Cesium Removal from Tanks 241-AN-103, -SX-105, and -AZ-101/102 Composite for Testing in Bench Scale Steam Reformer

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Abbreviations

BSR	Bench-Scale Reformer
BV	Bed Volume
DF	Decontamination Factor
Deionized	DI
EDS	Energy Dispersive Spectra
FBSR	Fluidized Bed Steam Reformer
HTWOS	Hanford Tank Waste Operations Simulator
SEM	Scanning Electron Microscopy
SRNL	Savannah River National Laboratory
TWINS	Tank Waste Information Network System
WRPS	Washington River Protection Solutions, LLC
AN-103	Tank 241-AN-103
SX-105	Tank 241-SX-105
AZ-101/102	Composite of tanks 241-AZ-101 and 241-AZ-102

Units

cm	Centimeter
g	Gram
L	Liter
M	moles/liter (mol/L)
mL	Milliliter
mol	Number of moles
µg	Microgram
[X]	mol/L of X

1.0 INTRODUCTION

This report documents the preparation of three actual Hanford tank waste samples for shipment to the Savannah River National Laboratory (SRNL). Two of the samples were dissolved saltcakes from tank 241-AN-103 (hereafter AN-103) and tank 241-SX-105 (hereafter SX-105); one sample was a supernate composite from tanks 241-AZ-101 and 241-AZ-102 (hereafter AZ-101/102). The preparation of the samples was executed following the test plans LAB-PLAN-10-00006, *Test Plan for the Preparation of Samples from Hanford Tanks 241-SX-105, 241-AN-103, 241-AN-107*, and LAB-PLN-10-00014, *Test Plan for the Preparation of a Composite Sample from Hanford Tanks 241-AZ-101 and 241-AZ-102 for Steam Reformer Testing at the Savannah River National Laboratory*. All procedural steps were recorded in laboratory notebook HNF-N-274 3. Sample breakdown diagrams for AN-103 and SX-105 are presented in Appendix A.

The tank samples were prepared in support of a series of treatability studies of the Fluidized Bed Steam Reforming (FBSR) process using a Bench-Scale Reformer (BSR) at SRNL. Tests with simulants have shown that the FBSR mineralized waste form is comparable to low-activity waste glass with respect to environmental durability (WSRC-STI-2008-00268, *Mineralization of Radioactive Wastes by Fluidized Bed Steam Reforming (FBSR): Comparisons to Vitreous Waste Forms and Pertinent Durability Testing).* However, a rigorous assessment requires long-term performance data from FBSR product formed from actual Hanford tank waste. Washington River Protection Solutions, LLC (WRPS) has initiated a Waste Form Qualification Program (WP-5.2.1-2010-001, *Fluidized Bed Steam Reformer Low-level Waste Form Qualification*) to gather the data required to demonstrate that an adequate FBSR mineralized waste form can be produced.

The documentation of the selection process of the three tank samples has been separately reported in RPP-48824, *Sample Selection Process for Bench-Scale Steam Reforming Treatability Studies Using Hanford Waste Samples*.

2.0 SAMPLE PREPARATION

2.1 SALT CAKE DISSOLUTION (AN-103 and SX-105)

The amount of each core solubilized for sample preparation was based on a calculated target of 5.5 moles of sodium, using the Tank Waste Information Network System (TWINS) data for each respective core. The following description applies to both saltcake samples.

Approximately 300 mL of deionized (DI) water were added to a 2–L Erlenmeyer flask placed on a hotplate with magnetic stirrer. For each sample an Erlenmeyer flask was labeled AN-103 or SX-105, respectively. Jar weights were taken before and after each transfer to determine the mass transferred. As the contents of each sample jar were transferred to the respective

Erlenmeyer flask, the transferred mass was allowed to mix with the solution. After visually determining adequate mixing, more DI water and saltcake were added to the Erlenmeyer flasks until the total volume measured ~ 1 L in each. Table 1 shows the masses used in the AN-103 composite.

