Contract No:

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-08SR22470 with the U.S. Department of Energy (DOE) Office of Environmental Management (EM).

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Analysis of Tank 38H (HTF-38-14-150, 151) and Tank 43H (HTF-43-14-152, 53) Surface and Subsurface Supernatant Samples in Support of Enrichment Control, Corrosion Control and Sodium Aluminosilicate Formation Potential Programs

L. N. Oji

January 2015

SRNL-STI-2015-00008, Revision 0

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Prepared for
U.S. Department of Energy

SRNL-STI-2015-00008
Revision 0

Keywords: 2H Evaporator System
Supernatant Liquid samples,
Characterization, Tank farms

Retention: *Permanent*

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EXECUTIVE SUMMARY

This report provides the results of analyses on Tanks 38H and 43H surface and subsurface supernatant liquid samples in support of the Enrichment Control Program (ECP), the Corrosion Control Program and Sodium Aluminosilicate Formation Potential in the Evaporator.

The U-235 mass divided by total uranium mass averaged 0.0060 (0.6 % uranium enrichment) for all sample measurements for both types of tank samples. The U-235 concentration in Tank 38H samples ranged from 5.74E-01 to 5.96E-01 mg/L, while the U-238 concentration in Tank 38H ranged from 9.48E+01 to 9.84E+01 mg/L. Similarly, U-235 concentration in the Tank 43H ranged from 3.77E-01 to 4.12E-01 mg/L and the U-238 concentration in Tank 43H ranged from 6.22E+01 to 6.90E+01mg/L. Thus, the U-235/total uranium ratio is in line with the prior 2H-evaporator ECP samples.

Measured sodium concentration averaged 6.82 M in the Tank 38H subsurface samples, and 4.37 M in the Tank 43H subsurface samples. Measured silicon averaged 258 mg/L and 157 mg/L in Tanks 38H and 43H supernate subsurface samples, respectively. The measured aluminum concentration in Tanks 38H and 43H subsurface samples averaged 924 and 705 mg/L.

In general, the nitrate, nitrite, free-OH and specific gravity of the Tank 43H samples were lower in magnitude than those of the Tank 38H samples.

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LIST OF ABBREVIATIONS

CCP	Corrosion Control Program
ECP	Enrichment Control Program
HTF	H Tank Farm
IC	Ion Chromatography
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
ICP-ES	Inductively Coupled Plasma – Emission Spectrometry
SpG	Specific Gravity
SRNL	Savannah River National Laboratory
SRR	Savannah River Remediation
TIC	Total Inorganic Carbon
TTQAP	Task Technical and Quality Assurance Plan

1.0 Introduction

Barriers have been established to ensure that a nuclear criticality remains incredible for the 2H Evaporator.[i] The barriers include the Enrichment Control Program (ECP), which requires sampling to determine the equivalent enriched uranium at two locations in Tanks 38H and 43H every 26 weeks.[ii] The Corrosion Control Program (CCP) establishes concentration and temperature limits for key constituents and periodic sampling and analysis to confirm that waste supernate is within these limits.[iii]

In late November 2014, Savannah River Remediation (SRR) sampled from two locations within Tanks 38H and 43H. As summarized in Table 1, these supernatant samples were delivered to the Savannah River National Laboratory (SRNL) between November 25, 2014 and December 01, 2014 for analyses to support the Enrichment Control Program, Corrosion Control Program and Sodium Aluminosilicate Formation Potential in the Evaporator. The Tank 38H and 43H **surface** samples were identified as HTF-38-14-150 for the Tank 38H sample and HTF-43-14-152 for the Tank 43H sample while the **subsurface** Tanks 38H and 43H samples were identified, respectively, as HTF-38-14-151 and HTF-43-14-153. Four samples, in all, (two from Tank 38H and two from Tank 43H) were delivered to SRNL.

Tanks 38H and 43H serve, respectively, as the drop tank and the feed tank for the 2H-evaporator system. This work is governed by the Technical Task Request and the experimental details are presented in the Task Technical and Quality Assurance Plan.[iv,v,] Requirements for performing reviews of technical reports and the extent of review are established in manual E7 2.60. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.

2.0 General Supernatant Sample Description

Table 2 contains a description of the sampling locations and the quantity of material received for the "as-received" Tanks 38H and 43H samples. As shown in Figure 1, the four samples were free of significant amounts of insoluble solids. The two tank surface samples (HTF-38-14-150 and HTF-43-14-152) were relatively clear and transparent, while the two subsurface samples (HTF-38-14-151 and HTF-43-14-153) appeared cloudy compared to the two surface samples. The Tank 43H subsurface sample appeared to show a higher amount of visible dark-brown fine particles when the liquid content was stirred than the Tank 38H subsurface samples.

In general, the visual appearance of these samples was consistent with supernatant liquid containing <1 wt. % insoluble solids.

