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Analysis of Tank 38H (HTF-38-15-47, 49) and Tank 43H (HTF-43-15-51, 53) Surface and Subsurface Supernatant Samples in Support of Enrichment and Corrosion Control Programs

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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) and the Corrosion Control Program (CCP).

The U-235 mass divided by the total uranium mass averaged 6.13E-03 ± 7.05E-05 (6.13E-01 ± 7.05E-03 % uranium enrichment) for all sample measurements in both types of tank samples. The average U-235 concentration in Tank 38H samples ranged from 6.75E-01 to 6.83E-01 mg/L, while the average U-238 concentration in the Tank 38H samples ranged from 1.11E+02 to 1.12E+02 mg/L. In contrast, the average U-235 concentration in the Tank 43H samples ranged from 4.23E-01 to 4.35E-01 mg/L and the average U-238 concentration in the Tank 43H samples ranged from 6.81E+01 to 6.97E+01 mg/L. Thus, the U-235/total uranium ratio is in line with the prior 2H-evaporator ECP samples.

The measured sodium concentration averaged, respectively, 7.17 M and 7.19 M in the Tank 38H surface sample and the Tank 38H subsurface sample. The measured sodium concentration in the Tank 43H surface sample and the Tank 43 subsurface sample averaged, respectively, 4.46 and 4.35 M.

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 May 2015, 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) in May, 2015 for analyses to support the ECP and CCP. The Tank 38H and 43H surface samples were identified as HTF-38-15-47 and HTF-43-15-51, respectively, while the Tank 38H subsurface samples were identified as HTF-38-15-49 and HTF-43-15-53, respectively. Four samples, in all, (two from Tank 38H and two from Tank 43H) were delivered to SRNL.

The Tank 38H variable depth sample (HTF-38-15-49) was taken at a depth of 265 inches while the Tank 43H variable depth sample (HTF-43-15-53) was taken at a depth of 161 inches.

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” Tank 38H and 43H samples. As shown in Figure 1, the four samples were essentially free of any visible settled insoluble solids. The three tank samples (HTF-38-15-47, HTF-43-15-52 and HTF-43-15-53) were relatively clear and transparent, while the Tank 38H subsurface sample (HTF-38-15-49) appeared slightly hazy and cloudy.

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 and analysis for CCP was performed on the two surface samples. The customer further requested an additional analysis for nitrates and nitrites on the variable depth samples for tanks 38 and 43 samples in support for salt batch activities. The ECP and CCP analysis requirements for the Tank 38H and 43H slurry supernatant samples are summarized in Table 1. The ECP analysis includes inductively-coupled plasm-mass spectroscopy (ICP-MS) for uranium isotopic analysis 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 de-ionized 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.

Most of the analyses were performed and reported in triplicate.

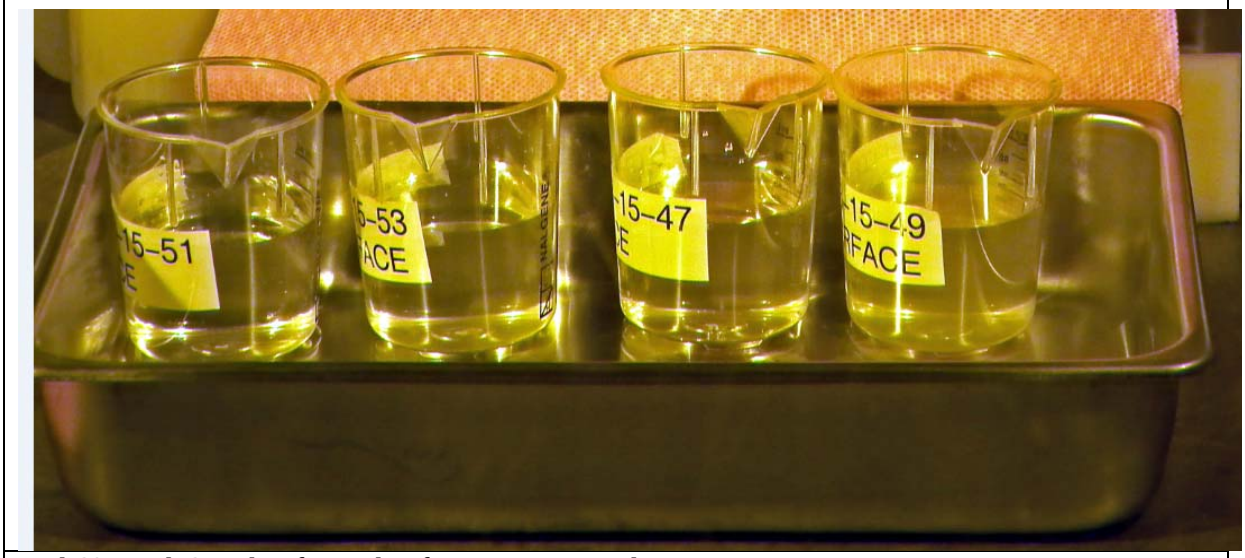
Table 1 Tanks 38H and 43H Sample Delivery Dates and Analysis Suite Summary.