Table 1. Tank 241-AN-103 Core 274 Jar Numbers and Associated Masses Solubilized.

Jar Number	Mass (g)
17909	114.649
17913	141.197
17917	155.073
17924	172.828
Total	583.747

The density of the AN-103 composite was estimated using the TWINS database as 1.52 g/cm^3. The mass taken from the archive would thus occupy approximately 384 cm^3 or mL. The 2-L Erlenmeyer flasks, when finished solubilizing the tank saltcake, were at approximately 1000 mL. The estimated volume of water added was then 616 mL. This is only an estimate as some of the jars did contain drainable liquid; any liquid from the jars was used in the composite.

Table 2 shows the masses used in the SX-105 composite.

Table 2. Tank 241-SX-105 Core 229 Jar Numbers and Associated Masses Solubilized.

Jar Number	Mass (g)
13845	21.781
14199	20.688
13862	0.571
14240	34.707
14227	35.933
14208	40.441
19061	43.398
14196	35.593
14046	77.842
14239	59.484
14229	74.775
14228	73.591
14238	77.539
14241	75.751
Total	672.094

There are no density data available in the TWINS database for the SX-105 tank solids, only for drainable liquid; therefore, there is no estimate of density given. Specific gravity values of the samples after ion exchange are shown in Table 7.

After both samples were solubilized, they were filtered through a Whatman®[1] prefilter (~2 microns) followed by a Whatman® glass fiber filter (~0.7 microns). The resulting filtrate from both tanks was a clear yellowish liquid. The filtrate was allowed to sit overnight. Each filtrate was pumped through a column of IE-911®[2], a cesium-specific sorbent. The bed volume (BV) was 26.5 cm^3 and the flow rate was ~3.3 BV/hour.

The AN-103 filtrate did form a white precipitate overnight that was not readily visible in the polyethylene container. Consequently, the inlet to the flow controller plugged at 8 hr, 45 min and had to be taken offline; approximately 800 mL of AN-103 were collected. The remaining volume of AN-103 was filtered and became the influent for the SX-105 ion exchange column. This resulted in approximately 900 mL of AN-103 liquid being collected after the ion exchange process.

Samples of the AN-103 precipitate were analyzed using scanning electron microscopy (SEM). Appendix B shows the SEM microphotographs with respective energy dispersive spectra (EDS). The 100+ µm aggregates appear to be made of ~1x2 µm gibbsite crystallites cemented by sodium carbonate. This explains the rather large precipitate after a very short ripening time. The SX-105 filtrate showed no propensity to precipitate, and approximately 950 mL of effluent were collected.

In Tables 3 and 4, selected ions of interest are presented in gravimetric and molar units, post ion exchange. These ions of interest were identified by the SRNL researchers directing and performing the BSR test runs. More details on the selection of these ions and related sample selection criteria can be found in the report RPP-48824.

Table 3. Tank 241-AN-103 Analytes of Interest after Contact with IE-911®.

AN-103	µg/mL	g/L	g/mol	L	mol/L	mol	mol ion/mol Na
Na	1.19E+05	1.19E+02	23	0.90	5.17E+00	4.66E+00	1.00E+00
SO_4	1.11E+03	1.11E+00	96.06	0.90	1.16E-02	1.04E-02	2.23E-03
Cl	2.10E+03	2.10E+00	35.45	0.90	5.92E-02	5.33E-02	1.14E-02
F	3.50E+02	3.50E-01	18.99	0.90	1.84E-02	1.66E-02	3.56E-03
PO_4	7.39E+02	7.39E-01	94.9	0.90	7.79E-03	7.01E-03	1.51E-03

Table 4. Tank 241-SX-105 Analytes of Interest after Contact with IE-911®.