3.0 Experimental

Analysis for the ECP was performed on all four samples. Analysis for CCP was performed on the two surface samples, while analysis for Sodium Aluminosilicate Formation Potential in the Evaporator was performed on the two subsurface Tank 38H and 43H samples. These Enrichment, Corrosion Control and Aluminosilicate Formation Potential program Plans for Tanks 38 and 43 slurry supernatant samples are summarized in Table 1. The ECP analysis includes inductively-coupled plasm-mass spectroscopy (ICP-MS) for uranium isotopics and radiochemical separation and counting methods for Pu-238, Pu-239/240, and Pu-241. The preparation for ECP analyses was by dilution with 2M nitric acid. The CCP analysis includes ion chromatography (IC) for anions (nitrate and nitrite), acid titration for free hydroxide, and gamma scan for detectable gamma-emitting isotopes. The preparation for IC and titration analyses was by dilution with water. Density of the as-received samples was measured by determining the weight of 1.0 mL sample portions in triplicate and the specific gravity (SpG) was calculated from these density measurements relative to density of water. The pH results reported were calculated from the free OH^- concentration using the following equation:

$$pH = 14 + \log_{10}\left(OH^-\right)$$

Preparation of samples for inductively-coupled plasma – emissions spectroscopy (ICP-ES) measurement for silicon and other elements was performed by warm acid strike, which yielded an approximately 50-fold dilution. Twenty milliliters of 3 M nitric acid were added to two milliliters of sample, and the mixture was heated at 90 °C for four hours before dilution to 100 milliliters. This method was previously determined to be the optimal method for accurate silicon measurement in this waste matrix.[vi]

Most of the analyses were performed and reported in triplicate.

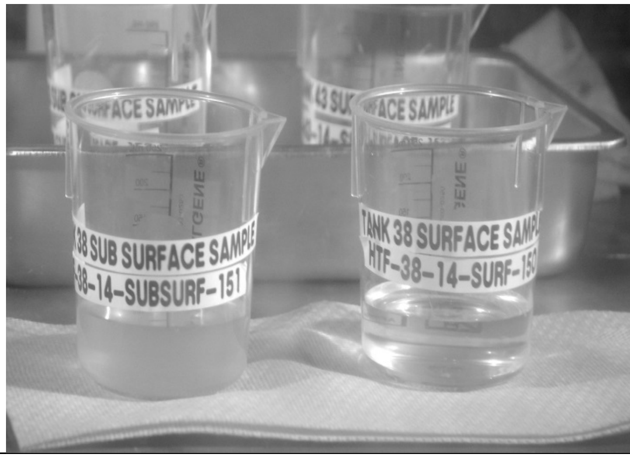
Table 1 Tanks 38H and 43H Sample Delivery Dates and Analysis Suite Summary.

Sample	Sample ID	Description	Date at SRNL	Date in cell
Tank 38 surface	HTF-38-14-150	Tank 38 Surface sample	12/1/2014	12/2/2014
Tank 38 VDS	HTF-38-14-151	Tank 38 variable depth sample	12/1/2014	12/2/2014
Tank 43 surface	HTF-43-14-152	Tank 43 Surface sample	11/25/2014	12/2/2014
Tank 43 VDS	HTF-43-14-153	Tank 43 variable depth sample	11/25/2014	12/2/2014

ECP + CCP Sample location	Analysis Suite summary
Tank 38 surface sample	ECP + CCP
Tank 38 Sub-surface Sample or variable depth sample	ECP, Na-Al Si formation potential
Tank 43 surface sample	ECP + CCP
Tank 43 Sub-surface Sample or variable depth sample	ECP, Na-Al Si formation potential

Table 2 General Supernate Sample Description (As-received) for Tanks 38H and 43H Samples

Tank Sample ID	Sample location	Approx. Volume, mL	Mass, g	Clarity of supernate
HTF-38-14-150	Surface sample	74	97.262	Clear supernate without visible solids
HTF-38-14-151	SubSurface	75	98.868	Cloudy supernate with visible faint particles but still with less than 1 wt% solids.
HTF-43-14-152	Surface sample	74	91.676	Clear supernate without visible solids
HTF-43-14-153	SubSurface (161 inches from tank bottom)	72	83.891	Cloudy supernate with visible dark brown fine particles. Visual appearance of samples is consistent with supernatant liquid containing <1 wt. % insoluble solids.



Insert A: Tank 38H subsurface and surface supernate samples

Insert B: Tank 43H subsurface and surface supernate samples

Figure 1 From left to right, samples from the Tank 38H supernate subsurface, Tank 38H supernate surface Tank 43H supernate subsurface, and Tank 43H supernate surface

4.0 Analytical Results

Table 3 contains a summary of the ECP, CCP and sodium aluminosilicate formation potential analytical result for both tanks. This summary includes only the average values for the analytes and the standard deviation for each analysis in triplicate.

Results for analytes that were below the limits of quantification are preceded by "<". The three individual determinations of the triplicate preparations and measurements are reported, along with the average values and the standard deviations.

The Pu-239 value reported in mg/L for the ECP analysis assumes that all of the activity measured as Pu-239/240 is from Pu-239. This assumption results in a high bias to the Pu-239 result and thus the assumption is conservative with respect to concentration of this fissile isotope. All measurements reported for U-233 and U-234 results for all Tanks 38H and 43H samples are below the ICP-MS detection limit. Measurements for U-236 for Tank 43H surface samples were all also below the ICP-MS detection limit. As a result, the uranium enrichment calculations are based on U-total; where U-total excludes uranium data below the detection limit.