Sample	Sample ID	Description	Date at SRNL	Date put in shielded cell
Tank 38H surface	HTF-38-15-47	Tank 38H Surface sample	5/11/2015	5/13/2015
Tank 38H VDS	HTF-38-15-49	Tank 38H sample collected at a depth of 265 inches	5/11/2015	5/13/2015
Tank 43H surface	HTF-43-15-51	Tank 43H Surface sample	5/11/2015	5/13/2015
Tank 43H VDS	HTF-43-15-53	Tank 43H sample collected at a depth of 261 inches	5/11/2015	5/13/2015

ECP + CCP Sample location	Analysis Suite summary
Tank 38 surface sample	ECP + CCP
Tank 38 Sub-surface Sample or variable depth sample	ECP
Tank 43 surface sample	ECP + CCP
Tank 43 Sub-surface Sample or variable depth sample	ECP

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-38-15-47	Tank 38 surface sample	80	78.212	Clear supernate without visible settled solids
HTF-38-15-49	Tank 38 sub-surface	80	82.488	Slightly hazy supernate without visible settled solids.
HTF-43-15-51	Tank 43 surface sample	80	92.533	Clear supernate without visible settled solids
HTF-43-15-53	Tank 43 sub-surface	80	92.153	Clear supernate without visible settled solids



Tank 38H and 43H subsurface and surface supernate samples

Figure 1 From left to right: samples from the Tank 43H supernate surface (51) subsurface (53), 38H supernate surface (47) and 38H supernate subsurface (49).

4.0 Analytical Results

Table 3 contains a summary of the ECP/CCP analytical results for both tanks. This summary includes only the average values for the analytes and the standard deviation for each analysis in triplicate. However, analyses for select cations for all four tank 38 and 43 samples, which were not requested by the customer, were performed only in single runs to support cation/anion balance only.

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, U-234, U-235, U-236 and U-238 for all Tanks 38H and 43H samples are above the ICP-MS detection limit. As a result, the uranium enrichment calculations are based on U-total; where U-total includes the masses of uranium isotopes, U-233-U-238.

Table 3 ECP and CCP Analytical Data for Tanks 38H and 43H Samples.