SX-105	µg/mL	g/L	g/mol	L	mol/L	mol	mol ion/mol Na
Na	1.18E+05	1.18E+02	23	0.95	5.13E+00	4.87E+00	1.00E+00
SO_4	5.27E+03	5.27E+00	96.06	0.95	5.49E-02	5.21E-02	1.07E-02
Cl	2.35E+03	2.35E+00	35.45	0.95	6.63E-02	6.30E-02	1.29E-02
F	6.98E+01	6.98E-02	18.99	0.95	3.68E-03	3.49E-03	7.16E-04
PO_4	7.95E+03	7.95E+00	94.9	0.95	8.38E-02	7.96E-02	1.63E-02

[1] Whatman is a registered trademark of the Whatman Paper Limited Company, Kent, United Kingdom.
[2] IE-911 is a registered trademark of UOP LLC Limited Liability Company, Des Plaines, Illinois.

The decontamination factor (DF) for AN-103 was approximately 100,000 (calculated 107,017), and for SX-105 the DF was ~2,000 (calculated 2,458). The large difference in DF can be attributed to differences in either the matrix or the superficial velocity, and hence, zone of mass transfer effects. The SX-105 column flowed at a fairly constant rate with minimal, if any, pump correction. However, due to plugging, the AN-103 column was flowing at a considerably lower rate and, therefore, may have had more opportunity for cesium exchange.

Appendices C to F contain the compiled analytical data for AN-103 and SX-105 before and after IE-911® contact.

2.2 TANK 241-AZ-101 AND TANK 241-AZ-102 SUPERNATE COMPOSITE.

The AZ-101/102 sample was composited from available grab samples (supernates) in the 222-S Laboratory 11A hot cell archive. The supernate was decanted into a 2-L Erlenmeyer flask, and filtered using a Whatman® glass fiber filter (~0.7 µm) followed by a Millipore®[3] PVDF 0.45 µm filter. Table 5 shows the archived jar identification numbers and associated masses from each respective jar. The overall yield for the composite was 1.5 L. Appendices G and H show the analytical data before and after ion exchange, respectively.

Table 5. Tank 241-AZ-101 and Tank 241-AZ-102 Archived Jar Numbers and Associated Masses for Composite.

Jar Number	Mass (g)
AZ101-10-01	75.737
AZ101-10-01DUP	157.287
AZ101-10-01TRIP	152.432
AZ101-10-03	92.389
AZ101-10-04	89.589
AZ101-10-05	94.432
AZ101-10-06 DUP	75.186
AZ101-10-07	93.426
2AZ-09-02A	262.569
2AZ-09-02B	64.427
2AZ-09-03A	297.751
2AZ-09-03B	38.484
2AZ-09-04A	299.968
2AZ-09-04B	88.617
Total	1882.294

Table 6 is the equivalent to Tables 3 and 4 and presents the concentration of the ions of interest in gravimetric and molar units, post ion exchange.

[3] Millipore is a registered trademark of Millipore Corporation, Bedford, Massachusetts.

Table 6. Tank 241-AZ-101 and Tank 241-AZ-102 Supernate Composite Analytes of Interest after Contact with IE-911®.

AZ-101/102	µg/mL	g/L	g/mol	L	mol/L	mol	mol ion/mol Na
Na	1.13E+05	1.13E+02	23	1.52	4.91E+00	7.46E+00	1.00E+00
SO_4	1.55E+04	1.55E+01	96.06	1.52	1.61E-01	2.45E-01	3.28E-02
Cl	1.10E+03	1.10E+00	35.45	1.52	3.10E-02	4.71E-02	6.32E-03
F	1.38E+03	1.38E+00	18.99	1.52	7.27E-02	1.10E-01	1.48E-02
PO_4	2.37E+03	2.37E+00	94.9	1.52	2.50E-02	3.79E-02	5.08E-03

3.0 RESULTS

Table 7 shows the radioisotopic cesium concentrations for all three samples, before and after contact with IE-911®, as well as sodium, volume recovered, and specific gravity.