Due to preparation errors for one of the replicates, the average data presented in Table 3 for the cations on Tank 43H subsurface sample (HTF-43-14-153) sodium alumino silicate formation potential [Appendix D, Table 16] are based on duplicate runs and not on the standard triplicate runs.

Table 3 ECP, CCP and Sodium Aluminosilicate Formation Potential Analytical Data for Tanks 38H and 43H Samples.

Analytes	Tank 38H Surface HTF-38-14-150		Tank 38H Sub-Surface HTF-38-14-151		Tank 43H Surface HTF-43-14-152		Tank 43H Sub-Surface HTF-43-14-153		Methods	Units
	Average	Stdev.	Average	Stdev.	Average	Stdev.	Average	Stdev.		
U-233	<2.10E-02	--	<2.17E-02	--	<2.20E-02	--	<2.07E-02	--	ICP-MS	mg/L
U-234	<2.10E-02	--	<2.17E-02	--	<2.20E-02	--	<2.07E-02	--	ICP-MS	mg/L
U-235	5.96E-01	*1.02E-02*	5.74E-01	*6.20E-03*	3.77E-01	*1.06E-02*	4.12E-01	*6.02E-03*	ICP-MS	mg/L
U-236	3.33E-02	*4.67E-04*	3.17E-02	*2.90E-04*	<2.20E-02		2.39E-02	*5.80E-04*	ICP-MS	mg/L
U-238	9.84E+01	*1.22E+00*	9.48E+01	*1.25E+00*	6.22E+01	*1.44E+00*	6.90E+01	*4.54E-01*	ICP-MS	mg/L
Total U	9.91E+01	*1.23E+00*	9.54E+01	*1.26E+00*	6.26E+01	*1.45E+00*	6.94E+01	*4.60E-01*	ICP-MS	mg/L
U-235/U-total	6.02E-01	*2.92E-03*	6.02E-01	*1.62E-03*	6.02E-01	*3.85E-03*	5.94E-01	*6.16E-03*	Calc.	%
Pu-238	4.01E-04	*3.14E-05*	4.10E-04	*2.98E-05*	2.74E-04	*6.34E-06*	3.01E-03	*3.13E-04*	PuTTA	mg/L
Pu-239	5.24E-03	*3.30E-04*	4.89E-03	*2.41E-03*	3.23E-03	*7.78E-04*	9.51E-03	*2.41E-03*	PuTTA	mg/L
Pu-239/240	7.29E+02	*5.50E+01*	6.7E+02	*3.32E+02*	4.46E+02	*1.07E+02*	1.31E+03	*3.33E+02*	PuTTA	dpm/mL
Pu-241	1.15E-05	*1.39E-06*	1.12E-05	*1.31E-06*	6.56E-06	*2.45E-07*	5.11E-05	*4.88E-06*	Pu-238/241	mg/L
Cs-137	1.17E+08	*1.38E+06*	1.14E+08	*1.37E+06*	7.53E+07	*1.37E+06*	7.73E+07	*5.30E+05*	gamma scan	dpm/mL
Ba-137m	1.11E+08	*1.30E+06*	1.08E+08	*1.30E+06*	7.12E+07	*1.30E+06*	7.31E+07	*4.97E+05*	gamma scan	dpm/mL
OH^-	2.69E+00	*1.61E-02*	2.64E+00	*5.24E-02*	1.66E+00	*8.85E-03*	1.73E+00	*4.00E-02*	Titration	M
NO_2^-	1.83E+00	*1.23E-02*	1.65E+00	*1.85E-02*	1.15E+00	*1.39E-02*	1.23E+00	*1.28E-01*	IC	M
NO_3^-	9.68E-01	*1.93E-02*	8.62E-01	*1.10E-02*	5.95E-01	*1.18E-02*	6.44E-01	*6.84E-02*	IC	M
F^-	<6.26E-03	-	<5.39E-03	-	<5.83E-03	-	<5.86E-03	-	IC	M
CHO_2^-	3.62E-02	*3.71E-04*	3.22E-02	*3.84E-04*	3.48E-02	*3.34E-04*	**2**.32E-02	*2.23E-04*	IC	M
Cl^-	4.24E-03	*7.39E-05*	3.84E-03	*7.13E-05*	<3.12E-03	-	<3.13E-03	-	IC	M
PO_4^{3-}	3.25E-03	*1.80E-05*	2.95E-03	*2.40E-05*	2.02E-03	*5.40E-05*	2.11E-03	*3.13E-05*	IC	M
SO_4^{2-}	1.93E-02	*1.82E-04*	1.73E-02	*3.49E-04*	1.27E-02	*1.99E-04*	1.27E-02	*1.99E-04*	IC	M
$C_2O_4^{2-}$	2.97E-03	*2.81E-05*	2.56E-03	*5.43E-05*	1.59E-03	*6.63E-05*	1.60E-03	*1.25E-04*	IC	M
Br^-	<1.49E-03	-	<1.28E-03	-	<1.39E-03	-	<1.39E-03	-	IC	M
CO_3^{2-}	4.65E-01	*5.62E-03*	4.46E-01	*5.98E-03*	2.91E-01	*2.74E-03*	2.92E-01	*3.69E-04*	TIC	M
Al	--	--	9.24E+02	*7.84E+00*	--	--	7.05E+02	*9.10E+00*	ICP-ES	mg/L
B	--	--	1.60E+02	*1.99E+00*	--	--	1.01E+02	*1.08E+00*	ICP-ES	mg/L
Ca	--	--	4.42E+00	*2.35E+00*	--	--	6.98E+00	*6.62E-02*	ICP-ES	mg/L
Cr	--	--	5.02E+01	*4.57E-01*	--	--	3.89E+01	*4.14E-01*	ICP-ES	mg/L
Fe	--	--	7.99E+00	*2.56E-01*	--	--	1.12E+01	*5.15E+00*	ICP-ES	mg/L
K	--	--	3.42E+02	*5.70E+01*	--	--	2.47E+02	*1.08E+01*	ICP-ES	mg/L
Li	--	--	7.87E+01	*4.50E-01*	--	--	4.80E+01	*4.14E-01*	ICP-ES	mg/L
Na	--	--	1.57E+05	*7.51E+02*	--	--	1.01E+05	*1.32E+03*	ICP-ES	mg/L
P	--	--	1.34E+02	*7.51E-01*	--	--	8.94E+01	*1.41E+00*	ICP-ES	mg/L
Si	--	--	2.58E+02	*3.27E+00*	--	--	1.57E+02	*1.65E+00*	ICP-ES	mg/L
Zn	--	--	6.41E+00	*2.24E+00*	--	--	5.55E+00	*2.07E-01*	ICP-ES	mg/L
Na	--	--	6.82E+00	*3.26E-02*	--	--	4.37E+00	*5.76E-02*		M
Total cation	--	--	6.90E+00	--	--	--	4.43E+00	--	Calc.	M
Total anion	6.54E+00	--	6.31E+00	--	4.07E+00	--	3.99E+00	--	Calc.	M
SpG	1.33 E+00	*2.00E-02*	1.30 E+00	*1.00E-02*	1.18 E+00	*1.00E-02*	1.17 E+00	*1.00E-02*	Calc.	-
pH	14.4E+01	*2.61E-03*	1.44E+01	*8.62E-03*	1.42E+01	*9.95E-03*	1.42E+01	*9.95E-03*	Calc.	-

