Final Report on the Analytical Results for Tank Farm Samples in Support of Salt Disullison Evaluation

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Final Report on the Analytical Results for Tank Farm Samples in Support of Salt Dissolution Evaluations (U)

SUMMARY

Recent processing of dilute solutions through the 2H-Evaporator system caused dissolution of salt in Tank 38H, the concentrate receipt tank. This report documents analytical results for samples HTF-001, HTF-002, HTF-003, HTF-004 and ITP-309, taken from this evaporator system. The results indicate the following:

- the presence of significant quantities of insoluble species (i.e., sodium, iron, chromium and manganese) to mitigate concerns of nuclear criticality safety,
- the composition of the Tank 41 saltcake sample is similar to previously analyzed samples taken in 1993, and
- neptunium-237 concentrations in the liquid phases of the Tank 43H and Tank 38H samples and the soluble salt fraction of the Tank 41 saltcake sample are sufficiently high such that the Saltstone limit for neptunium-237 concentration in the decontaminated salt solution may be exceeded if these wastes were processed in a single In-Tank Precipitation batch.

INTRODUCTION

Recent operations in the 2H-Evaporator system resulted in the dissolution of salt in Tank 38H. At the request of High-Level Waste Engineering, SRTC analyzed samples from three tanks to provide data confirming the presence of sufficient neutron poisons associated with the fissile material contained in the undissolved solids [1]. The samples consisted of two variable depth samples (VDS) from Tank 38H (HTF-001 and HTF-004), one saltcake sample from Tank 38H (HTF-003), one VDS from Tank 43H (HTF-002) and one saltcake sample from Tank 41H (ITP-309[a]).

EXPERIMENTAL

The following five samples were received and analyzed at SRTC. To ensure the presence of neutron poisons during storage and processing of the wastes in these tanks, the actinide and metals content were determined in the as-received sample, in the individual solid and liquid fractions after performing a solid-liquid separation and in the insoluble solids fraction after removing residual intersitial liquid and soluble salts by washing.

Sample ID	Tank	Type	Description[b]
HTF-001	38H	VDS	entrained sludge/supernate mix taken 6" above salt
HTF-002	43H	VDS	sludge/supernate mix taken at eductor suction
HTF-003	38H	Saltcake	salt taken at salt supernate interface
HTF-004	38H	VDS	entrained sludge/supernate mix at salt interface
ITP-309	41H	Saltcake	salt from eductor well after removal of jet

[a] Preliminary results for this sample identified as 41SC0696 were reported in reference 10.

[b] See reference 11 for further details on the Tank 38H samples.

The samples were placed into the Shielded Cells in 773-A and prepared for analysis. Details of the preparation methods are described below.

VDS Sample HTF-001
This sample was originally sent to Analytical Laboratories in 772-F for determination of corrosion chemistry. Visual inspection of the sample in 772-F revealed the presence of sludge solids. The sample was filtered in 772-F to separate the solid and liquid phases. The solids were recovered from the filter, returned to the sample bottle and transported to SRTC for analysis.

VDS Samples HTF-002 and HTF-004
Three subsamples were taken from the as-received slurry samples, dried for 48 hours at 100 °C and dissolved in aqua regia. The aqua regia dissolutions were diluted to 100 mL and aliquots analyzed for actinides and metals contents.

Forty milliliters of each slurry sample were placed in a glass centrifuge tube. The tubes were centrifuged for two hours at which time no further settling was observed visually. The supernatant liquid was decanted from the solids. Duplicate portions of the supernatant liquid were diluted into 2M nitric acid and analyzed for actinides and metals contents. The settled solids were rinsed twice with 0.015M sodium hydroxide solution. After centrifuging for 30 minutes, the rinse solutions were decanted from the settled solids. The rinse solutions were combined, diluted into 2M nitric acid and analyzed for actinides and metals contents. The settled solids were dried for 48 hours at 100 °C. A subsample of the settle solids was dissolved in aqua regia. The aqua regia dissolutions were diluted to 250 mL and aliquots analyzed for actinides and metals contents.

Between 5.0 and 10.0 grams of the solids isolated from above were washed with one 25 mL and two 5 mL portions of 0.015M sodium hydroxide solution to remove any residual water soluble salts. After centrifuging, the liquid phase was decanted from the solids. All of the decanted wash water was combined and analyzed for actinides and metals contents. The remaining solids were dried at 100 °C. Between 2.0 and 2.5 grams of the washed and dried solids were dissolved in aqua regia and analyzed for actinides and metals contents.

The remainder of the partially washed solids were washed with one 25 mL portion and two 10 mL portions of inhibited water. After centrifuging, the wash waters were decanted off and discarded. The undissolved solids were dried at 100 °C overnight. Subsamples were analyzed for total inorganic and organic carbon, presence of crystalline phases by x-ray diffraction analysis and particle morphology, particle size and elemental composition by scanning electron microscopy. A portion of the insoluble solids were also dissolved in concentrated hydrochloric acid and analyzed for anions by ion chromatography (IC).

Saltcake Samples HTF-003 and ITP-309 (41SC0696)
Approximately 10 grams of the as-received samples were dried at 100 °C. Three subsamples of the dried saltcake from each sample were dissolved in aqua regia. The aqua regia dissolutions were diluted to 100 mL and aliquots analyzed for actinides and metals contents.

Approximately ten grams of each damp saltcake sample were placed in duplicate glass centrifuge tubes. Twenty-five milliliters of 0.015M sodium hydroxide solution were added to each tube and the contents shaken. The samples were centifuged for one hour. The supernatant liquid was decanted from the settled solids into a clean polyethylene (PE) bottle. Aliquots of the supernatant liquid were diluted into 2M nitric acid and analyzed for actinides and metals content. The settled solids were contacted in a similar manner two more times with approximately 5 mL of 0.015M sodium hydroxide solution. Each rinse

more times with approximately 5 mL of 0.015M sodium hydroxide solution. Each rinse was diluted into 2M nitric acid solution and analyzed for actinides and metals contents. The remaining solids were dried at 100 °C and dissolved in aqua regia. The aqua regia dissolutions were diluted to 100 mL and aliquots analyzed for actinides and metals contents.

Analytical Methods

Each sample was analyzed for the following: (1) specific gravity, (2) total uranium using a kinetic phosphoresence method referred to as Chemchek, (3) selected metallic and nonmetallic elements by inductively coupled plasma emission spectroscopy (ICP-ES) and (4) uranium and plutonium isotopes by inductively coupled plasma mass spectrometry (ICP-MS). Aqua regia blank and nitric acid blank samples analyzed with each set of samples. A uranium and metals standard was prepared by dissolving a measured quantity of previously characterized powdered glass in aqua regia [2]. Analytical results were corrected for the measured responses of the acid solution blanks and the glass standard. The insoluble solids fractions of HTF-002 and HTF-004 were also analyzed by alpha and gamma spectroscopy for plutonium-238 and americium-241, respectively, as well as total inorganic carbon (TIC), total organic carbon (TOC), scanning electon microscopic (SEM) and x-ray diffraction (XRD).

RESULTS AND DISCUSSION

Appendices 1-5 contain a compilation of all ICP-ES, ICP-MS, alpha spectroscopy and gamma spectroscopy results and calculated weight ratios for each of the five samples. Results are provided for the as-received sample, the liquid and solids fractions for each VDS slurry sample, the soluble salt fraction for each saltcake sample and the insoluble solids fraction of the VDS slurry and saltcake samples.

Table I presents the analytical results for the two as-received VDS samples (HTF-002 & HTF-004) and the two as-received salt samples (HTF-003 and ITP-309). The reported concentrations use a dry solids basis. For all samples, the weight ratio of neutron poisons to equivalent fissile uranium is sufficient to mitigate concerns of nuclear criticality safety. The high chromium concentration in the as-received Tank 38H VDS sample results from a high chromium concentration in the liquid phase. After removing the liquid phase from the VDS samples, the chromium concentration in the solids fraction is below that of iron (see Table II).

A solid-liquid separation of the VDS samples was performed so that the actinides and metals content could be determined in the solid fraction of the slurry. The resulting solids would represent the layer of settled solids for the waste tanks conditions including the 2H-Evaporator under current operating conditions. Table II gives the analytical results for the solids fraction of the three VDS samples. As in the case of the as-received samples, the concentrations of neutron poisons relative to the equivalent fissile uranium concentration is sufficient to mitigate concerns of nuclear criticality safety.