Table 7. Cesium, Sodium, Specific Gravity, and Decontamination Factor of AN-103, SX-105 and AZ-101/102 Tank Samples.

Tank	Cesium-137		Volume (L)	Sodium		Specific Gravity (g/cm^3)	DF Cs-137
	Before IE-911® (µCi/mL)	After IE-911® (µCi/mL)		mol/L	Moles per sample		
AN-103	1.22E+02	1.14E-03	0.9	5.17	4.66	1.27	1.0E05
SX-105	9.54E-01	3.88E-04	0.95	5.13	4.87	1.28	2.5E03
AZ-101/102	8.37E+02	3.79E-04	1.5	4.91	7.46	1.24	2.2E06

A sodium-normalized comparison of the contents of the selected ions sulfate, chloride, fluoride, and phosphate in the three samples to the target values is shown in Table 8.

Table 8. Comparison of Actual Mole Ratios to Targeted High and Low Values for Analytes of Interest.

Measured Mole Ratios		AN-103		SX-105		AZ-101/102	
	Target Value	Before Ion Exchange	After Ion Exchange	Before Ion Exchange	After Ion Exchange	Before Ion Exchange	After Ion Exchange
mol SO_4/ mol Na							
High	0.032	0.002	0.002	0.011	0.011	0.035	0.033
Low	0.008						
mol Cl / mol Na							
High	0.016	0.011	0.012	0.013	0.013	0.008	0.006
Low	0.007						
mol F / mol Na							
High	0.06	0.003	0.003	0.0007	0.0007	0.015	0.015
Low	0.013						
mol PO_4 / mol Na							
High	0.040	0.002	0.002	0.016	0.016	0.005	0.005
Low	0.008						

The normalization (target) values were derived from a systematic approach to identify the 10^{th} and 90^{th} percentile of the individual anions in the batches of waste feed to the Waste Treatment and Immobilization Plant (WTP) per the Hanford Tank Waste Operations Simulator (HTWOS) model, version 6.2. The sample selection approach was based on including a sample with high anion content (when normalized to sodium), and one with low anion content. The predictions were based on available TWINS data. In case of AN-103, the "low" sample, this approach was successful; for SX-105 the predictions as a "high" were not fulfilled. Therefore, the composite of AZ-101/102 was chosen in order to have one sample with high sulfate content. A more detailed explanation of the sample selection process has been reported in RPP-48824.

4.0 REFERENCES

LAB-PLAN-10-00006, R0, 2011, *Test Plan for the Preparation of Samples from Hanford Tanks 241-SX-105, 241-AN-103, 241-AN-107*, Washington River Protection Solutions, LLC, Richland, Washington.

LAB-PLN-10-00014, R0, 2011, *Test Plan for the Preparation of a Composite Sample from Hanford Tanks 241-AZ-101 and 241-AZ-102 for Steam Reformer Testing at the Savannah River National Laboratory*, Washington River Protection Solutions, LLC, Richland, Washington.