To check the results, a cation-anion normality balance was performed. The normal concentrations of cations (mainly Na^+ and K^+) were summed, as were the anions (NO_3^-, NO_2^-, SO_4^{--}, Cl^-, CO_3^{2-}, PO_4^{3-}, AlO_2^-, $C_2O_4^{2-}$ and free OH^-). The two sums were compared. Since only the subsurface samples (Tank 38H sub-surface sample HTF-38-14-151 and Tank 43H sub-surface Sample HTF-43-14-153) were analyzed for both cations and anions the anion/cation comparisons were performed only for these two samples.

For the Tank 38H subsurface sample the cations summed to 6.86 M, while the anions summed to 6.31 M. Thus, the anions summed to about 92% of the cations. Similarly, for the Tank 43H subsurface sample the calculated cation and anions were 4.39 and 3.99, respectively. The anions summed to about 91 % of the cation value. The differences between the cation and anion molarity values are within ± 10% of each other, which is fairly good when one takes into consideration that the nominal uncertainties (1 sigma) for ICP-ES, IC and OH are about 10%. The small difference can be attributed to analytical uncertainties.

Tables 4 through 17 in Appendices A-D contain all the analytical results for the characterization of Tanks 38H and 43H samples. These detail analyses results are grouped by the required programs (ECP, CCP and Na-Al Si formation potential) in separate sections of the tables. Results for ***Tank 38H surface supernate*** are summarized in Appendix A, Table 4 through Table 6, while Tables 7 through Table 10, Appendix B, contain the analyses results for ***Tank 38H subsurface samples***. The analyses results for ***Tank 43H surface supernate*** samples are presented in Appendix C, Tables 11through Tables 13, while the analyses results for ***Tank 43H subsurface*** supernates are presented in Tables 14 through Table 17 in Appendix D. The last table of each Appendix (Tables 6, 10, 13 and 17) contains the results for additional analytes which were measured by the same group of methods but were not required by any of the major programs. The characterization of ***Tanks 38H and 43H subsurface samples*** for analytes with aluminosilicate formation potentials (Al, Si and Na) are presented, respectively, in Tables 9 and 16. Additional characterization data was requested for salt batch planning (Tc-99 and I-129). These results will be reported in a later document along with Tc-99 and I-129 results from Tank 13H.

5.0 Conclusions

The U-235 mass divided by the total uranium averaged 0.0060 (0.6 % uranium enrichment) for all sample measurements for both types of tank samples. The U-235 concentration in Tank 38H samples ranged from 5.74E-01 to 5.96E-01 mg/L, while the U-238 concentration in Tank 38H ranged from 9.48E+01 to 9.84E+01 mg/L. Similarly, U-235 concentration in the Tank 43H ranged from 3.77E-01 to 4.12E-01 mg/L and the U-238 concentration in Tank 43H ranged from 6.22E+01 to 6.90E+01mg/L. Thus, The U-235/total uranium ratio is in line with the prior 2H-evaporator ECP samples.