Good agreement was observed for the two Tank 38H VDS samples with the exception of manganese. Manganese is most likely present as manganese dioxide, a black or brown/black solid sparingly soluble in alkaline solutions. The presence of this compound may explain the much darker appearance of the earlier VDS sample (HTF-001) compared to the later sample (HTF-004).

The solids fraction of the Tank 43H VDS sample had much higher uranium, plutonium, iron, chromium and manganese content than the Tank 38H samples (see Table II). The sodium content was also lower for the Tank 43H sample compared to the Tank 38H samples. These results suggest that the Tank 43H sample contains a higher sludge

fraction, which is expected since Tank 43H is the H-Area low activity fresh waste receipt tank. High Na/U, Fe/U, Cr/U and Mn/U weight ratios were observed for all three solids fractions in the VDS samples. Relative to the as-received sample results, the Na/U ratios decrease, but all others increase. This trend is expected. As the solids settle, liquid is displaced which is high in Na due to the presence of sodium salts, but low in Fe, Cr and Mn. Sodium remains high in the solids fraction due to the presence of undissolved salt. Undissolved salt in the second Tank 38H VDS sample is suspected due to the lighter color compared to typical sludge samples.

The compositions of the water-soluble and water-insoluble fractions of the two salt samples (HTF-003 and ITP-309) were also determined. Table III presents the results for the water-insoluble fractions. The results for the water-soluble fraction of the saltcake samples are provided in Appendices 3 and 5. The insoluble solids represent that fraction of the waste in the tank that would remain undissolved upon addition of dilute liquids to these tanks. These additions produce the greatest possible concentrating mechanism for actinides. On a mass basis, the actinide content is higher for these solids than that of the as-received samples or the solids separated from the VDS samples. However, appreciable quantities of neutron poisons Na, Fe, Cr and Mn (Tank 38H only) remain in the water-insoluble solids.

The composition of the insoluble solids fraction of the two VDS samples, HTF-002 and HTF-004) were also determined as presented in Table IV. There was insufficient sample to perform the same analyses on the other Tank 38H VDS sample, HTF-001. For both samples, there are sufficient concentrations of neutron poisons to mitigate concerns of nuclear criticality safety. Results indicate a higher actinide concentration for the Tank 43H sample compared to the Tank 38H sample. The higher actinide concentration in Tank 43H also suggests a higher fraction of sludge solids in this tank versus that in Tank 38H.

In principle, the results for the insoluble solids fraction of the Tank 38H VDS (HTF-004) and saltcake (HTF-003) samples should be similar. The relative abundance of the uranium and plutonium isotopes are very similar for both samples indicating that the uranium and plutonium is from a similar source. However, the actinides and other metals concentrations are significantly different. The saltcake sample showed higher actinide and metals concentrations which suggests the insoluble solids in the saltcake sample are comprised of a higher fraction of Separations Canyon sludge waste than the VDS sample. Other insoluble solids could arise from solid phases produced during and after evaporation and from other waste generators (e.g., Receipt Basin for Offsite Fuels, 299-H Decontamination Facility and Defense Waste Processing Facility).

Total inorganic and organic carbon analysis of the solids indicated a relatively high organic carbon content in the insoluble solids. The SEM analyses of solids for particle morphology and elemental composition indicated no evidence of spherical shaped material ion-exchange resin beads. The HTF-002 sample was comprised of aggregates of irregularly shaped solids comprised of Fe, Mn, Ca, Si, Al, Na, Cr. The HTF-004 sample was comprised of aggregates of irregularly and cubic shaped solids comprised of Na, Si, Al, Ca, Cr and Fe.

Semi-volatile organic analysis (SVOA) using gas chromatography-mass spectrometry detected no extractable organic compounds [5]. Portions of the insoluble solids were dissolved in concentrated hydrochloric acid and analyzed by ion chromatography and TOC. Hydrochloric acid was chosen to minimize the oxidation of the organic compounds present in the samples. Formate and oxalate were detected in both samples. However, as a result of the poor reproducibility of replicate measurements for formate, oxalate, and other analytes (e.g., nitrate and phosphate), quantification of the formate and oxalate content was not possible. It is recommended that further development be undertaken to improve anaytical methods for the determination of organic compounds in high-level waste samples.

Sample ID	Tank	Concentration (µg/g) TIC	TOC
HTF-002	43H	3450	18600
HTF-004	38H	3100	9200

XRD analysis of the HTF-002 (Tank 43H) and HTF-004 (Tank 38H) insoluble solids revealed the presence of sodium salts of carbonate, oxalate, nitrate and aluminate silicate. A list of the crystalline phases for both samples are provided below.

Sample ID	Tank	Cystalline Phases Identified by XRD
HTF-002	43H	$Na_2C_2O_4$ $Na_8(Al_6Si_6O_{24})(NO_3)_2 4H_2O$
HTF-004	38H	$Na_2CO_3 H_2O$ $Na_2C_2O_4$ $NaNO_3$ $Na_8(Al_6Si_6O_{24})(NO_3)_2 4H_2O$

Analytical results for the liquid fraction of the Tank 43H (HTF-002) and Tank 38H (HTF-004) VDS samples are provided in Appendices 2A and 4A. Comparison of the results indicated the liquid phases in both tank samples are very similar in metals and actinide composition and actinide isotopics. Comparison of the hydroxide, nitrate and other anionic species contents is not possible as neither sample was analyzed for these type of components. Neptunium-237 concentrations in both samples are high enough to be a concern for disposal in Saltstone. After correcting for dilution to a sodium ion concentration of 5.0 molar (target In-Tank Precipitation (ITP) feed concentration) and assuming no removal during ITP processing, the neptunium-237 concentrations are about a factor of 3 higher than that allowed in Saltstone feed[6]. Thus, the liquid fraction of the waste in Tank 43H and 38H should not be processed in a single ITP batch.

Analytical results for the soluble salt fractions of the two saltcake samples, Tank 38H (HTF-003) and Tank 41H (ITP-309)), are presented in Appendices 3A and 5A. These results are based on the as-received saltcake and, therefore, include interstitial liquid. Tank 41H saltcake contained a higher concentration of insoluble solids than Tank 38H saltcake. The insoluble solids content for Tank 41H is consistent with that found in previous Tank 41H saltcake samples (0.52 - 1.7 wt %)[7].

	Tank 38H (HTF-003)	Tank 41H (ITP-309)
wt % insoluble solids	0.493 ± 0.0035	1.39 ± 0.28

The two saltcake samples were similar in aluminum, sodium, uranium and plutonium content. Tank 41H contained much higher concentrations of chromium and phosphorus as well as higher concentrations of uranium-235 and equivalent fissile uranium. The neptunium-237 content in the Tank 38H sample is such that upon dissolution to produce a 5.0 molar sodium ion salt solution, the neptunium-237 concentration would be below the Saltstone feed requirement of 0.03 nCi/g. For the Tank 41H saltcake sample, the neptunium-237 concentration is such that the resulting salt solution would have a neptunium-237 concentration of 0.045 nCi/g, which exceeds the Saltstone feed requirement.

Sodium, aluminum and phoshorous concentrations in this Tank 41H saltcake sample are similar to those determined in previous Tank 41H saltcake samples [7]. The uranium and plutonium content as well as the isotopic abundances for uranium-235 and uranium-238 are within the range of values determined for the previous samples [7,8].

QUALITY ASSURANCE

All results reported in this document obtained in accordance with the requirements outlined in the technical task and quality assurance plans governing this work [3,4]. Results recorded in laboratory notebook, WSRC-NB-96-694.

