NaOH Wash		3M NaOH Leach		Residual Solids					
Density (kg/L)	1.64	Volume (L)/tank	10613140 <th>Volume leachate (L)/tank</th> <td>4467715<th>Residual solids/tank (kg)</th><td>2212379</td></td>	Volume leachate (L)/tank	4467715 <th>Residual solids/tank (kg)</th> <td>2212379</td>	Residual solids/tank (kg)	2212379				
Volume (L)/tank	2653285	(4 volume wash:1 volume sludge)		Mass removed (kg)/tank	409824						
Mass (kg)/tank	4351387	Mass removed (kg)/tank	1905141	Vol leachate (L)/kg sludge (after wash)	1.83						
Solids (mg/kg)	565000	Water (mg/kg)	435000								
--- UNTREATED ---		--- 0.1M NaOH WASH ---		--- 3M NaOH LEACH ---		--- RESIDUAL SOLIDS ---					
Component	ug/g sludge (element)	kg/tank (element)	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)	FINAL COMPOSITION	dry wt% (oxide)
Aluminum	29040.000	126364	170	0.13	15	0.02	0	0.00	0	107749	17.97
Barium	1930.000	8398	0.3	0.02	0.1	0.0001				8396	0.71
Bismuth	27230.000	118488	38	0.03	3	0.003				59697	9.96
Boron	NR									38	19
Cadmium	10.600	46	9	18.49	1	0.0008				9765	0.003
Calcium	NR									6453	1.08
Chromium	9400.000	40903	1845	4.51	161	0.16	29294	71.62	6305	6.62	
Cobalt	NR									174477	112776
Copper	NR									947	461
Iron	40150.000	174708	231	0.13	20	0.02				2360	1687
Lead	224.000	975	28	2.84	2	0.002				21815	13893
Magnesium	NR									0	0.00
Manganese	558.000	2428	68	2.81	6	0.01				166911	161375
Nickel	5090.000	22149	334	1.51	29	0.03				13	6
Phosphate	74230.000	323003	70362	21.78	6150	6.29	252642	78.22	54378	29.16	
Potassium	NR									201469	122755
Silicon	38680.000	168312	1401	0.83	122	0.13				1660	1013
Silver	3.850	17	3	20.39	0.3	0.0003				10134	5506
Sodium	121300.000	527823	326354	61.83	30656	31.35				>0	>0
Strontium	NR									>0	>0
Zinc	NR									>0	>0
Zirconium	385.000	1675	16	0.94	1	0.001				>0	>0
Uranium	2340.000	10182	49	0.48	4	0.004				>0	>0
Nitrate	≥ 45000.000	630951	630951	≤100	55144	56.39				>0	>0
Chloride	≥ 757.000	3294	3294	≤100	288	0.29				>0	>0
Fluoride	≥ 3370.000	14664	14664	≤100	1282	1.31				>0	>0
Free OH	≥ 0.212	0.2	0.2	≤100	1577	1.61				>0	>0
Carbonate	NR									>0	>0
Organic Salts	1620.000	7049	2697	38.26	236	0.24				4352	1967
Nitrite	NR									>0	>0
Sulfate	≥ 5490.000	23889	23889	≤100	2088	2.14				>0	>0
Water	435000.000	1892854	828736	43.78			178273	9.42		885844	400403
					100.00					1000000	100.00
Radionuclides	uCi/g	Ci/tank	Ci/tank								
Pu-239,240	0.192	835.466	4.351	0.52							
C-14	0.001	4.351	1.741	40.00							
Sr-90	12.5	54392.343	≥0	≥0							
Tc-99	0.007	30.460	17.406	57.14							
Am-241	0.013	56.568	≥0	≥0							
Co-60	0.01	43.514	≥0	≥0							
Cs-137	0.294	1279.308	≥0	≥0							
I-129	≥ 0.000047	0.205	0.205	≤ 100.00							