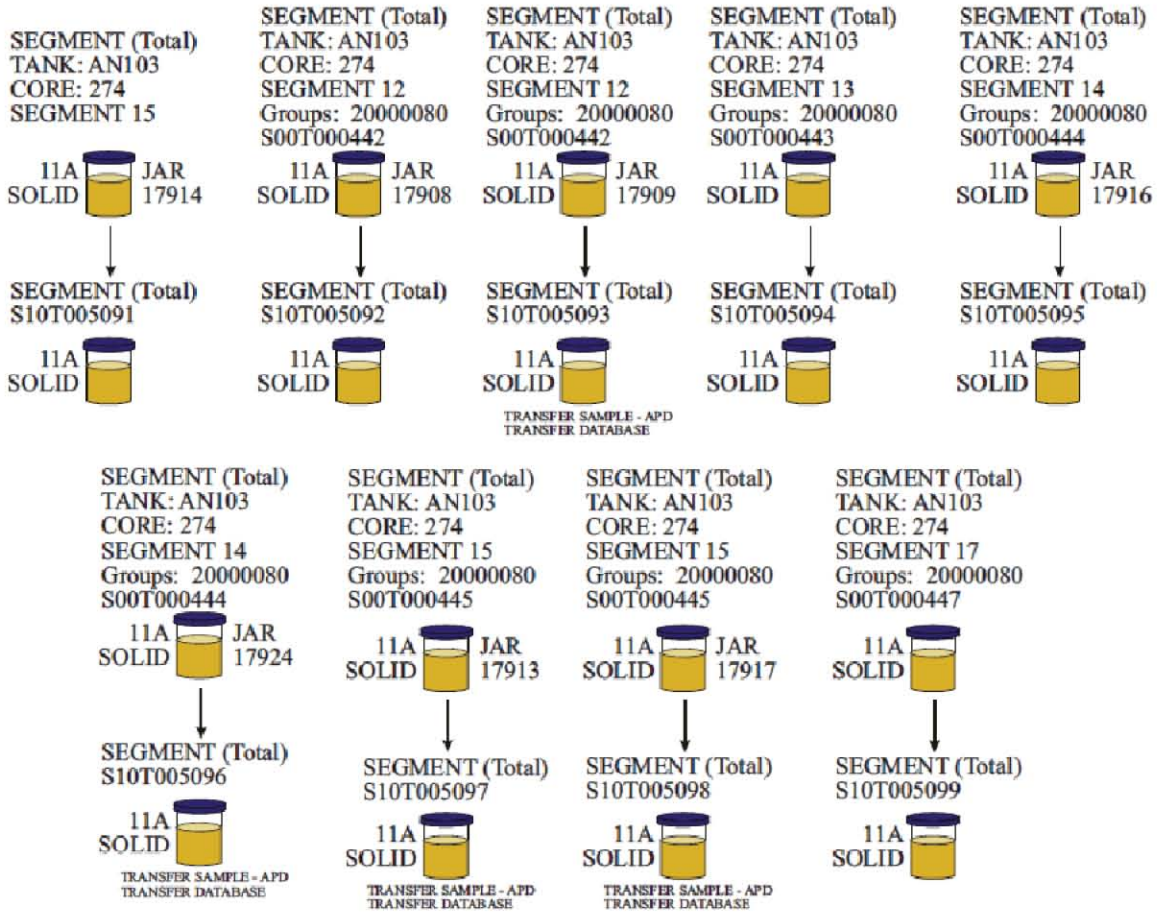
RPP-48824, Rev. 0, 2011, *Sample Selection Process for Bench-Scale Steam Reforming Treatability Studies Using Hanford Waste Samples*, Washington River Protection Solutions, LLC, Richland, Washington.

WP-5.2.1-2010-001, Rev. 0, 2010, *Fluidized Bed Steam Reformer Low-level Waste Form Qualification,* DOE EM-31 Technology Development & Deployment Program Task Plan, Washington, D.C.

WSRC-STI-2008-00268, 2008, Rev. 0, *Mineralization of Radioactive Wastes by Fluidized Bed Steam Reforming (FBSR): Comparisons to Vitreous Waste Forms and Pertinent Durability Testing*, Savannah River National Laboratory, Aiken, South Carolina.