REFERENCES

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Table I. Analytical Results for As-Received VDS and Salt Samples

	HTF-004 Tk 38H VDS		HTF-003 Tk 38H Salt		HTF-002 Tk 43H VDS		ITP-309 Tk 41H Salt	
	Average (µg/g)	Std. Dev. (µg/g)	Average (µg/g)	Std. Dev. (µg/g)	Average (µg/g)	Std. Dev. (µg/g)	Average (µg/g)	Std. Dev. (µg/g)
Total U	15	2.8	3.9	0.11	120	1.9	39	14
U-233	bdl	-	bdl	-	bdl	-	0.056	0.012
U-234	1.7	0.28	0.30	0.028	6.5	0.30	0.68	0.077
U-235	0.57	0.14	0.11	0.0046	3.2	0.21	1.7	0.26
U-236	0.21	0.027	0.050	0.016	1.2	0.065	0.83	0.12
U-238	12	2.4	3.4	0.084	110	1.4	36	13
Total Pu	0.38	0.075	0.85	0.11	9.7	0.84	11	4.3
Pu-239	0.38	0.075	0.78	0.093	7.0	0.82	10	4.3
Pu-240	bdl	-	0.059	0.021	1.1	0.066	0.13	0.040
Pu-241	bdl	-	0.0080	0.0032	1.4	0.087	0.018	0.0063
Pu-242	bdl	-	0.0041	0.0035	0.25	0.082	0.014	0.0095
Eq. U	2.1	0.44	3.2	0.36	36	3.4	44	17
Na	350000	55000	300000	9100	330000	12000	400000	16000
Fe	230	29	260	100	19000	640	6000	5300
Cr	400	66	120	23	5500	210	2500	82
Zn	22	12	19	4.5	160	13	26	14
Mn	94	16	370	44	15000	590	240	320
Weight % Solids								
	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
	65.9	0.53	-		50.9	1.85	-	
Weight Ratio								
	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Na/Eq. U	170000	11000	97000	14000	9100	940	10000	3100
Fe/Eq. U	110	14	83	28	520	52	170	180
Cr/Eq. U	190	17	39	8.3	220	16	63	20
Zn/Eq. U	14	4.8	6.1	0.92	4.6	0.69	0.70	0.53
Mn/Eq. U	45	3.2	120	22	420	44	7.2	10

Actinide results are those determined by ICP-MS and corrected based on the U-238 result with the glass standard. Mass 238 is reported as U-238 and is not corrected for any Pu-238 present. Mass 241 is reported as Pu-241 and not corrected for Am-241 present. Total Pu is calculated as the sum of Pu-239, Pu-240, Pu-241 and Pu-242. Equivalent uranium fissile content (Eq. U) is calculated as the sum of U-233, U-235 and four times the sum of Pu-239 and Pu-241 [ref. 9]. Sodium, iron, chromium, zinc and manganese results are those determined by ICP-ES and corrected for acid blanks and glass standard responses. Weight percent solids (wt %) were determined by weighing samples before and after drying at 100 °C prior to dissolution in aqua regia. Weight ratios were determined by dividing measured metal concentration by the equivalent uranium fissile concentration. bdl = below detection limit

Table II. Analytical Results for the Solids Fraction in the Tank 38H and Tank 43H VDS Samples.

	HTF-001 Tk 38H VDS		HTF-004 Tk 38H VDS		HTF-002 Tk 43H VDS	
	Average (µg/g)	Std. Dev. (µg/g)	Average (µg/g)	Std. Dev. (µg/g)	Average (µg/g)	Std. Dev. (µg/g)
Total U	22	1.2	20	0.31	140	2.9
U-233	bdl	-	0.011	0.019	0.080	0.010
U-234	1.0	0.096	1.5	0.040	8.3	0.15
U-235	0.365	0.037	0.54	0.016	3.9	0.12
U-236	0.16	0.028	0.20	0.027	1.5	0.052
U-238	21	1.2	18	0.24	120	2.6
Total Pu	1.1	0.090	0.83	0.033	8.3	0.36
Pu-239	0.86	0.069	0.70	0.016	6.5	0.24
Pu-240	0.14	0.024	0.092	0.012	0.88	0.057
Pu-241	0.054	0.0088	0.036	0.0062	0.78	0.084
Pu-242	0.021	0.018	bdl	-	0.18	0.012
Eq. U	4.0	0.34	3.5	0.10	33	1.3
Na	360000	26000	260000	4900	220000	1200
Fe	900	92	470	9.5	22000	160
Cr	700	53	410	5.1	5900	36
Zn	<37	7.5	6.4	2.1	170	0.76
Mn	2400	170	170	5.1	17000	85
Weight % Solids						
	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
	not determined		not determined		not determined	
Weight Ratio						
	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Na/Eq. U	90000	1600	75000	790	6500	230
Fe/Eq. U	220	4.3	130	2.1	660	22
Cr/Eq. U	180	2.1	120	3.2	180	6.2
Zn/Eq. U	>9.3	2.0	1.8	0.56	5.3	0.19
Mn/Eq. U	610	10	49	0.79	520	19

Solid-liquid separation for sample HTF-001 performed in 772-F by filtration. Solids shipped to SRTC for analysis. Solid-liquid separation for samples HTF-004 and HTF-002 performed in 773-A by centrifugation and decantation. Actinide results are those determined by ICP-MS and corrected based on the U-238 result with the glass standard. Mass 238 is reported as U-238 and is not corrected for any Pu-238 present. Mass 241 is reported as Pu-241 and not corrected for Am-241 present. Total Pu is calculated as the sum of Pu-239, Pu-240, Pu-241 and Pu-242. Equivalent uranium fissile content (Eq. U) is calculated as the sum of U-233, U-235 and four times the sum of Pu-239 and Pu-241 [ref. 9]. Sodium, iron, chromium, zinc and manganese results are those determined by ICP-ES and corrected for acid blanks and glass standard responses. Weight ratios were determined by dividing measured metal concentration by the equivalent uranium fissile concentration. bdl = below detection limit

Table III. Analytical Results for the Water Insoluble Solids in the Tank 38H and Tank 41H Salt Samples.

	HTF-003 Tk 38H Salt		ITP-309 Tank 41H Salt	
	Average (μg/g)	Std. Dev. (μg/g)	Average (μg/g)	Std. Dev. (μg/g)
Total U	180	3.5	240	78
U-233	0.056	0.080	0.98	0.44
U-234	8.3	0.080	9.0	3.0
U-235	3.1	0.080	23	7.6
U-236	1.2	0.00	9.9	3.4
U-238	170	3.3	190	63
Total Pu	12	0.23	1.5	0.72
Pu-239	10	0.28	1.2	0.57
Pu-240	1.4	0.057	0.18	0.077
Pu-241	0.48	0.00	0.090	0.077
Pu-242	0.24	0.00	bdl	-
Eq. U	45	1.2	30	11
Na	170000	5200	100000	28000
Fe	29000	940	30000	12000
Cr	14000	420	8200	6700
Zn	210	32	140	26
Mn	56000	1800	570	300
Weight % Solids				
	Average	Std. Dev.	Average	Std. Dev.
	0.492	0.0035	1.39	0.283
Weight Ratio				
	Average	Std. Dev.	Average	Std. Dev.
Na/Eq. U	2900	11	3600	340
Fe/Eq. U	430	2.2	1000	61
Cr/Eq. U	220	0.53	250	140
Zn/Eq. U	43.3	0.41	5.0	1.0
Mn/Eq. U	870	4.7	19	3.5

Actinide results are those determined by ICP-MS and corrected based on the U-238 result with the glass standard. Mass 238 is reported as U-238 and is not corrected for any Pu-238 present. Mass 241 is reported as Pu-241 and not corrected for Am-241 present. Total Pu is calculated as the sum of Pu-239, Pu-240, Pu-241 and Pu-242. Equivalent uranium fissile content (Eq. U) is calculated as the sum of U-233, U-235 and four times the sum of Pu-239 and Pu-241 [ref. 9]. Sodium, iron, chromium, zinc and manganese results are those determined by ICP-ES and corrected for acid blanks and glass standard responses. Weight percent insolubles is the weight percent of the dried solids after removal of water soluble material from the damp as-received salt. Weight ratios were determined by dividing measured metal concentration by the equivalent uranium fissile concentration. bdl = below detection limit

Table IV. Analytical Results for the Water Insoluble Solids in the Tank 38H and Tank 43H VDS Samples.