2nd Cycle BIPO4 - Tank 5-6, B-Plant

Density (kg/L)	1.303
Volume (L)/tank	1934135
Mass (kg)/tank	2520178
Solids (mg/kg)	398510
Water (mg/kg)	601490

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	7736540
Mass removed (kg)/tank	1902715

3M NaOH Leach

Volume leachate (L)/tank	746597
Mass removed (kg)/tank	117897
Vol leachate (L)/kg sludge (after wash)	1.21

Residual Solids

Residual solids/tank (kg) 523027

2nd Cycle BIPO4 - 224 Cycle BIPO4

Density (kg/L)	1.1
Volume (L)/tank	3364865
Mass (kg)/tank	3701352
Solids (mg/kg)	239800
Water (mg/kg)	760200

0.1 M NaOH Wash

Volume wash (L)/tank (4 volume wash:1 volume sludge)	13459460
Mass removed (kg)/tank	1729332

3M NaOH Leach

Volume leachate (L)/tank	62115
Mass removed (kg)/tank	139334
Vol leachage (L)/kg sludge (after wash)	0.31

Residual Solids

Residual solids/tank (kg) 1769815

224 (Concentration) Cycle BiPO_4

Density (kg/L)	1.25
Volume (L)/tank	1044660
Mass (kg)/tank	1305825
Solids (mg/kg)	396000
Water (mg/kg)	604000

0.1 M NaOH Wash

Volume wash (L)/tank
(4 volume wash:1 volume sludge)
Mass removed (kg)/tank

3M NaOH Leach

Volume leachate (L)/tank	330440
Mass removed (kg)/tank	9010
Vol leachate (L)/kg sludge (after wash)	0.35

Residual Solids

Residual solids/tank (kg) 988195

Uranium Recovery - Diatomaceous Earth	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L)	1.37		
Volume (L)/tank	64345	Volume wash (L)/tank (4 volume wash:1 volume sludge)	257380
Mass (kg)/tank	88153	Mass removed (kg)/tank	39095
Solids (mg/kg)	638500	Volume leachate (L)/tank	49552
Water (mg/kg)	361500	Mass removed (kg)/tank	4692
		Vol leachage (L)/kg sludge (after wash)	1.01
		Residual solids/tank (kg)	44824

Uranium Recovery - CW - Portland Cement 0.1 M NaOH Wash

Density (kg/L)	1.69
Volume (L)/tank	174110
Mass (kg)/tank	294246
Solids (mg/kg)	430000
Water (mg/kg)	570000

volume wash (L)/tank	696440
volume wash:1 volume sludge)	
ass removed (kg)/tank	118006

3M NaOH Leach

Volume leachate (L)/tank	175971
Mass removed (kg)/tank	6377
Vol leachate (L)/kg sludge (after wash)	1.00

Residual Solids

Residual solids/tank (kg) 167500

Uranium Recovery - 1st Cycle BiPO4 (F)		0.1 M NaOH Wash		3M NaOH Leach		Residual Solids	
Density (kg/L)	1.7	Volume wash (L)/tank	3103700	Volume leachate (L)/tank	693342	Residual solids/tank (kg)	494634
Volume (L)/tank	775925	(4 volume wash:1 volume sludge)		Mass removed (kg)/tank	86196		
Mass (kg)/tank	1319073			Vol leachate (L)/kg sludge (after wash)	1.20		
Solids (mg/kg)	465155						
Water (mg/kg)	534845						