Measured sodium concentration averaged 6.82 M in the Tank 38H subsurface samples, and 4.37 M in the Tank 43H subsurface samples. Measured silicon averaged 258 mg/L and 157 mg/L in Tanks 38H and 43H supernate subsurface samples, respectively. The measured aluminum concentration in Tanks 38H and 43H subsurface samples averaged 924 and 705 mg/L.

In general, the nitrate, nitrite, free-OH and specific gravity of the Tank 43H samples were lower in magnitude than those of the Tank 38H samples.

6.0 Quality Assurance

Data are recorded in SRNL Electronic Notebook: L5575-00080 SRNL Electronic Notebook (Production); SRNL, Aiken, SC 29808 (2014) and various AD notebooks contain the analytical/experimental data.

7.0 References

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Acknowledgements

I acknowledge the contributions of Monica Jenkins, Phylis Burkhalter and Jeffery Mixon for preparing the samples and Mark Jones, Tom White, Amy Ekechukwu, Mira Malek and David DiPrete for providing analytical services.

Appendix A. Tank 38H Surface samples (HTF-38-14-150)

Table 4 Tank 38H Surface Sample HTF-38-14-150: ECP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-233	<2.13E-02	<2.11E-02	<2.07E-02	**<2.10E-02**	--	mg/L
U-234	<2.13E-02	<2.11E-02	<2.07E-02	**<2.10E-02**	--	mg/L
U-235	6.07E-01	5.90E-01	5.93E-01	**5.96E-01**	9.21E-03	mg/L
U-236	3.40E-02	3.31E-02	3.27E-02	**3.33E-02**	6.61E-04	mg/L
U-238	9.98E+01	9.79E+01	9.76E+01	**9.84E+01**	1.21E+00	mg/L
U-Total	1.00E+02	9.85E+01	9.82E+01	**9.91E+01**	1.22E+00	mg/L
Pu-239	5.29E-03	4.89E-03	5.54E-03	**5.24E-03**	3.30E-04	mg/L
Pu-241	1.31E-05	1.05E-05	1.10E-05	**1.15E-05**	*1.39E-06*	mg/L

Table 5 Tank 38H Surface Sample HTF-38-14-150: CCP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
NO_3^-	9.54E-01	9.60E-01	9.90E-01	**9.68E-01**	*1.93E-02*	Mole/L
NO_2^-	1.81E+00	1.83E+00	1.84E+00	**1.83E+00**	*1.23E-02*	Mole/L
OH^{-1}	2.69 E+00	2.70 E+00	2.67 E+00	**2.69E+00**	*1.61E-02*	Molar
SpG	1.31E+00	1.32 E+00	1.35 E+00	**1.33 E+00**	*2.00E-02*	--
pH	1.443 E+01	1.443 E+01	1.443 E+01	**14.43E+01**	*2.61E-03*	--
Cs-137	1.16E+08	1.18E+08	1.18E+08	**1.17E+08**	*1.38E+06*	dpm/mL
Ba-137m	1.10E+08	1.12E+08	1.12E+08	**1.11E+08**	*1.30E+06*	dpm/mL

SpG = Specific gravity

Table 6 Tank 38H Surface Sample HTF-38-14-150: Other Results from ECP & CCP

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-235/U-total *100	6.0E-01	6.0E-01	6.0E-01	**6.0E-01**	*2.92E-03*	%
Pu-238	4.25E-04	4.12E-04	3.65E-04	**4.01E-04**	*3.14E-05*	mg/L
Pu-239/240	7.30E+02	6.74E+02	7.84E+02	**7.29E+02**	*5.50E+01*	dpm/mL
SO_4^{2-}	1.91E-02	1.95E-02	1.94E-02	**1.93E-02**	*1.82E-04*	Mole/L
CHO_2^-	3.60E-02	3.66E-02	3.60E-02	**3.62E-02**	*3.71E-04*	Mole/L
Cl^-	4.21E-03	4.19E-03	4.32E-03	**4.24E-03**	*7.39E-05*	Mole/L
F^-	<6.05E-03	<6.52E-03	<6.22E-03	**<6.26E-03**		Mole/L
PO_4^{3-}	3.27E-03	3.26E-03	3.23E-03	**3.25E-03**	*1.80E-05*	Mole/L
$C_2O_4^{2-}$	3.00E-03	2.96E-03	2.95E-03	**2.97E-03**	*2.81E-05*	Mole/L
Br^-	<1.44E-03	<1.55E-03	<1.48E-03	**<1.49E-03**		Mole/L
Inorganic carbon	5.52E+06	5.65E+06	5.57E+06	**5.58E+06**	*6.75E+04*	µgC/L
Organic carbon	8.36E+05	8.47E+05	8.36E+05	**8.40E+05**	*6.45E+03*	µgC/L
Total carbon	6.35E+06	6.49E+06	6.41E+06	**6.42E+06**	*6.95E+04*	µgC/L
CO_3^{2-}	4.60E-01	4.71E-01	4.65E-01	**4.65E-01**	*5.62E-03*	M