	HTF-004 Tk 38H VDS		HTF-002 Tank 43H VDS	
	Average (µg/g)	Std. Dev. (µg/g)	Average (µg/g)	Std. Dev. (µg/g)
Total U	38	0.86	410	12
U-233	bdl	-	0.27	0.039
U-234	1.4	0.15	20	0.16
U-235	0.56	0.019	10	0.44
U-236	0.24	0.037	3.8	0.1
U-238	35	0.85	380	12
Total Pu	16	0.64	140	3.5
Pu-238	11	0.52	91	3.7
Pu-239	3.8	0.17	28	0.22
Pu-240	0.64	0.044	4.5	0.055
Pu-241	0.19	0.065	0.00	0.00
Pu-242	0.16	0.066	1.1	0.042
Am-241	0.15	0.011	6.5	0.022
Equiv. U	17	0.80	170	1.3
Na	270000	3900	200000	280
Fe	1600	20	70000	380
Cr	670	9.1	9500	10
Zn	110	2.4	680	2.6
Mn	570	8.6	<1.7	0.00

Weight % Solids

Average	Std. Dev.	Average	Std. Dev.
9.81	-	16.3	-

Weight Ratio

	Average	Std. Dev.	Average	Std. Dev.
Na/Eq. U	16000	1000	1200	10
Fe/Eq. U	98	5.4	420	4.8
Cr/Eq. U	40	2.3	56	0.49
Zn/Eq. U	6.7	0.45	4.1	0.036
Mn/Eq. U	34	2.0	<0.010	0.000079

Actinide results are those determined by ICP-MS and corrected based on the U-238 result with the glass standard. U-238 is difference between mass-238 determined by ICP-MS and Pu-238 determined by alpha spectroscopy. Pu-241 is difference between mass-241 determined by ICP-MS and Am-241 determined by gamma spectroscopy. Total Pu is calculated as the sum of Pu-238, Pu-239, Pu-240, Pu-241 and Pu-242. Equivalent uranium fissile content (Eq. U) is calculated as the sum of U-233, U-235 and four times the sum of Pu-239 and Pu-241 [ref. 9]. Sodium, iron, chromium, zinc and manganese results are those determined by ICP-ES and corrected for acid blanks and glass standard responses. Weight percent insolubles is the weight percent of the dried solids after removal of liquid and water soluble material from the as-received sample (100 times grams dried insoluble solids divided by grams as-received slurry sample). Weight ratios were determined by dividing measured metal concentration by the equivalent uranium fissile concentration. bdl = below detection limit

Appendices 1-5

Complete Analytical Results and Calculated Weight Ratios for

Tank 38H VDS Sample HTF-001
Tank 43H VDS Sample HTF-002
Tank 38H Saltcake Sample HTF-003
Tank 38H VDS Sample HTF-004
Tank 41H Saltcake Sample 41SC0696

The following notes apply to all results reported in the Appendices. Actinide results are those determined by ICP-MS and corrected based on the U-238 result with the glass standard. Unless a Pu-238 result is reported, mass 238 is reported as U-238. Unless an Am-241 result is reported, mass 241 is reported as Pu-241. Total Pu is calculated as the sum of Pu-239, Pu-240, Pu-241 and Pu-242. In selected samples, Pu-238 determined by alpha spectroscopy and Am-241 determined by gamma spectroscopy. For these samples, the U-238 is equal to the mass 238 minus the Pu-238. Pu-241 is mass 241 minus Am-241. Total Pu for these samples calculated as the sum of Pu-238, Pu-239, Pu-240, Pu-241 and Pu-242. Equivalent uranium fissile content (Eq. U) is calculated as the sum of U-233, U-235 and four times the sum of Pu-239 and Pu-241 [ref. 9]. Sodium, iron, chromium, zinc, manganese, boron, lithium, calcium, magnesium, nickel and titanium results are those determined by ICP-ES and corrected for acid blanks and glass standard responses. All other elements determined by ICP-ES are corrected for acid blanks only. Weight percent solids (wt %) were determined by weighing samples before and after drying at 100 °C prior to dissolution in aqua regia. Weight ratios were determined by dividing measured metal concentration by the equivalent uranium fissile concentration.

bdl = below detection limit nd = not determined

Appendix 1.

Complete ICP-ES and ICP-MS Results and Calculated Weight Ratios for Tank 38H VDS Sample HTF-001

Element	Average (µg/g)	Std. Dev. (µg/g)	Solids Fraction Weight Ratio	Average	Std. Dev.
Al	9.8E+03	6.5E+02	Al/Eq. U	2.4E+03	4.5E+01
B	7.5E+01	2.6E+01	B/Eq. U	1.8E+01	5.0E+00
Ba	< 8.1E+00	6.8E-02	Ba/Eq. U	< 2.0E+00	1.9E-01
Ca	3.7E+02	2.8E+01	Ca/Eq. U	9.1E+01	1.2E+00
Cd	< 4.0E+00	3.3E-02	Cd/Eq. U	< 1.0E+00	9.5E-02
Co	< 1.7E+01	1.4E-01	Co/Eq. U	< 4.2E+00	4.0E-01
Cr	7.0E+02	5.3E+01	Cr/Eq. U	1.8E+02	2.1E+00
Cu	< 1.8E+01	1.5E-01	Cu/Eq. U	< 4.6E+00	4.3E-01
Fe	9.0E+02	9.2E+01	Fe/Eq. U	2.2E+02	4.3E+00
La	< 5.7E+01	4.8E-01	La/Eq. U	< 1.4E+01	1.4E+00
Li	< 1.9E+01	1.6E-01	Li/Eq. U	< 4.8E+00	4.5E-01
Mg	3.1E+01	1.8E+00	Mg/Eq. U	7.8E+00	2.3E-01
Mn	2.4E+03	1.7E+02	Mn/Eq. U	6.1E+02	1.0E+01
Mo	< 6.7E+00	5.6E-02	Mo/Eq. U	< 1.7E+00	1.6E-01
Na	3.6E+05	2.6E+04	Na/Eq. U	9.0E+04	1.6E+03
Ni	2.3E+01	2.7E+00	Ni/Eq. U	5.9E+00	1.2E+00
P	2.1E+03	1.5E+02	P/Eq. U	5.3E+02	9.4E+00
Pb	< 1.1E+02	9.1E-01	Pb/Eq. U	< 2.8E+01	2.6E+00
Sn	< 1.9E+01	1.6E-01	Sn/Eq. U	< 4.9E+00	4.6E-01
Sr	< 3.3E+00	2.8E-02	Sr/Eq. U	< 8.4E-01	8.0E-02
Ti	< 1.4E+01	1.2E-01	Ti/Eq. U	< 3.5E+00	3.3E-01
V	< 1.4E+01	1.2E-01	V/Eq. U	< 3.5E+00	3.3E-01
Zn	< 3.7E+01	7.5E+00	Zn/Eq. U	< 9.3E+00	2.0E+00
Zr	< 1.8E+01	1.5E-01	Zr/Eq. U	< 4.5E+00	4.3E-01

Isotope	(µg/g)	(µg/g)
U-233	0.0E+00	0.0E+00
U-234	1.0E+00	9.6E-02
U-235	3.6E-01	3.7E-02
U-236	1.6E-01	2.8E-02
Np-237	4.8E-01	4.0E-02
U-238	2.1E+01	1.2E+00
Pu-238	nd	-
Pu-239	8.6E-01	6.9E-02
Pu-240	1.4E-01	2.4E-02
Pu-241	5.3E-02	8.8E-03
Pu-242	2.1E-02	1.9E-02
Total U	2.2E+01	1.2E+00
% U-235	1.6E+00	1.2E-01
% U-238	9.3E+01	4.6E-01
Total Pu	1.1E+00	9.0E-02
Equiv. Fissile U	4.0E+00	3.4E-01