Analytes	Tank 38H Surface HTF-38-15-47		Tank 38H Sub-Surface HTF-38-15-49		Tank 43H Surface HTF-43-15-51		Tank 43H Sub-Surface HTF-43-15-53		Methods	Units
	Average	Stdev.	Average	Stdev.	Average	Stdev.	Average	Stdev.		
U-233	**9.74E-03**	*6.76E-04*	**9.32E-03**	*7.12E-04*	**5.96E-03**	*1.17E-04*	**5.90E-03**	*4.44E-04*	ICP-MS	mg/L
U-234	**1.70E-02**	*3.06E-04*	**1.71E-02**	*5.02E-04*	**1.07E-02**	*1.12E-04*	**1.06E-02**	*2.73E-04*	ICP-MS	mg/L
U-235	**6.83E-01**	*9.48E-03*	**6.75E-01**	*6.40E-03*	**4.35E-01**	*5.05E-03*	**4.23E-01**	*4.00E-03*	ICP-MS	mg/L
U-236	**4.07E-02**	*1.19E-03*	**4.07E-02**	*1.68E-03*	**2.56E-02**	*2.40E-04*	**2.46E-02**	*6.28E-04*	ICP-MS	mg/L
U-238	**1.12E+02**	*1.55E+00*	**1.11E+02**	*1.07E+00*	**6.97E+01**	*3.75E-01*	**6.81E+01**	*1.00E+00*	ICP-MS	mg/L
Total U	**1.12E+02**	*1.56E+00*	**1.11E+02**	*1.08E+00*	**7.02E+01**	*3.79E-01*	**6.85E+01**	*1.01E+00*	ICP-MS	mg/L
U-235/U-total	**6.07E-01**	*1.23E-03*	**6.06E-01**	*1.36E-04*	**6.20E-01**	*5.64E-03*	**6.17E-01**	*4.12E-03*	Calc.	%
Pu-238	**4.62E-04**	*1.34E-05*	**4.28E-04**	*2.10E-05*	**2.78E-04**	*1.96E-05*	**2.52E-04**	*7.28E-06*	PuTTA	mg/L
Pu-239**	**4.54E-03**	*3.12E-05*	**4.19E-03**	*3.44E-04*	**2.88E-03**	*1.61E-04*	**1.41E-03**	*3.29E-04*	PuTTA	mg/L
Pu-239/240	**6.26E+02**	*4.30E+00*	**5.78E+02**	*4.74E+01*	**3.97E+02**	*2.22E+01*	**1.95E+02**	*4.53E+01*	PuTTA	dpm/mL
Pu-241	**1.13E-05**	*6.18E-07*	**1.20E-05**	*1.65E-06*	**7.21E-06**	*7.68E-07*	**6.18E-06**	*4.07E-07*	Pu-238/241	mg/L
Cs-137	**1.43E+08**	*2.06E+06*	**1.43E+08**	*2.46E+06*	**8.61E+07**	*2.09E+06*	**8.52E+07**	*1.26E+06*	gamma scan	dpm/mL
Ba-137m	**1.35E+08**	*1.95E+06*	**1.36E+08**	*2.33E+06*	**8.15E+07**	*1.98E+06*	**8.06E+07**	*1.20E+06*	gamma scan	dpm/mL
OH^-	**2.86E+00**	*9.86E-03*	-	-	**1.73E+00**	*8.94E-03*	-	-	Titration	M
NO_2^-	**2.02E+00**	*1.69E-01*	**2.10E+00**	*1.63E-02*	**1.30E+00**	*2.26E-02*	**1.25E+00**	*1.95E-02*	IC	M
NO_3^-	**1.04E+00**	*8.32E-02*	**1.06E+00**	*7.83E-03*	**6.59E-01**	*1.13E-02*	**6.31E-01**	*1.16E-02*	IC	M
F^-	**<6.02E-03**	-	**<6.61E-03**	-	**<6.14E-03**	-	**<6.49E-03**	-	IC	M
CHO_2^-	**4.12E-02**	*2.99E-04*	**4.15E-02**	*2.03E-04*	**2.64E-02**	*3.64E-04*	**2.56E-02**	*3.22E-04*	IC	M
Cl^-	**4.83E-03**	*8.99E-06*	**4.60E-03**	*1.02E-04*	**<3.29E-03**	-	**<3.47E-03**	-	IC	M
PO_4^{3-}	**3.65E-03**	*6.97E-05*	**3.52E-03**	*5.92E-06*	**1.84E-03**	*1.90E-05*	**1.95E-03**	*1.37E-05*	IC	M
SO_4^{2-}	**2.05E-02**	*1.05E-04*	**2.13E-02**	*4.47E-04*	**1.40E-02**	*2.86E-04*	**1.42E-02**	*1.70E-04*	IC	M
$C_2O_4^{2-}$	**3.68E-03**	*1.96E-04*	**3.99E-03**	*1.72E-04*	**2.03E-03**	*6.70E-05*	**2.33E-03**	*8.41E-05*	IC	M
Br^-	**<1.43E-03**	-	**<1.57E-02**	-	**<1.46E-03**	-	**<1.54E-02**		IC	M
CO_3^{2-}	**4.34E-01**	*1.06E-02*	-	-	**2.72E-01**	*2.61E-03*	-	-	TIC	M
Al*	9.36E+02	-	1.01+03	-	5.84E+02	-	5.88E+02	-	ICP-ES	mg/L
B	1.63E+02	-	1.65E+02	-	9.95E+01	-	9.89E+01	-	ICP-ES	mg/L
Ca	4.13E+00	-	<1.59E+00	-	2.15E+00	-	<1.55E+00	-	ICP-ES	mg/L
Cr	5.73E+01	-	5.55E+01	-	3.57E+01	-	3.50E+01	-	ICP-ES	mg/L
Fe	5.03E+00	-	5.99E+00	-	3.49E+00	-	2.84E+00	-	ICP-ES	mg/L
K	3.22E+02	-	3.45E+02	-	2.18E+02	-	2.23E+02	-	ICP-ES	mg/L
Li	7.87E+01	-	7.92E+01	-	4.78E+01	-	4.73E+01	-	ICP-ES	mg/L
Na	1.65E+05	-	1.65E+05	-	1.03E+05	-	1.00E+05	-	ICP-ES	mg/L
P	1.24E+02	-	1.36E+02	-	8.17E+01	-	7.07E+01	-	ICP-ES	mg/L
Si	3.00E+02	-	3.12E+02	-	2.16E+02	-	2.19E+02	-	ICP-ES	mg/L
Zn	4.52E+00	-	4.14E+00	-	2.32E+00	-	3.05E+00	-	ICP-ES	mg/L
Hg	3.74E+02	-	3.40E+02	-	2.41E+02	-	2.17E+02	-	CVAA-Hg	mg/L
Na	7.17E+00	-	7.19E+00	-	4.46E+00	-	4.35E+00			M
Total cation	7.17E+00		7.20E+00		4.47E+00		4.36E+00		Calc.	M
Total anion	6.92E+00		-		4.31E+00		-		Calc.	
SpG 24 °C	**1.31**	*0.00E+0*	**1.28**	*0.01*	**1.20**	*0.01*	**1.16**	*0.01*	Calc.	**-**