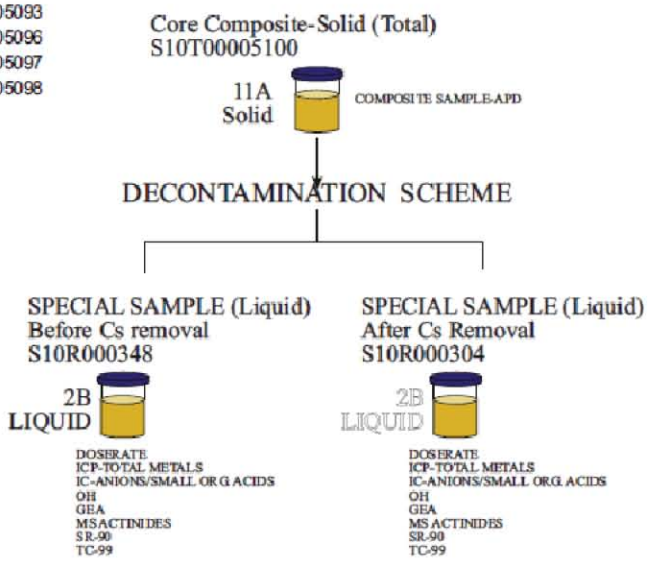
APPENDIX A: SAMPLE BREAKDOWN DIAGRAMS

SRS - STEAM REFORMING
Group 20100665



SRS - STEAM REFORMING
Group 20100665

Solid Composite					
Tank	Core	Segment	Jar	NET WEIGHT (g)	OmniLims ID
AN103	274	12	17909	144.1	S10T005093
		14	17924	177.3	S10T005096
		15	17913	149.4	S10T005097
		15	17917	164.8	S10T005098



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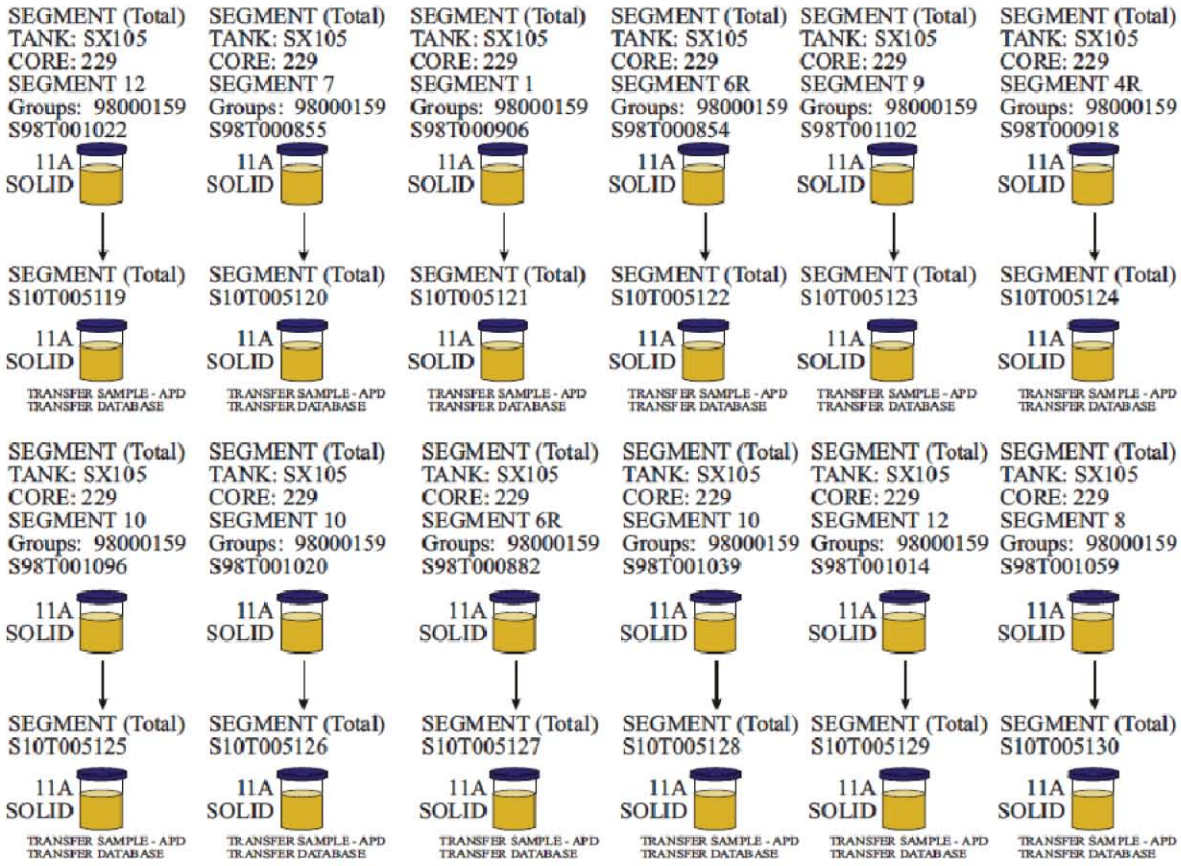