Appendix B. Tank 38H Sub-Surface samples (HTF-38-14-151)

Table 7 Tank 38H Sub-Surface Sample HTF-38-14-151: ECP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-233	<2.15E-02	<2.23E-02	<2.14E-02	**<2.17E-02**		mg/L
U-234	<2.15E-02	<2.23E-02	<2.14E-02	**<2.17E-02**		mg/L
U-235	5.73E-01	5.81E-01	5.69E-01	**5.74E-01**	6.20E-03	mg/L
U-236	3.18E-02	3.14E-02	3.20E-02	**3.17E-02**	2.90E-04	mg/L
U-238	9.44E+01	9.62E+01	9.38E+01	**9.48E+01**	1.25E+00	mg/L
U-Total	9.50E+01	9.68E+01	9.44E+01	**9.54E+01**	1.26E+00	mg/L
Pu-239	7.26E-03	4.95E-03	2.44E-03	**4.89E-03**	*2.41E-03*	mg/L
Pu-241	1.21E-05	1.19E-05	9.74E-06	**1.12E-05**	*1.31E-06*	mg/L

Table 8 Tank 38H Sub-Surface Sample HTF-38-14-151: CCP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
NO_3^-	8.69E-01	8.67E-01	8.49E-01	**8.62E-01**	*1.10E-02*	Mole/L
NO_2^-	1.66E+00	1.66E+00	1.62E+00	**1.65E+00**	*1.85E-02*	Mole/L
OH^{-1}	2.70 E+00	2.59 E+00	2.64 E+00	**2.64E+00**	*5.24E-02*	Molar
SpG	1.32 E+00	1.29 E+00	1.30 E+00	**1.30** E+00	*2.00E-02*	--
pH	1.443 E+01	1.441 E+01	1.442 E+01	**1.44E+01**	*8.62E-03*	--
Cs-137	1.15E+08	1.15E+08	1.12E+08	**1.14E+08**	*1.37E+06*	dpm/mL
Ba-137m	1.09E+08	1.09E+08	1.06E+08	**1.08E+08**	*1.30E+06*	dpm/mL

Table 9 Tank 38H Sub-Surface Sample HTF-38-14-151: Alumino-silicate Formation Potential

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
Al	9.23E+02	9.32E+02	9.17E+02	**9.24E+02**	*7.84E+00*	mg/L
B	1.60E+02	1.63E+02	1.59E+02	**1.60E+02**	*1.99E+00*	mg/L
Ca	No entry	6.08E+00	2.76E+00	**4.42E+00**	*2.35E+00*	mg/L
Cr	5.02E+01	5.07E+01	4.98E+01	**5.02E+01**	*4.57E-01*	mg/L
Fe	8.09E+00	8.18E+00	7.70E+00	**7.99E+00**	*2.56E-01*	mg/L
K	3.00E+02	4.07E+02	3.19E+02	**3.42E+02**	*5.70E+01*	mg/L
Li	7.92E+01	7.84E+01	7.84E+01	**7.87E+01**	*4.50E-01*	mg/L
Na	1.57E+05	1.57E+05	1.56E+05	**1.57E+05**	*7.51E+02*	mg/L
P	1.34E+02	1.35E+02	1.34E+02	**1.34E+02**	*7.51E-01*	mg/L
Si	2.57E+02	2.61E+02	2.55E+02	**2.58E+02**	*3.27E+00*	mg/L
Zn	No entry	8.00E+00	4.82E+00	**6.41E+00**	*2.24E+00*	mg/L

Table 10 Tank 38H SubSurface Sample HTF-38-14-151: Other Results from ECP & CCP

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-235/U-total*100	6.03E-01	6.00E-01	6.02E-01	**6.02E-01**	*1.62E-03*	%
Pu-238	4.09E-04	4.40E-04	3.80E-04	**4.10E-04**	*2.98E-05*	mg/L
Pu-239/240	1.00E+03	6.83E+02	3.37E+02	**6.7E+02**	*3.32E+02*	dpm/mL
SO_4^{2-}	1.75E-02	1.69E-02	1.74E-02	**1.73E-02**	*3.49E-04*	Mole/L
CHO_2^-	3.26E-02	3.18E-02	3.21E-02	**3.22E-02**	*3.84E-04*	Mole/L
Cl^-	3.78E-03	3.92E-03	3.83E-03	**3.84E-03**	*7.13E-05*	Mole/L
F^-	<5.43E-03	<5.23E-03	<5.51E-03	**<5.39E-03**		Mole/L
PO_4^{3-}	2.93E-03	2.93E-03	2.97E-03	**2.95E-03**	*2.40E-05*	Mole/L
$C_2O_4^{2-}$	2.58E-03	2.60E-03	2.50E-03	**2.56E-03**	*5.43E-05*	Mole/L
Br^-	<1.29E-03	<1.24E-03	<1.31E-03	**<1.28E-03**		Mole/L
Inorganic carbon	5.27E+06	5.40E+06	5.40E+06	**5.36E+06**	*7.18E+04*	µgC/L
Organic carbon	7.83E+05	8.09E+05	8.08E+05	**8.00E+05**	*1.49E+04*	µgC/L
Total carbon	6.06E+06	6.20E+06	6.21E+06	**6.16E+06**	*8.53E+04*	µgC/L
CO_3^{2-}	4.40E-01	4.50E-01	4.50E-01	**4.46E-01**	*5.98E-03*	M