Appendix 2A.
Complete ICP-ES and ICP-MS Results for Tank 43H VDS Sample HTF-002

	Total Sample		Liquid Fraction		Solids Fraction		Insoluble Solids	
	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Element	(µg/g dried sample)		(µg/g liquid)		(µg/g dried solids)		(µg/g insol. solids)	
Al	2.1E+04	7.8E+02	9.9E+03	1.6E+03	1.2E+04	9.2E+01	3.6E+04	9.6E+01
B	1.9E+02	1.8E+01	6.6E+01	2.6E+01	6.7E+02	6.4E+00	7.8E+02	5.0E+00
Ba	2.4E+03	4.1E+03	< 5.2E+00	7.1E-01	9.3E+01	1.4E+00	3.2E+02	2.1E+00
Ca	1.3E+04	5.0E+02	3.2E+00	3.6E+00	1.7E+04	8.7E+01	< 1.0E+00	0.0E+00
Cd	2.1E+01	1.9E+00	< 2.5E+00	3.6E-01	2.0E+01	1.7E+00	7.2E+01	1.1E+00
Co	2.2E+01	3.3E+00	< 1.1E+01	1.5E+00	< 7.8E+00	0.0E+00	3.7E+01	2.0E+00
Cr	5.5E+03	2.1E+02	5.8E+02	8.7E+01	5.9E+03	3.6E+01	9.5E+03	1.0E+01
Cu	7.3E+01	6.7E+00	< 1.2E+01	1.7E+00	4.7E+01	1.9E+00	1.9E+02	3.9E+00
Fe	1.9E+04	6.4E+02	1.6E+01	4.4E+00	2.2E+04	1.6E+02	7.0E+04	3.8E+02
La	< 2.0E+01	1.2E+00	< 3.7E+01	5.2E+00	< 2.7E+01	0.0E+00	< 3.4E+01	0.0E+00
Li	7.8E+01	7.4E+00	< 1.1E+01	1.7E+00	6.7E+01	8.1E-01	2.7E+02	2.4E+00
Mg	1.0E+03	4.0E+01	9.8E-01	9.1E-03	1.2E+03	6.9E+00	3.8E+03	1.3E+01
Mn	1.5E+04	5.9E+02	2.0E+01	1.5E+01	1.7E+04	8.5E+01	< 1.7E+00	0.0E+00
Mo	6.4E+01	4.1E+00	2.1E+01	1.2E+00	2.7E+01	1.2E+00	2.2E+01	2.1E+00
Na	3.3E+05	1.2E+04	1.8E+05	3.0E+04	2.2E+05	1.2E+03	2.0E+05	2.8E+02
Ni	1.6E+03	6.0E+01	< 1.3E+01	1.9E+00	1.8E+03	1.7E+01	6.0E+03	2.1E+01
P	4.1E+03	1.8E+02	5.3E+02	4.7E+01	3.9E+03	9.0E+01	1.3E+04	2.9E+01
Pb	1.6E+02	1.3E+01	< 7.0E+01	9.8E+00	8.8E+01	2.0E+01	3.1E+02	1.9E+01
Sn	2.2E+01	1.4E+00	< 1.2E+01	1.7E+00	9.2E+00	3.4E-01	2.8E+03	1.1E+03
Sr	4.9E+01	2.3E+00	< 2.1E+00	2.7E-01	5.3E+01	5.6E-01	1.6E+02	9.4E-01
Ti	6.9E+01	8.1E+00	< 8.1E+00	1.2E+00	5.5E+01	1.6E+00	3.8E+02	7.6E+01
V	2.3E+01	4.6E+00	< 8.9E+00	1.3E+00	< 6.5E+00	8.4E-08	< 8.4E+00	0.0E+00
Zn	1.6E+02	1.3E+01	4.6E+01	6.5E+00	1.7E+02	7.6E-01	6.8E+02	2.6E+00
Zr	1.8E+01	6.0E+00	< 1.1E+01	1.6E+00	< 8.4E+00	0.0E+00	< 1.1E+01	0.0E+00
Isotope								
U-233	0.0E+00	0.0E+00	7.4E-03	1.3E-02	8.0E-02	1.0E-02	2.7E-01	3.9E-02
U-234	6.5E+00	3.0E-01	5.5E-01	1.0E-01	8.3E+00	1.5E-01	2.0E+01	1.6E-01
U-235	3.2E+00	2.1E-01	4.4E-01	7.0E-02	3.9E+00	1.2E-01	1.0E+01	4.4E-01
U-236	1.2E+00	6.7E-02	1.8E-01	3.2E-02	1.5E+00	5.1E-02	3.8E+00	1.0E-01
Np-237	1.3E+01	2.1E-01	2.7E-01	3.6E-02	1.6E+01	5.7E-01	4.9E+01	1.1E-01
U-238	1.1E+02	1.4E+00	3.8E+00	6.1E-01	1.2E+02	2.6E+00	3.8E+02	1.2E+01
Pu-238	nd	-	nd	-	nd	-	9.1E+01	3.7E+00
Pu-239	7.0E+00	8.2E-01	0.0E+00	0.0E+00	6.5E+00	2.4E-01	2.8E+01	2.2E-01
Pu-240	1.1E+00	6.6E-02	0.0E+00	0.0E+00	8.8E-01	5.7E-02	4.5E+00	5.5E-02
Pu-241	1.4E+00	8.7E-02	0.0E+00	0.0E+00	7.8E-01	8.4E-02	0.0E+00	0.0E+00
Am-241	nd	-	nd	-	nd	-	1.5E+00	1.1E-02
Pu-242	2.5E-01	8.0E-02	0.0E+00	0.0E+00	1.8E-01	1.2E-02	1.1E+00	4.2E-02
Total U	1.2E+02	1.9E+00	5.0E+00	7.0E-01	1.4E+02	2.9E+00	4.1E+02	1.2E+01
% U-235	2.7E+00	1.4E-01	8.9E+00	1.5E+00	2.8E+00	3.1E-02	2.4E+00	3.4E-02
% U-238	9.1E+01	3.4E-01	7.6E+01	3.5E+00	9.0E+01	4.2E-02	9.2E+01	8.6E-02
Total Pu	9.7E+00	8.4E-01	0.0E+00	0.0E+00	8.3E+00	3.6E-01	1.4E+02	3.5E+00
Eq. U	3.7E+01	3.4E+00	4.5E-01	8.3E-02	3.3E+01	1.3E+00	1.7E+02	1.3E+00
Cs-137	nd	-	nd	-	nd	-	3.8E+00	1.2E-01
Eu-154	nd	-	nd	-	nd	-	2.6E-03	7.9E-04

Appendix 2B.

Calculated Weight Ratios for Tank 38H VDS Sample HTF-002

	Total Sample		Liquid Fraction		Solids Fraction		Insoluble Solids	
	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Weight Ratio	(µg/g dried sample)		(µg/g liquid)		(µg/g dried solids)		(µg/g insol. solids)	
Al/Eq. U	5.9E+02	6.1E+01	2.2E+04	9.1E+02	3.8E+02	1.3E+01	2.1E+02	2.0E+00
B/Eq. U	5.2E+00	5.5E-01	1.5E+02	3.5E+01	2.0E+01	1.0E+00	4.6E+00	6.2E-02
Ba/Eq. U	7.0E+01	1.2E+02	< 1.2E+01	3.5E+00	2.8E+00	9.2E-02	1.9E+00	2.4E-02
Ca/Eq. U	3.7E+02	3.9E+01	6.4E+00	6.2E+00	5.2E+02	1.9E+01	< 6.2E-03	4.9E-05
Cd/Eq. U	5.9E-01	9.2E-02	< 5.9E+00	1.7E+00	6.1E-01	2.5E-02	4.3E-01	9.6E-03
Co/Eq. U	6.2E-01	1.3E-01	< 2.5E+01	7.1E+00	< 2.4E-01	9.5E-03	2.2E-01	1.3E-02
Cr/Eq. U	1.5E+02	1.6E+01	1.3E+03	6.3E+01	1.8E+02	6.2E+00	5.6E+01	4.9E-01
Cu/Eq. U	2.0E+00	3.4E-01	< 2.7E+01	7.9E+00	1.4E+00	3.4E-02	1.1E+00	3.0E-02
Fe/Eq. U	5.2E+02	5.2E+01	3.5E+01	7.3E+00	6.6E+02	2.2E+01	4.1E+02	4.8E+00
La/Eq. U	< 5.6E-01	7.8E-02	< 8.5E+01	2.5E+01	< 8.1E-01	3.3E-02	< 2.0E-01	1.6E-03
Li/Eq. U	2.2E+00	3.5E-01	< 2.6E+01	7.8E+00	2.0E+00	9.0E-02	1.6E+00	2.1E-02
Mg/Eq. U	2.9E+01	2.9E+00	2.2E+00	4.0E-01	3.6E+01	1.3E+00	2.3E+01	2.4E-01
Mn/Eq. U	4.2E+02	4.4E+01	4.2E+01	2.3E+01	5.2E+02	1.9E+01	< 1.0E-02	7.9E-05
Mo/Eq. U	1.8E+00	2.4E-01	4.8E+01	5.8E+00	8.1E-01	2.5E-02	1.3E-01	1.2E-02
Na/Eq. U	9.1E+03	9.4E+02	4.1E+05	1.7E+04	6.5E+03	2.3E+02	1.2E+03	1.0E+01
Ni/Eq. U	4.5E+01	4.8E+00	< 2.9E+01	8.8E+00	5.6E+01	1.8E+00	3.6E+01	3.7E-01
P/Eq. U	1.1E+02	1.1E+01	1.2E+03	2.3E+02	1.2E+02	3.0E+00	7.6E+01	7.1E-01
Pb/Eq. U	4.4E+00	7.2E-01	< 1.6E+02	4.7E+01	2.6E+00	5.7E-01	1.9E+00	1.2E-01
Sn/Eq. U	6.0E-01	8.9E-02	< 2.9E+01	8.3E+00	2.8E-01	1.5E-02	1.7E+01	6.6E+00
Sr/Eq. U	1.4E+00	1.6E-01	< 4.9E+00	1.4E+00	1.6E+00	5.0E-02	9.7E-01	1.2E-02
Ti/Eq. U	1.9E+00	3.4E-01	< 1.9E+01	5.5E+00	1.7E+00	3.0E-02	2.2E+00	4.6E-01
V/Eq. U	6.3E-01	1.7E-01	< 2.1E+01	6.1E+00	< 2.0E-01	8.0E-03	< 5.0E-02	3.9E-04
Zn/Eq. U	4.6E+00	6.9E-01	1.0E+02	5.7E+00	5.3E+00	1.9E-01	4.1E+00	3.6E-02
Zr/Eq. U	5.1E-01	2.0E-01	< 2.7E+01	7.8E+00	< 2.5E-01	1.0E-02	< 6.4E-02	5.0E-04

Appendix 3A.