*Analyses for elementals were not requested hence single analysis runs were performed for cation/anion balance only.

** The Pu-239 mass concentrations were calculated from the Pu-239/240 results, based on the assumption that all activity was due to Pu-239 (as opposed to Pu-240). Note that the ICP-MS results for Pu-239 were all below the minimum detection limits.

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^{2-}, Cl^-, CO_3^{2-}, PO_4^{3-}, AlO_2^-, $C_2O_4^{2-}$ and free OH^-). The two sums were compared. Since only the surface samples (Tank 38H surface sample HTF-38-15-47 and Tank 43H surface Sample HTF-43-15-51) were analyzed fully for both cation and anion the anion/cation comparisons were performed only for these two samples. For these comparisons, the primary contributing cations included Na^+ and K^+, while the primary contributing anions included hydroxide, nitrite, nitrate, carbonate, formate, sulfate, phosphate, oxalate, chloride, and aluminate.

For the Tank 38H surface sample the cations summed to 7.17 M, while the anions summed to 6.92 M. Thus, the anions summed to about 96.5 % of the cations. Similarly, for the Tank 43H surface sample the calculated cation and anions were 4.47 and 4.31, respectively. The anions summed to about 96.4 % 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 19 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 and CCP) in separate sections of the tables. Results for ***Tank 38H surface supernate*** are summarized in Appendix A, Table 4 through Table 7, while Tables 8 through Table 11, 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 12 through Tables 15, while the analyses results for ***Tank 43H subsurface*** supernates are presented in Tables 16 through Table 19 in Appendix D. Tables 6, 11, 14 and 19 contain the results for additional analytes which were measured by the same group of methods but were not required by any of the major programs.

5.0 Conclusions

The U-235 mass divided by the total uranium mass averaged 6.13E-03 ± 7.05E-05 (6.13E-01± 7.05E-03 % uranium enrichment) for all sample measurements in both types of tank samples. The average U-235 concentration in the Tank 38H samples ranged from 6.75E-01 to 6.83E-01 mg/L, while the average U-238 concentration in Tank 38H samples ranged from 1.11E+02 to 1.12E+02 mg/L. In contrast, the average U-235 concentration in the Tank 43H samples ranged from 4.23E-01 to 4.35E-01 mg/L and the average U-238 concentration in the Tank 43H samples ranged from 6.81E+01 to 6.97E+01 mg/L. Thus, the U-235/total uranium ratio is in line with the prior 2H-evaporator ECP samples[a].

The measured sodium concentration averaged, respectively, 7.17 M and 7.19 M in the Tank 38H surface sample and Tank 38H subsurface sample. The measured sodium concentration in the Tank 43H surface samples and Tank 43 subsurface samples averaged, respectively, 4.46 and 4.35 M.

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

[a] C. J. Martino, "Analysis of Tank 38H (HTF-38-13-156, 157) and Tank 43H (HTF-43-13-158, 159) Samples for Support of the Enrichment Control and Corrosion Control Programs," SRNL-TR-2013-00205, Rev. 0, October 2013.