Appendix C. Tank 43H Surface sample (HTF-43-14-152)

Table 11 Tank 43H Surface Sample HTF-43-14-152: ECP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-233	<2.08E-02	<2.32E-02	<2.21E-02	**<2.20E-02**	--	mg/L
U-234	<2.08E-02	<2.32E-02	<2.21E-02	**<2.20E-02**	--	mg/L
U-235	3.67E-01	3.76E-01	3.88E-01	**3.77E-01**	*1.06E-02*	mg/L
U-236	<2.08E-02	<2.32E-02	<2.21E-02	**<2.20E-02**	--	mg/L
U-238	6.10E+01	6.18E+01	6.38E+01	**6.22E+01**	*1.44E+00*	mg/L
U-Total	6.14E+01	6.22E+01	6.42E+01	**6.26E+01**	*1.45E+00*	mg/L
Pu-239	3.60E-03	2.33E-03	3.75E-03	**3.23E-03**	*7.78E-04*	mg/L
Pu-241	6.82E-06	6.34E-06	6.53E-06	**6.56E-06**	*2.45E-07*	mg/L

Table 12 Tank 43H Surface Sample HTF-43-14-152: CCP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
NO_3^-	5.90E-01	6.08E-01	5.86E-01	**5.95E-01**	*1.18E-02*	Mole/L
NO_2^-	1.15E+00	1.16E+00	1.13E+00	**1.15E+00**	*1.39E-02*	Mole/L
OH^{-1}	1.65 E+00	1.67 E+00	1.67 E+00	**1.66E+00**	*8.85E-03*	Molar
SpG	1.18 E+00	1.19 E+00	1.17 E+00	**1.18 E+00**	*1.00E-02*	--
pH	14.251	14.232	14.235	**1.42E+01**	*9.95E-03*	--
Cs-137	7.52E+07	7.67E+07	7.40E+07	**7.53E+07**	*1.37E+06*	dpm/mL
Ba-137m	7.11E+07	7.26E+07	7.00E+07	**7.12E+07**	*1.30E+06*	dpm/mL

Table 13 Tank 43H Surface Sample HTF-43-14-152: Other Results from ECP & CCP

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-235/U-total *100	5.98E-01	6.04E-01	6.05E-01	**6.02E-01**	*3.85E-03*	%
Pu-238	2.69E-04	2.73E-04	2.81E-04	**2.74E-04**	*6.34E-06*	mg/L
Pu-239/240	4.97E+02	3.22E+02	5.18E+02	**4.46E+02**	*1.07E+02*	dpm/mL
SO_4^{2-}	1.25E-02	1.26E-02	1.24E-02	**1.25E-02**	*9.39E-05*	Mole/L
CHO_2^-	3.48E-02	3.52E-02	3.45E-02	**3.48E-02**	*3.34E-04*	Mole/L
Cl^-	<3.13E-03	<3.10E-03	<3.14E-03	**<3.12E-03**	--	Mole/L
F^-	<5.84E-03	<5.78E-03	<5.86E-03	**<5.83E-03**	--	Mole/L
PO_4^{3-}	1.99E-03	2.08E-03	1.99E-03	**2.02E-03**	*5.40E-05*	Mole/L
$C_2O_4^{2-}$	1.64E-03	1.62E-03	1.52E-03	**1.59E-03**	*6.63E-05*	Mole/L
Br^-	<1.39E-03	<1.38E-03	<1.39E-03	**<1.39E-03**	--	Mole/L
Inorganic carbon	3.50E+06	3.52E+06	3.45E+06	**3.49E+06**	*3.29E+04*	µgC/L
Organic carbon	5.51E+05	5.50E+05	5.38E+05	**5.46E+05**	*6.81E+03*	µgC/L
Total carbon	4.05E+06	4.07E+06	3.99E+06	**4.04E+06**	*3.88E+04*	µgC/L
Carbonate, CO_3^{2-}	2.91E-01	2.93E-01	2.88E-01	**2.91E-01**	*2.74E-03*	M

Appendix D. Tank 43H Sub-Surface sample (HTF-43-14-153)

Table 14 Tank 43H Sub-Surface Sample HTF-43-14-153: ECP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-233	<2.04E-02	<2.08E-02	<2.09E-02	**<2.07E-02**	--	mg/L
U-234	<2.04E-02	<2.08E-02	<2.09E-02	**<2.07E-02**	--	mg/L
U-235	4.06E-01	4.18E-01	4.13E-01	**4.12E-01**	6.02E-03	mg/L
U-236	2.32E-02	2.42E-02	2.42E-02	**2.39E-02**	5.80E-04	mg/L
U-238	6.85E+01	6.91E+01	6.94E+01	**6.90E+01**	4.54E-01	mg/L
U-Total	6.89E+01	6.95E+01	6.98E+01	**6.94E+01**	4.60E-01	mg/L
Pu-239	6.81E-03	1.14E-02	1.03E-02	**9.51E-03**	*2.41E-03*	mg/L
Pu-241	5.55E-05	4.59E-05	5.20E-05	**5.11E-05**	*4.88E-06*	mg/L