Complete ICP-ES and ICP-MS Results for Tank 38H Saltcake Sample HTF-003

	Total Sample		Soluble Salt		Insoluble Solids	
	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Element	(µg/g dried sample)		(µg/g salt)		(µg/g insol. solids)	
Al	2.1E+03	4.0E+02	2.5E+03	7.7E+01	1.5E+04	6.7E+02
B	<5.0E+01	3.1E+00	< 1.7E+01	6.0E+00	<3.6E+02	0.0E+00
Ba	<7.8E+00	3.6E-01	< 3.6E+00	1.8E+00	<5.7E+01	0.0E+00
Ca	5.4E+01	8.0E+00	< 4.8E-01	1.1E-03	1.0E+04	3.2E+02
Cd	<3.8E+00	1.8E-01	< 1.2E+00	1.4E-01	<2.8E+01	0.0E+00
Co	<1.6E+01	7.4E-01	< 5.0E+00	1.6E-01	<1.2E+02	0.0E+00
Cr	1.2E+02	2.3E+01	4.9E+01	5.0E+00	1.4E+04	4.2E+02
Cu	<1.7E+01	8.1E-01	< 6.9E+00	2.3E+00	1.8E+02	0.0E+00
Fe	2.6E+02	1.0E+02	< 4.2E+00	1.1E+00	2.7E+04	8.9E+02
La	<5.5E+01	2.5E+00	< 1.9E+01	3.1E+00	<4.0E+02	0.0E+00
Li	<1.8E+01	8.6E-01	< 7.4E+00	3.4E+00	<1.3E+02	0.0E+00
Mg	1.3E+01	1.3E+00	< 4.4E-01	4.7E-02	2.3E+03	7.7E+01
Mn	3.7E+02	4.4E+01	< 1.6E+00	1.8E+00	5.6E+04	1.8E+03
Mo	<6.4E+00	3.0E-01	< 4.2E+00	3.2E+00	<4.7E+01	0.0E+00
Na	3.0E+05	9.1E+03	3.4E+05	8.0E+03	1.8E+05	5.7E+03
Ni	<2.0E+01	9.8E-01	< 7.0E+00	1.8E+00	7.9E+02	2.8E+01
P	1.9E+02	3.3E+01	2.4E+02	9.4E+00	5.7E+02	6.0E+01
Pb	<1.0E+02	4.9E+00	< 3.2E+01	6.4E-01	<7.7E+02	0.0E+00
Sn	<1.9E+01	8.6E-01	< 7.8E+00	3.3E+00	<1.4E+02	0.0E+00
Sr	<3.2E+00	1.5E-01	< 1.5E+00	7.5E-01	<2.4E+01	0.0E+00
Ti	<1.3E+01	6.1E-01	< 4.9E+00	1.7E+00	<9.8E+01	0.0E+00
V	<1.3E+01	6.2E-01	< 5.9E+00	2.7E+00	<9.9E+01	0.0E+00
Zn	1.9E+01	4.5E+00	2.6E+00	5.0E-01	2.1E+02	3.2E+01
Zr	<1.7E+01	8.0E-01	< 7.6E+00	3.4E+00	<1.3E+02	0.0E+00
Isotope						
U-233	0.0E+00	0.0E+00	1.4E-03	2.0E-03	5.7E-02	8.0E-02
U-234	3.0E-01	2.8E-02	2.6E-01	7.5E-03	8.3E+00	8.0E-02
U-235	1.1E-01	4.6E-03	8.8E-02	4.6E-03	3.1E+00	8.0E-02
U-236	5.0E-02	1.7E-02	3.4E-02	3.2E-03	1.2E+00	0.0E+00
Np-237	1.0E-01	1.4E-02	5.8E-02	8.8E-03	2.4E+00	8.0E-02
U-238	3.4E+00	8.4E-02	2.0E+00	4.4E-02	1.7E+02	3.3E+00
Pu-238	nd	-	nd	-	nd	-
Pu-239	7.8E-01	9.2E-02	9.4E-03	0.00E+00	1.5E+01	4.0E-01
Pu-240	5.9E-02	2.1E-02	0.0E+00	0.0E+00	2.0E+00	8.0E-02
Pu-241	8.0E-03	3.2E-03	0.0E+00	0.0E+00	6.8E-01	0.0E+00
Pu-242	4.1E-03	3.5E-03	0.0E+00	0.0E+00	3.4E-01	0.0E+00
Total U	3.9E+00	1.1E-01	2.4E+00	3.7E-02	1.8E+02	3.5E+00
% U-235	2.9E+00	7.4E-02	3.6E+00	2.5E-01	1.7E+00	1.1E-02
% U-238	8.8E+01	1.0E+00	8.4E+01	5.4E-01	9.3E+01	4.1E-03
Total Pu	8.5E-01	1.1E-01	9.4E-03	0.0E+00	1.8E+01	3.2E-01
Eq. U	3.3E+00	3.6E-01	1.3E-01	2.7E-03	6.4E+01	1.8E+00

Appendix 3B.

Calculated Weight Ratios for Tank 38H Saltcake Sample HTF-003

	Total Sample		Soluble Salt		Insoluble Solids	
Weight Ratio	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Al/Eq. U	6.8E+02	1.5E+02	2.5E+04	1.8E+03	2.4E+02	4.0E+00
B/Eq. U	<1.6E+01	1.6E+00	< 1.7E+02	7.2E+01	<5.6E+00	1.5E-01
Ba/Eq. U	<2.5E+00	2.5E-01	< 3.7E+01	2.1E+01	<9.0E-01	2.5E-02
Ca/Eq. U	1.8E+01	4.5E+00	< 4.6E+00	1.6E-01	1.6E+02	6.6E-01
Cd/Eq. U	<1.2E+00	1.2E-01	< 1.2E+01	1.9E+00	<4.4E-01	1.2E-02
Co/Eq. U	<5.1E+00	5.0E-01	< 4.8E+01	3.5E+00	<1.8E+00	5.1E-02
Cr/Eq. U	3.9E+01	8.3E+00	4.8E+02	7.2E+01	2.2E+02	5.3E-01
Cu/Eq. U	<5.5E+00	5.5E-01	< 6.9E+01	2.7E+01	2.7E+00	7.5E-02
Fe/Eq. U	8.3E+01	2.9E+01	< 4.1E+01	1.3E+01	4.3E+02	2.2E+00
La/Eq. U	<1.7E+01	1.7E+00	< 1.8E+02	4.0E+01	<6.3E+00	1.7E-01
Li/Eq. U	<5.8E+00	5.6E-01	< 7.5E+01	3.9E+01	<2.1E+00	5.7E-02
Mg/Eq. U	4.3E+00	7.9E-01	< 4.3E+00	6.7E-01	3.6E+01	2.0E-01
Mn/Eq. U	1.2E+02	2.2E+01	< 1.7E+01	1.3E+01	8.7E+02	4.7E+00
Mo/Eq. U	<2.0E+00	2.0E-01	< 4.4E+01	3.7E+01	<7.4E-01	2.0E-02
Na/Eq. U	9.7E+04	1.4E+04	3.2E+06	2.6E+04	2.9E+03	1.1E+01
Ni/Eq. U	<6.5E+00	6.2E-01	< 6.9E+01	2.3E+01	1.2E+01	7.7E-01
P/Eq. U	6.3E+01	1.8E+01	2.4E+03	1.9E+02	8.9E+00	1.2E+00
Pb/Eq. U	<3.3E+01	3.3E+00	< 3.1E+02	1.8E+01	<1.2E+01	3.3E-01
Sn/Eq. U	<5.9E+00	5.9E-01	< 7.9E+01	3.7E+01	<2.1E+00	5.9E-02
Sr/Eq. U	<1.0E+00	1.0E-01	< 1.5E+01	8.7E+00	<3.7E-01	1.0E-02
Ti/Eq. U	<4.2E+00	4.2E-01	< 4.8E+01	2.0E+01	<1.5E+00	4.2E-02
V/Eq. U	<4.3E+00	4.2E-01	< 6.0E+01	3.1E+01	<1.5E+00	4.2E-02
Zn/Eq. U	6.1E+00	9.2E-01	2.6E+01	6.0E+00	3.3E+00	4.1E-01
Zr/Eq. U	<5.5E+00	5.4E-01	< 7.7E+01	4.0E+01	<2.0E+00	5.4E-02