Component	UNTREATED		0.1M NaOH WASH		3M NaOH LEACH		RESIDUAL SOLIDS				
	ug/g sludge (element)	kg/tank (element)	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	removed kg/tank (element)	% removed (element)	FINAL COMPOSITION	remaining kg/tank (element)	FINAL COMPOSITION mg/kg res (oxide)	dry wt% (oxide)
Aluminum	8400.000	11080	125	1.13	36	0.03	≥ 0	≥ 0.00	0	0.00	10955
Barium	483.000	637	8	1.18	2	0.002	630	1422	0.30		
Bismuth	26280.000	34665	10	0.03	3	0.003	34655	78119	16.57		
Boron	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0.00	
Cadmium	8.770	12	3	22.20	1	0.007	9	21	0.00		
Calcium	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0.00	
Chromium	1290.000	1702	938	55.14	268	0.26	572	33.64	774	0.80	
Cobalt	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	191	564	
Copper	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0.00	
Iron	25730.000	33940	185	0.55	53	0.05	33754	97585		20.82	
Lead	493.000	650	8	1.28	2	0.002	642	1398		0.30	
Magnesium	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0.00	
Manganese	585.000	772	18	2.28	5	0.005	754	2412		0.51	
Nickel	2310.000	3047	70	2.31	20	0.02	2977	8480		1.81	
Phosphate	66340.000	87507	34954	39.94	9986	9.78	52554	60.06	71072	37.54	
Potassium	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0.00	
Silicon	9120.000	12030	122	1.01	35	0.03	11908	51495		10.99	
Silver	9.750	13	1	11.43	0.4	0.0004	11	25		0.01	
Sodium	107500.000	141800	101034	71.25	30904	30.27	40766	111097		23.71	
Strontium	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0.00	
Zinc	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0	≥0.00	
Zirconium	80.100	106	4	4.18	1	0.001	101	277		0.06	
Uranium	16960.000	22371	54	0.24	15	0.02	22318	54234		11.57	
Nitrate	131900.000	173986	166267	95.56	47501	46.53	7719	15605		3.33	
Chloride	≥1070.000	1411	1411	≤100	403	0.40	≥0	≥0	≥0	≥0.00	
Fluoride	>1850.000	2440	2440	≤100	697	0.68	≥0	≥0	≥0	≥0.00	
Free OH	≥352.000	464	464	≤100	1640	1.61	10425				
Carbonate	7740.000	10210	10210	≤100	2917	2.86	≥0	≥0	≥0	≥0	
Organic Salts	3890.000	5131	3660	71.32	1046	1.02	1471	2975		0.63	
Nitrite	≥9000.000	11872	11872	≤100	3392	3.32	≥0	≥0	≥0	≥0.00	
Sulfate	8790.000	11595	11045	95.26	3155	3.09	550	1111		0.24	
Water	534845.000	705499	396577	56.21			262820	531343			
					100.01				1000000	100.00	
Radionuclides	uCi/g	Ci/tank	Ci/tank								
Pu-239,240	0.177	233.476	0.702	0.30							
C-14	0.0018	2.374	1.609	67.78							
Sr-90	111	146417.048	20.578	0.01							
Tc-99	0.02	26.381	18.282	69.30							
Am-241	0.029	38.253	1.609	4.21							
Co-60	0.009	11.872	1.899	16.00							
Cs-137	29.3	38648.824	4789.262	12.39							
I-129	>0.003	>4	≤0.003	≤4							

Uranium Recovery (F) - 1st Cycle BiPO4	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L)	1.45		
Volume (L)/tank	1741100		
Mass (kg)/tank	2524595		
Solids (mg/kg)	567800		
Water (mg/kg)	432200		
	Volume wash (L)/tank (4 volume wash:1 volume sludge)	6964400	Residual solids/tank (kg)
	Mass removed (kg)/tank	1314426	939009
	Volume leachate (L)/tank	1464216	
	Mass removed (kg)/tank	136610	
	Vol leachate (L)/kg sludge (after wash)	1.21	

REDOX	0.1 M NaOH Wash	3M NaOH Leach	Residual Solids
Density (kg/L)	1.5		
Volume (L)/tank	2626790		
Mass (kg)/tank	3940185		
Solids (mg/kg)	652000		
Water (mg/kg)	348000		
	Volume wash (L)/tank (4 volume wash:1 volume sludge)	10507160	Residual solids/tank (kg)
	Mass removed (kg)/tank	2189386	324120
	Volume leachate (L)/tank	5580706	
	Mass removed (kg)/tank	1619345	
	Vol leachate (L)/kg sludge (after wash)	3.19	

5.0 References

5.0 References

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