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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Appendix A. Tank 38H Surface samples (HTF-38-15-47)

Table 4 Tank 38H Surface Sample HTF-38-15-47: ECP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-233	9.26E-03	9.45E-03	1.05E-02	**9.74E-03**	*6.76E-04*	mg/L
U-234	1.71E-02	1.72E-02	1.66E-02	**1.70E-02**	*3.06E-04*	mg/L
U-235	6.84E-01	6.92E-01	6.73E-01	**6.83E-01**	*9.48E-03*	mg/L
U-236	4.18E-02	3.94E-02	4.09E-02	**4.07E-02**	*1.19E-03*	mg/L
U-238	1.12E+02	1.13E+02	1.10E+02	**1.12E+02**	*1.55E+00*	mg/L
U-Total	1.13E+02	1.14E+02	1.11E+02	**1.12E+02**	*1.56E+00*	mg/L
U-Enrichment	6.06E-03	6.08E-03	6.08E-03	**6.07E-03**	*1.23E-05*	
Pu-239	4.54E-03	4.56E-03	4.50E-03	**4.54E-03**	*3.12E-05*	mg/L
Pu-241	1.20E-05	1.07E-05	1.14E-05	**1.13E-05**	*6.18E-07*	mg/L

Table 5 Tank 38H Surface Sample HTF-38-15-47: CCP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
NO_3^-	9.44E-01	1.08E+00	1.10E+00	**1.04E+00**	*8.32E-02*	Mole/L
NO_2^-	1.83E+00	2.09E+00	2.14E+00	**2.02E+00**	*1.69E-01*	Mole/L
OH^{-1}	2.87E+00	2.85E+00	2.85E+00	**2.86E+00**	*9.86E-03*	Molar
SpG @ 24 °C	1.31	1.31	1.31	**1.31**	*0.00E+0*	-
Cs-137	1.46E+08	1.42E+08	1.42E+08	**1.43E+08**	*2.06E+06*	dpm/mL
Ba-137m	1.38E+08	1.34E+08	1.35E+08	**1.35E+08**	*1.95E+06*	dpm/mL

SpG = Specific gravity

Table 6 Tank 38H Surface Sample HTF-38-15-47: Other Results from ECP & CCP

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-235/U-total *100	6.06E-01	6.08E-01	6.08E-01	**6.07E-01**	*1.23E-03*	%
Pu-238	4.50E-04	4.77E-04	4.60E-04	**4.62E-04**	*1.34E-05*	mg/L
Pu-239/240	6.27E+02	6.30E+02	6.21E+02	**6.26E+02**	*4.30E+00*	dpm/mL
Sr-90	3.14E+06	2.91E+06	2.57E+06	**2.87E+06**	*2.91E+05*	dpm/mL
SO_4^{2-}	2.06E-02	2.04E-02	2.04E-02	**2.05E-02**	*1.05E-04*	Mole/L
CHO_2^-	4.14E-02	4.08E-02	4.12E-02	**4.12E-02**	*2.99E-04*	Mole/L
Cl^-	4.83E-03	4.82E-03	4.84E-03	**4.83E-03**	*8.99E-06*	Mole/L
F^-	<6.02E-03	<6.01E-03	<6.03E-03	**<6.02E-03**		Mole/L
PO_4^{3-}	3.73E-03	3.60E-03	3.62E-03	**3.65E-03**	*6.97E-05*	Mole/L
$C_2O_4^{2-}$	3.90E-03	3.63E-03	3.51E-03	**3.68E-03**	*1.96E-04*	Mole/L
Br^-	<1.43E-03	<1.43E-03	<1.43E-03	**<1.43E-03**		Mole/L
Inorganic carbon	5.21E+06	5.34E+06	5.09E+06	**5.21E+06**	*1.27E+05*	µgC/L
Organic carbon	8.09E+05	8.03E+05	7.65E+05	**7.93E+05**	*2.40E+04*	µgC/L
Total carbon	6.02E+06	6.14E+06	5.85E+06	**6.01E+06**	*1.44E+05*	µgC/L
CO_3^{2-}	4.34E-01	4.45E-01	4.24E-01	**4.34E-01**	*1.06E-02*	M

Table 7 Tank 38H Surface Sample (HTF-38-15-49): Select Elemental Analysis Results

Analytes	Analysis	Units
Al	9.36E+02	mg/L
B	1.63E+02	mg/L
Ca	4.13E+00	mg/L
Cr	5.73E+01	mg/L
Fe	5.03E+00	mg/L
K	3.22E+02	mg/L
Li	7.87E+01	mg/L
Na	1.65E+05	mg/L
P	1.24E+02	mg/L
Si	3.00E+02	mg/L
Zn	4.52E+00	mg/L
Hg	3.74E+02	mg/L

Appendix B. Tank 38H Sub-Surface samples (HTF-38-15-49)