Apprendix 4A.
Complete ICP-ES and ICP-MS Results for Tank 38H VDS Sample HTF-004

Element	Total Sample Average (µg/g dried sample)	Total Sample Std. Dev.	Liquid Fraction Average (µg/g liquid)	Liquid Fraction Std. Dev.	Solids Fraction Average (µg/g dried solids)	Solids Fraction Std. Dev.	Insoluble Solids Average (µg/g insol. solids)	Insoluble Solids Std. Dev.
Al	1.4E+04	2.4E+03	9.2E+03	3.6E+02	8.4E+03	1.6E+02	4.5E+04	6.1E+02
B	< 7.8E+01	1.9E+00	6.6E+01	2.0E+01	6.9E+02	1.4E+01	6.9E+02	9.0E+00
Ba	< 1.3E+01	1.3E+00	< 4.4E+00	1.4E+00	< 4.0E+00	0.0E+00	< 4.0E+00	0.0E+00
Ca	2.5E+02	4.0E+01	5.5E+00	7.7E+00	4.6E+02	1.1E+01	2.5E+03	3.3E+01
Cd	< 6.3E+00	6.5E-01	< 2.0E+00	8.9E-01	< 2.0E+00	0.0E+00	< 1.9E+00	3.0E-08
Co	< 2.7E+01	2.7E+00	< 8.0E+00	4.5E+00	< 8.3E+00	0.0E+00	< 8.2E+00	1.2E-07
Cr	4.0E+02	6.6E+01	1.8E+02	4.6E+00	4.1E+02	5.1E+00	6.7E+02	9.1E+00
Cu	< 2.9E+01	3.0E+00	< 1.1E+01	1.2E+00	< 9.0E+00	0.0E+00	< 8.9E+00	0.0E+00
Fe	2.3E+02	2.9E+01	2.3E+01	4.2E+00	4.7E+02	9.5E+00	1.6E+03	2.0E+01
La	< 9.2E+01	9.4E+00	< 2.7E+01	1.6E+01	< 2.8E+01	0.0E+00	< 2.8E+01	4.8E-07
Li	< 2.9E+01	2.9E+00	< 9.5E+00	3.1E+00	< 9.0E+00	0.0E+00	< 8.7E+00	0.0E+00
Mg	2.2E+01	3.6E+00	< 7.7E-01	2.4E-01	4.3E+01	9.1E-01	1.5E+02	2.2E+00
Mn	9.4E+01	1.6E+01	1.6E+01	1.2E+00	1.7E+02	5.1E+00	5.7E+02	8.5E+00
Mo	2.2E+01	8.6E+00	2.5E+01	4.1E+00	1.6E+01	2.3E+00	9.9E+00	4.7E-01
Na	3.5E+05	5.5E+04	2.1E+05	2.9E+03	2.6E+05	4.9E+03	2.7E+05	3.9E+03
Ni	4.2E+01	9.9E+00	< 1.0E+01	4.0E+00	4.8E+01	5.5E+00	2.4E+02	4.5E+00
P	1.5E+03	3.4E+02	7.2E+02	7.3E+01	1.4E+03	3.0E+01	3.7E+02	2.7E+00
Pb	< 1.8E+02	1.8E+01	< 5.9E+01	2.0E+01	< 5.4E+01	0.0E+00	< 5.4E+01	9.5E-07
Sn	< 3.1E+01	3.2E+00	< 1.1E+01	2.8E+00	< 9.6E+00	0.0E+00	3.5E+03	1.0E+03
Sr	< 5.2E+00	5.4E-01	< 1.7E+00	6.4E-01	< 1.7E+00	0.0E+00	< 1.6E+00	0.0E+00
Ti	< 1.9E+01	2.0E+00	< 6.4E+00	2.9E+00	< 6.4E+00	8.4E-08	< 9.6E+00	1.7E-07
V	< 2.5E+01	1.5E+00	< 7.5E+00	2.6E+00	< 6.9E+00	0.0E+00	< 6.8E+00	0.0E+00
Zn	2.2E+01	1.2E+01	2.0E+01	2.0E+00	6.4E+00	2.1E+00	1.1E+02	2.3E+00
Zr	< 2.9E+01	3.0E+00	< 9.4E+00	3.7E+00	< 8.9E+00	0.0E+00	1.2E+01	1.7E+00
Isotope								
U-233	0.0E+00	0.0E+00	6.6E-03	5.8E-03	1.1E-02	1.8E-02	0.0E+00	0.0E+00
U-234	1.7E+00	2.8E-01	9.7E-01	1.2E-01	1.5E+00	4.0E-02	1.4E+00	1.5E-01
U-235	5.7E-01	1.4E-01	3.2E-01	4.0E-02	5.4E-01	1.6E-02	5.6E-01	1.9E-02
U-236	2.1E-01	2.7E-02	1.2E-01	1.1E-02	2.0E-01	2.7E-02	2.4E-01	3.7E-02
Np-237	5.0E-01	1.2E-01	2.9E-01	6.8E-02	4.8E-01	3.7E-02	1.6E+00	1.2E-01
U-238	1.2E+01	2.4E+00	4.2E+00	5.7E-01	1.8E+01	2.4E-01	3.5E+01	8.5E-01
Pu-238	nd	-	nd	-	nd	-	1.1E+01	5.2E-01
Pu-239	3.8E-01	7.5E-02	1.7E-02	1.9E-02	7.0E-01	1.6E-02	3.8E+00	1.7E-01
Pu-240	0.0E+00	0.0E+00	2.9E-03	2.5E-03	9.2E-02	1.2E-02	6.4E-01	4.4E-02
Pu-241	0.0E+00	0.0E+00	1.4E-03	1.3E-03	3.6E-02	6.2E-03	1.9E-01	6.5E-02
Am-241	nd	-	nd	-	nd	-	6.5E+00	2.2E-02
Pu-242	0.0E+00	0.0E+00	4.4E-04	7.6E-04	0.0E+00	0.0E+00	1.6E-01	6.6E-02
Total U	1.5E+01	2.8E+00	5.6E+00	7.2E-01	2.0E+01	3.1E-01	3.8E+01	8.6E-01
% U-235	3.9E+00	2.2E-01	5.7E+00	3.3E-01	2.7E+00	6.0E-02	1.5E+00	7.3E-02
% U-238	8.3E+01	3.4E-01	7.5E+01	1.1E+00	8.9E+01	1.9E-01	9.4E+01	3.6E-01
Total Pu	3.8E-01	7.5E-02	2.2E-02	2.3E-02	8.3E-01	3.3E-02	1.6E+01	6.4E-01
Eq. U	2.1E+00	4.4E-01	4.0E-01	9.4E-02	3.5E+00	1.0E-01	1.7E+01	8.0E-01
Cs-137	nd	-	nd	-	nd	-	4.1E+00	3.2E-02
Eu-154	nd	-	nd	-	nd	-	3.2E-04	2.8E-04

Appendix 5A.
Complete ICP-ES and ICP-MS Results for Tank 41H Saltcake Sample ITP-309 (41SC0696)