Table 15 Tank 43H Sub-Surface Sample HTF-43-14-153: CCP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
NO_3^-	6.03E-01	6.06E-01	7.23E-01	**6.44E-01**	*6.84E-02*	Mole/L
NO_2^-	1.15E+00	1.16E+00	1.38E+00	**1.23E+00**	*1.28E-01*	Mole/L
OH^{-1}	1.78 E+00	1.71 E+00	1.72 E+00	**1.73E+00**	*4.00E-02*	Molar
SpG	1.16 E+00	1.18 E+00	1.16 E+00	**1.17** E+**00**	*1.00E-02*	--
pH	1.425 E+01	1.423 E+01	1.424 E+01	**1.424E+01**	*9.95E-03*	--
Cs-137	7.68E+07	7.72E+07	7.78E+07	**7.73E+07**	*5.30E+05*	dpm/mL
Ba-137m	7.26E+07	7.30E+07	7.36E+07	**7.31E+07**	*4.97E+05*	dpm/mL

Table 16 Tank 43H Sub-Surface Sample HTF-43-14-153: Alumino-Silicate Formation Potential

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
Al	No entry	7.11E+02	6.98E+02	**7.05E+02**	*9.19E+00*	mg/L
B	No entry	1.01E+02	9.98E+01	**1.00E+02**	*8.49E-01*	mg/L
Ca	No entry	7.03E+00	6.94E+00	**6.99E+00**	*6.36E-02*	mg/L
Cr	No entry	3.92E+01	3.86E+01	**3.89E+01**	*4.24E-01*	mg/L
Fe	No entry	7.57E+00	1.49E+01	**1.12E+01**	*5.18E+00*	mg/L
K	No entry	2.55E+02	2.40E+02	**2.48E+02**	*1.06E+01*	mg/L
Li	No entry	4.83E+01	4.77E+01	**4.80E+01**	*4.24E-01*	mg/L
Na	No entry	1.01E+05	9.96E+04	**1.00E+05**	*9.90E+02*	mg/L
P	No entry	9.04E+01	8.85E+01	**8.95E+01**	*1.34E+00*	mg/L
Si	No entry	1.58E+02	1.56E+02	**1.57E+02**	*1.41E+00*	mg/L
Zn	No entry	5.70E+00	5.41E+00	**5.55E+00**	*2.07E-01*	mg/L

Table 17 Tank 43H SubSurface Sample HTF-38-14-153: Other Results from ECP & CCP

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-235/U-total*100	5.89E-01	6.01E-01	5.92E-01	**5.94E-01**	*6.16E-03*	%
Pu-238	3.33E-03	2.71E-03	2.99E-03	**3.01E-03**	*3.13E-04*	mg/L
Pu-239/240	9.39E+02	1.58E+03	1.42E+03	**1.31E+03**	*3.33E+02*	dpm/mL
SO_4^{2-}	1.26E-02	1.29E-02	1.26E-02	**1.27E-02**	*1.99E-04*	Mole/L
CHO_2^-	2.32E-02	2.34E-02	2.30E-02	**2.32E-02**	*2.23E-04*	Mole/L
Cl^-	<3.14E-03	<3.18E-03	<3.09E-03	**<3.13E-03**		Mole/L
F^-	<5.86E-03	<5.94E-03	<5.77E-03	**<5.86E-03**		Mole/L
PO_4^{3-}	2.11E-03	2.14E-03	2.08E-03	**2.11E-03**	*3.13E-05*	Mole/L
$C_2O_4^{2-}$	1.52E-03	1.54E-03	1.74E-03	**1.60E-03**	*1.25E-04*	Mole/L
Br^-	<1.39E-03	<1.41E-03	<1.37E-03	**<1.39E-03**		Mole/L
Inorganic carbon	3.50E+06	3.51E+06	3.50E+06	**3.50E+06**	*4.43E+03*	µgC/L
Organic carbon	5.47E+05	5.53E+05	5.58E+05	**5.53E+05**	*5.44E+03*	µgC/L
Total carbon	4.05E+06	4.07E+06	4.06E+06	**4.06E+06**	*8.68E+03*	µgC/L
Carbonate, CO_3^{2-}	2.92E-01	2.92E-01	2.92E-01	**2.92E-01**	*3.69E-04*	M

Distribution:

S. L. Marra, 773-A
T. B. Brown, 773-A
D. H. McGuire, 999-W
S. D. Fink, 773-A
C. C. Herman, 773-A
E. N. Hoffman, 999-W
F. M. Pennebaker, 773-42A
W. R. Wilmarth, 773-A
C. J. Martino, 999-W, Rm 390
C. B. Sherburne, 707-7E, Rm 1
D. J. Martin, 241-152H
P. R. Jackson, DOE-SR, 703-46A
E. A. Brass, 241-12H
H. Bui, 707-7E, Rm. 4
J. R. Jacobs, 241-152H, Rm 12
Records Administration (EDWS)