Table 8 Tank 38H Sub-Surface Sample HTF-38-15-49: ECP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-233	9.59E-03	8.51E-03	9.86E-03	**9.32E-03**	*7.12E-04*	mg/L
U-234	1.68E-02	1.77E-02	1.68E-02	**1.71E-02**	*5.02E-04*	mg/L
U-235	6.71E-01	6.72E-01	6.83E-01	**6.75E-01**	*6.40E-03*	mg/L
U-236	3.96E-02	3.98E-02	4.26E-02	**4.07E-02**	*1.68E-03*	mg/L
U-238	1.10E+02	1.10E+02	1.12E+02	**1.11E+02**	*1.07E+00*	mg/L
U-Total	1.11E+02	1.11E+02	1.13E+02	**1.11E+02**	*1.08E+00*	mg/L
U-Enrichment	6.06E-03	6.06E-03	6.06E-03	**6.06E-03**	*1.36E-06*	
Pu-239	3.80E-03	4.29E-03	4.47E-03	**4.19E-03**	*3.44E-04*	mg/L
Pu-241	1.14E-05	1.07E-05	1.39E-05	**1.20E-05**	*1.65E-06*	mg/L

Table 9 Tank 38H Sub-Surface Sample HTF-38-15-49: CCP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
NO_3^-	1.06E+00	1.06E+00	1.07E+00	**1.06E+00**	*7.83E-03*	Mole/L
NO_2^-	2.10E+00	2.08E+00	2.11E+00	**2.10E+00**	*1.63E-02*	Mole/L
OH^{-1}	Not requested	Not requested	Not requested	Not requested	Not requested	Molar
SpG @ 24 °C	1.29	1.29	1.27	**1.28**	*0.01*	--
Cs-137	1.43E+08	1.46E+08	1.42E+08	**1.43E+08**	*2.46E+06*	dpm/mL
Ba-137m	1.35E+08	1.38E+08	1.34E+08	**1.36E+08**	*2.33E+06*	dpm/mL

Table 10 Tank 38H Sub-Surface Sample (HTF-38-15-49): Select Elemental Analysis Results

Analytes	Analysis	Units
Al	1.01+03	mg/L
B	1.65E+02	mg/L
Ca	<1.59E+00	mg/L
Cr	5.55E+01	mg/L
Fe	5.99E+00	mg/L
K	3.45E+02	mg/L
Li	7.92E+01	mg/L
Na	1.65E+05	mg/L
P	1.36E+02	mg/L
Si	3.12E+02	mg/L
Zn	4.14E+00	mg/L
Hg	3.40E+02	mg/L

Table 11 Tank 38H Sub-Surface Sample HTF-38-15-49: Other Results from ECP & CCP

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-235/U-total*100	6.06E-01	6.06E-01	6.06E-01	**6.06E-01**	*1.36E-04*	%
Pu-238	4.32E-04	4.05E-04	4.46E-04	**4.28E-04**	*2.10E-05*	mg/L
Pu-239/240	5.25E+02	5.93E+02	6.16E+02	**5.78E+02**	*4.74E+01*	dpm/mL
SO_4^{2-}	2.18E-02	2.12E-02	2.10E-02	**2.13E-02**	*4.47E-04*	Mole/L
CHO_2^-	4.18E-02	4.14E-02	4.15E-02	**4.15E-02**	*2.03E-04*	Mole/L
Cl^-	4.71E-03	4.54E-03	4.53E-03	**4.60E-03**	*1.02E-04*	Mole/L
F^-	<6.77E-03	<6.53E-03	<6.51E-03	**<6.61E-03**		Mole/L
PO_4^{3-}	3.52E-03	3.53E-03	3.52E-03	**3.52E-03**	*5.92E-06*	Mole/L
$C_2O_4^{2-}$	4.10E-03	4.09E-03	3.79E-03	**3.99E-03**	*1.72E-04*	Mole/L
Br^-	<1.61E-02	<1.55E-02	<1.55E-02	**<1.57E-02**		Mole/L
Inorganic carbon	Not requested	Not requested	Not requested	Not requested	Not requested	µgC/L
Organic carbon	Not requested	Not requested	Not requested	Not requested	Not requested	µgC/L
Total carbon	Not requested	Not requested	Not requested	Not requested	Not requested	µgC/L
CO_3^{2-}	Not requested	Not requested	Not requested	Not requested	Not requested	M

Appendix C. Tank 43H Surface samples (HTF-38-15-51)