	Total Sample		Soluble Salt		Insoluble Solids	
	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Element	(µg/g dried sample)		(µg/g salt)		(µg/g insol. solids)	
Al	3.7E+03	1.5E+02	2.7+03	5.3E+01	1.2E+03	1.1E+03
B	< 4.8E+01	7.3E-01	< 1.3E+01	8.5E-01	< 1.7E+02	3.4E+01
Ba	< 7.8E+00	1.2E-01	< 3.5E+00	8.5E-01	< 2.8E+01	5.5E+00
Ca	1.8E+02	2.5E+02	1.9E+01	1.2E+00	8.2E+02	3.5E+02
Cd	< 3.8E+00	5.7E-02	< 1.2E+00	8.7E-02	< 1.4E+01	2.7E+00
Co	< 1.6E+01	2.4E-01	< 5.2E+00	3.7E-01	< 5.7E+01	1.1E+01
Cr	2.5E+03	8.2E+01	8.6E+02	9.6E+01	8.2E+03	6.7E+03
Cu	< 1.7E+01	2.6E-01	< 6.3E+00	4.0E-01	< 6.2E+01	1.2E+01
Fe	6.0E+03	5.3E+03	4.6E+01	1.3E+01	3.0E+04	1.2E+04
La	< 5.5E+01	8.3E-01	< 1.8E+01	3.8E-01	< 2.0E+02	3.9E+01
Li	< 1.8E+01	2.8E-01	< 5.8E+00	4.1E-01	< 6.5E+01	1.3E+01
Mg	3.5E+01	1.8E+01	< 5.7E-01	1.4E-01	4.5E+02	2.5E+02
Mn	2.4E+02	3.2E+02	< 1.2E+00	3.7E-01	5.7E+02	3.0E+02
Mo	3.6E+01	2.6E+00	4.2E+01	7.8E+00	< 2.3E+01	4.5E+00
Na	4.0E+05	1.6E+04	3.0E+05	5.9E+03	1.0E+05	2.8E+04
Ni	6.0E+01	2.7E+01	< 6.1E+00	4.5E-01	1.5E+02	1.1E+02
P	9.2E+03	1.2E+03	5.4E+03	4.7E+01	1.8E+04	1.3E+04
Pb	< 1.0E+02	1.6E+00	< 2.5E+01	2.4E+00	< 3.7E+02	7.4E+01
Sn	< 1.9E+01	2.8E-01	< 1.0E+01	5.0E+00	< 6.6E+01	1.3E+01
Sr	< 3.2E+00	4.8E-02	< 1.4E+00	3.4E-01	< 1.1E+01	2.3E+00
Ti	< 1.3E+01	2.0E-01	< 4.0E+00	2.8E-01	7.7E+01	5.2E+01
V	< 1.3E+01	2.0E-01	< 5.7E+00	1.4E+00	< 4.8E+01	9.5E+00
Zn	2.6E+01	1.3E+01	< 3.4E+00	3.8E+00	1.4E+02	2.6E+01
Zr	< 1.7E+01	2.6E-01	< 5.8E+00	4.0E-01	< 6.1E+01	1.2E+01
Isotope						
U-233	5.6E-02	1.2E-02	2.2E-02	1.3E-03	9.8E-01	4.4E-01
U-234	6.8E-01	7.7E-02	1.7E-01	2.2E-03	9.0E+00	3.0E+00
U-235	1.7E+00	2.6E-01	4.3E-01	5.1E-03	2.3E+01	7.6E+00
U-236	8.3E-01	1.2E-01	1.8E-01	1.3E-02	9.9E+00	3.4E+00
Np-237	4.2E+00	1.2E+00	2.0E-01	1.4E-03	6.7E+00	2.0E+00
U-238	3.6E+01	1.3E+01	3.3E+00	1.4E-01	1.9E+02	6.3E+01
Pu-238	nd	-	nd	-	nd	-
Pu-239	1.0E+01	4.3E+00	1.9E-02	6.9E-03	1.2E+00	5.7E-01
Pu-240	1.3E-01	4.0E-02	3.0E-03	4.3E-03	1.8E-01	7.7E-02
Pu-241	1.8E-02	6.3E-03	0.0E+00	0.0E+00	9.0E-02	7.7E-02
Pu-242	1.4E-02	9.5E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Total U	3.9E+01	1.4E+01	4.1E+00	1.5E-01	2.4E+02	7.7E+01
% U-235	4.6E+00	1.0E+00	1.0E+01	5.0E-01	1.0E+01	6.9E-02
% U-238	9.1E+01	2.0E+00	8.0E+01	6.0E-01	8.2E+01	5.4E-02
Total Pu	1.1E+01	4.3E+00	2.2E-02	1.1E-02	1.5E+00	7.3E-01
Eq. U	4.4E+01	1.7E+01	5.3E-01	2.1E-02	3.0E+01	1.1E+01

Appendix 5B.

Calculated Weight Ratios for Tank 41H Saltcake Sample ITP-309 (41SC0696

	Total Sample		Dissolved Salt		Insoluble Solids	
Weight Ratio	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Al/Eq. U	9.3E+01	3.3E+01	5.1E+03	8.0E+01	3.6E+01	2.5E+01
B/Eq. U	<1.2E+00	4.1E-01	< 2.5E+01	7.0E-01	<6.0E+00	1.0E+00
Ba/Eq. U	<2.0E-01	6.7E-02	< 6.7E+00	1.8E+00	<9.7E-01	1.6E-01
Ca/Eq. U	5.4E+00	8.0E+00	3.6E+01	3.5E+00	2.7E+01	2.2E+00
Cd/Eq. U	<9.6E-02	3.2E-02	< 2.2E+00	8.5E-02	<4.7E-01	8.0E-02
Co/Eq. U	<4.0E-01	1.4E-01	< 1.0E+01	3.6E-01	<2.0E+00	3.4E-01
Cr/Eq. U	6.3E+01	2.0E+01	1.6E+03	1.2E+02	2.5E+02	1.4E+02
Cu/Eq. U	<4.4E-01	1.5E-01	< 1.2E+01	3.9E-01	<2.2E+00	3.6E-01
Fe/Eq. U	1.7E+02	1.8E+02	8.8E+01	2.8E+01	1.0E+03	6.1E+01
La/Eq. U	<1.4E+00	4.7E-01	< 3.3E+01	2.0E+00	<6.9E+00	1.2E+00
Li/Eq. U	<4.6E-01	1.6E-01	< 1.1E+01	4.2E-01	<2.3E+00	3.8E-01
Mg/Eq. U	9.1E-01	6.9E-01	< 1.1E+00	3.1E-01	1.5E+01	3.3E+00
Mn/Eq. U	7.2E+00	1.0E+01	< 2.2E+00	7.7E-01	1.9E+01	3.5E+00
Mo/Eq. U	9.1E-01	3.4E-01	8.0E+01	1.7E+01	<8.0E-01	1.3E-01
Na/Eq. U	1.0E+04	3.1E+03	5.8E+05	9.6E+03	3.6E+03	3.4E+02
Ni/Eq. U	1.6E+00	1.1E+00	< 1.2E+01	4.6E-01	4.7E+00	2.2E+00
P/Eq. U	2.3E+02	5.2E+01	1.0E+04	4.6E+02	5.8E+02	2.2E+02
Pb/Eq. U	<2.6E+00	8.9E-01	< 4.6E+01	2.3E+00	<1.3E+01	2.2E+00
Sn/Eq. U	<4.7E-01	1.6E-01	< 2.0E+01	1.0E+01	<2.3E+00	3.9E-01
Sr/Eq. U	<8.1E-02	2.7E-02	< 2.8E+00	7.3E-01	<4.0E-01	6.7E-02
Ti/Eq. U	<3.3E-01	1.1E-01	< 7.6E+00	2.7E-01	2.5E+00	8.8E-01
V/Eq. U	<3.4E-01	1.1E-01	< 1.1E+01	3.1E+00	<1.7E+00	2.8E-01
Zn/Eq. U	7.0E-01	5.3E-01	< 6.6E+00	7.4E+00	5.0E+00	9.7E-01
Zr/Eq. U	<4.3E-01	1.5E-01	< 1.1E+01	3.9E-01	<2.1E+00	3.6E-01

cc: T. Monahon, 703-H
V. Dickert, 703-H
B. L. Lewis, 703-H
M. C. Chandler, 703-H
R. L. Boyleston, 706-23C
R. H. Ross, 703-H
J. R. Hester, 703-H
M. E. Jamison, 703-H
G. A. Taylor, 703-H
M. D. Johnson, 704-56H
J. E. Marra, 704-56H
A. W. Wiggins, 241-152H
M. S. Miller, 704-56H
P. L. Rutland, 241-152H
J. N. Brooke, 719-4A
J. A. Pike, 707-H
D. E. Lott, 241-197H
T. K. Bragg, 241-197H
A. L. Blancett, 773-A
K. Andringa, 773-41A
P. L. Cloesner, 773-A
J. C. Griffin, 773-A
C. J. Coleman, 773-A
M. A. Polochko, 773-A
P. E. Lowe, 773-41A
L. M. Nelson, 773-43A
G. T. Wright, 773-A
L. M. Papauchado, 773-A
W. L. Tamosaitis, 773-A
W. E. Stevens, 773-A
S. D. Fink, 773-A
W. B. Van-Pelt, 676-T
M. C. Thompson, 773-A
D. D. Walker, 773-A
M. J. Barnes, 773-A
M. S. Hay, 773-A
M. Poirier, 676-T
N. E. Bibler, 773-A
B. J. Wiersma, 773-A
W. R. Wilmarth, 773-42A
SRTC/LWP Files c/o A. Patterson, 773-A
ITP Files, c/o A. Lennay, 241-121H

For file room

File Code: 301.0