Table 12 Tank 43H Surface Sample HTF-43-15-51: ECP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-233	5.92E-03	6.09E-03	5.86E-03	**5.96E-03**	*1.17E-04*	mg/L
U-234	1.08E-02	1.08E-02	1.06E-02	**1.07E-02**	*1.12E-04*	mg/L
U-235	4.41E-01	4.32E-01	4.32E-01	**4.35E-01**	*5.05E-03*	mg/L
U-236	2.54E-02	2.58E-02	2.58E-02	**2.56E-02**	*2.40E-04*	mg/L
U-238	7.00E+01	6.99E+01	6.93E+01	**6.97E+01**	*3.75E-01*	mg/L
U-Total	7.05E+01	7.04E+01	6.98E+01	**7.02E+01**	*3.79E-01*	mg/L
U-Enrichment	6.26E-03	6.14E-03	6.19E-03	**6.20E-03**	*5.64E-05*	
Pu-239	2.72E-03	2.88E-03	3.04E-03	**2.88E-03**	*1.61E-04*	mg/L
Pu-241	7.23E-06	6.43E-06	7.96E-06	**7.21E-06**	*7.68E-07*	mg/L

Table 13 Tank 43H Surface Sample HTF-43-15-51: CCP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
NO_3^-	6.70E-01	6.48E-01	6.58E-01	**6.59E-01**	*1.13E-02*	Mole/L
NO_2^-	1.32E+00	1.28E+00	1.30E+00	**1.30E+00**	*2.26E-02*	Mole/L
OH^{-1}	1.74E+00	1.72E+00	1.73E+00	**1.73E+00**	*8.94E-03*	Molar
SpG @ 24 °C	1.20	1.21	1.19	**1.20**	*0.01*	-
Cs-137	8.70E+07	8.76E+07	8.37E+07	**8.61E+07**	*2.09E+06*	dpm/mL
Ba-137m	8.23E+07	8.29E+07	7.92E+07	**8.15E+07**	*1.98E+06*	dpm/mL

Table 14 Tank 43H Surface Sample HTF-43-15-51: Other Results from ECP & CCP

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-235/U-total *100	6.26E-01	6.14E-01	6.19E-01	**6.20E-01**	*5.64E-03*	%
Pu-238	*2.90E-04*	*2.56E-04*	*2.89E-04*	**2.78E-04**	*1.96E-05*	mg/L
Pu-239/240	3.75E+02	3.97E+02	4.19E+02	**3.97E+02**	*2.22E+01*	dpm/mL
Sr-90	1.18E+06	8.98E+05	1.45E+06	**1.18E+06**	*2.78E+05*	dpm/mL
SO_4^{2-}	1.44E-02	1.39E-02	1.39E-02	**1.40E-02**	*2.86E-04*	Mole/L
CHO_2^-	2.68E-02	2.60E-02	2.63E-02	**2.64E-02**	*3.64E-04*	Mole/L
Cl^-	<3.33E-03	<3.27E-03	<3.26E-03	**<3.29E-03**		Mole/L
F^-	<6.21E-03	<6.11E-03	<6.10E-03	**<6.14E-03**		Mole/L
PO_4^{3-}	1.86E-03	1.83E-03	1.83E-03	**1.84E-03**	*1.90E-05*	Mole/L
$C_2O_4^{2-}$	2.01E-03	1.98E-03	2.11E-03	**2.03E-03**	*6.70E-05*	Mole/L
Br^-	<1.48E-03	<1.45E-03	<1.45E-03	**<1.46E-03**		Mole/L
Inorganic carbon	3.26E+06	3.30E+06	3.23E+06	**3.26E+06**	*3.13E+04*	µgC/L
Organic carbon	5.24E+05	5.25E+05	5.15E+05	**5.21E+05**	*5.63E+03*	µgC/L
Total carbon	3.78E+06	3.82E+06	3.74E+06	**3.78E+06**	*3.72E+04*	µgC/L
Carbonate, CO_3^{2-}	2.72E-01	2.75E-01	2.69E-01	**2.72E-01**	*2.61E-03*	M

Table 15 Tank 43 Surface Sample (HTF-15-51): Select Elemental Analysis Results

Analytes	Analysis-1	Units
Al	5.84E+02	mg/L
B	9.95E+01	mg/L
Ca	2.15E+00	mg/L
Cr	3.57E+01	mg/L
Fe	3.49E+00	mg/L
K	2.18E+02	mg/L
Li	4.78E+01	mg/L
Na	1.03E+05	mg/L
P	8.17E+01	mg/L
Si	2.16E+02	mg/L
Zn	2.32E+00	mg/L
Hg	2.41E+02	mg/L

Appendix D. Tank 43H Sub-Surface samples (HTF-38-15-53)

Table 16 Tank 43H Sub-Surface Sample HTF-43-15-153: ECP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-233	6.21E-03	5.39E-03	6.09E-03	**5.90E-03**	*4.44E-04*	mg/L
U-234	1.09E-02	1.04E-02	1.06E-02	**1.06E-02**	*2.73E-04*	mg/L
U-235	4.27E-01	4.19E-01	4.22E-01	**4.23E-01**	*4.00E-03*	mg/L
U-236	2.40E-02	2.52E-02	2.47E-02	**2.46E-02**	*6.28E-04*	mg/L
U-238	6.89E+01	6.69E+01	6.83E+01	**6.81E+01**	*1.00E+00*	mg/L
U-Total	6.94E+01	6.74E+01	6.88E+01	**6.85E+01**	*1.01E+00*	mg/L
U-Enrichment	6.16E-03	6.22E-03	6.14E-03	**6.17E-03**	*4.12E-05*	
Pu-239	1.37E-03	1.11E-03	1.76E-03	**1.41E-03**	*3.29E-04*	mg/L
Pu-241	6.61E-06	5.80E-06	6.14E-06	**6.18E-06**	*4.07E-07*	mg/L

Table 17 Tank 43H Sub-Surface Sample HTF-43-15-53: CCP Results

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
NO_3^-	6.33E-01	6.18E-01	6.41E-01	**6.31E-01**	*1.16E-02*	Mole/L
NO_2^-	1.26E+00	1.23E+00	1.27E+00	**1.25E+00**	*1.95E-02*	Mole/L
OH^{-1}	Not requested	Not requested	Not requested	Not requested	Not requested	Molar
SpG @ 24 °C	1.16	1.18	1.15	**1.16**	*0.01*	--
Cs-137	8.63E+07	8.38E+07	8.56E+07	**8.52E+07**	*1.26E+06*	dpm/mL
Ba-137m	8.15E+07	7.93E+07	8.09E+07	**8.06E+07**	*1.20E+06*	dpm/mL

Table 18 Tank 43H Sub-Surface Sample (HTF-43-15-53): Select Elemental Analysis Results

Analytes		Units
Al	5.88E+02	mg/L
B	9.89E+01	mg/L
Ca	<1.55E+00	mg/L
Cr	3.50E+01	mg/L
Fe	2.84E+00	mg/L
K	2.23E+02	mg/L
Li	4.73E+01	mg/L
Na	1.00E+05	mg/L
P	7.07E+01	mg/L
Si	2.19E+02	mg/L
Zn	3.05E+00	mg/L
Hg	2.18E+02	mg/L

Table 19 Tank 43H Sub-Surface Sample HTF-38-15-53: Other Results from ECP & CCP

Analytes	Analysis-1	Analysis-2	Analysis-3	Average	St. Deviation	Units
U-235/U-total*100	6.16E-01	6.22E-01	6.14E-01	**6.17E-01**	*4.12E-03*	%
Pu-238	2.59E-04	2.44E-04	2.52E-04	**2.52E-04**	*7.28E-06*	mg/L
Pu-239/240	1.88E+02	1.53E+02	2.43E+02	**1.95E+02**	*4.53E+01*	dpm/mL
SO_4^{2-}	1.44E-02	1.40E-02	1.42E-02	**1.42E-02**	*1.70E-04*	Mole/L
CHO_2^-	2.57E-02	2.53E-02	2.59E-02	**2.56E-02**	*3.22E-04*	Mole/L
Cl^-	<3.47E-03	<3.45E-03	<3.50E-03	**<3.47E-03**		Mole/L
F^-	<6.48E-03	<6.44E-03	<6.53E-03	**<6.49E-03**		Mole/L
PO_4^{3-}	1.94E-03	1.93E-03	1.96E-03	**1.95E-03**	*1.37E-05*	Mole/L
$C_2O_4^{2-}$	2.24E-03	2.36E-03	2.40E-03	**2.33E-03**	*8.41E-05*	Mole/L
Br^-	<1.54E-02	<1.53E-02	<1.55E-02	**<1.54E-02**		Mole/L
Inorganic carbon	Not requested	Not requested	Not requested	Not requested	Not requested	µgC/L
Organic carbon	Not requested	Not requested	Not requested	Not requested	Not requested	µgC/L
Total carbon	Not requested	Not requested	Not requested	Not requested	Not requested	µgC/L
Carbonate, CO_3^{2-}	Not requested	Not requested	Not requested	Not requested	Not requested	M

Distribution:

C. J. Martino, 999-W Room 390
K. B. Martin, 707-7E Room 10
C. B. Sherburne, 707-7E Room 1
D. J. Martin, 241-152H
C. C. Herman, 773-A Room B-136
A. P. Fellinger, 773-42A
F. M. Pennebaker, 773-42A
W. R. Wilmarth, 773-A