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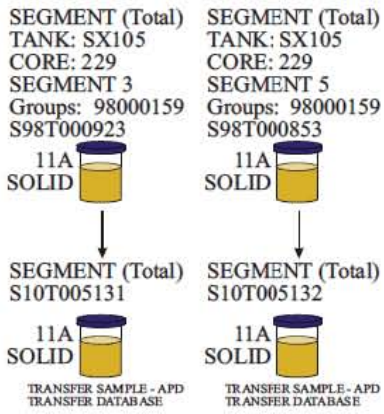
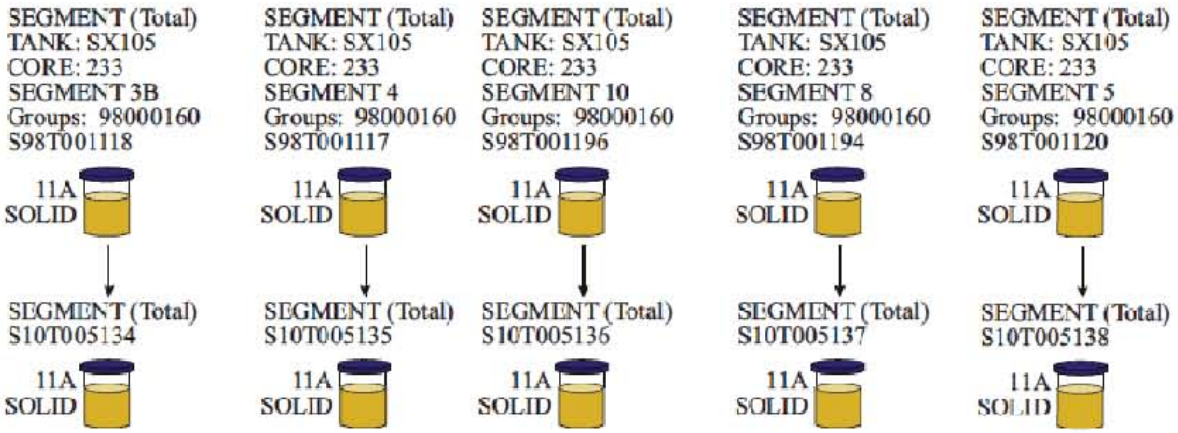
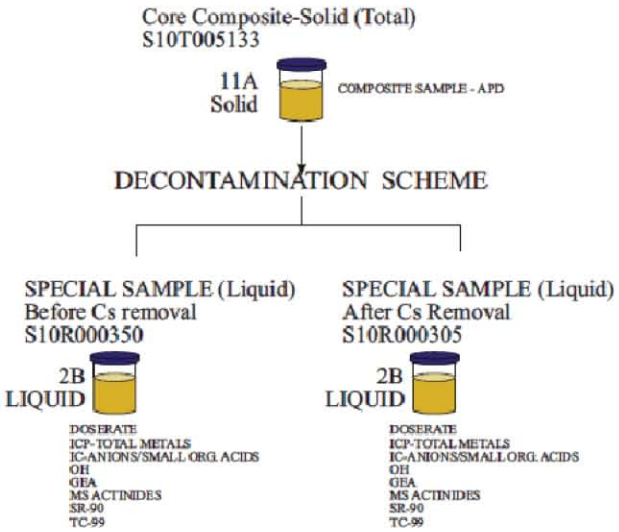




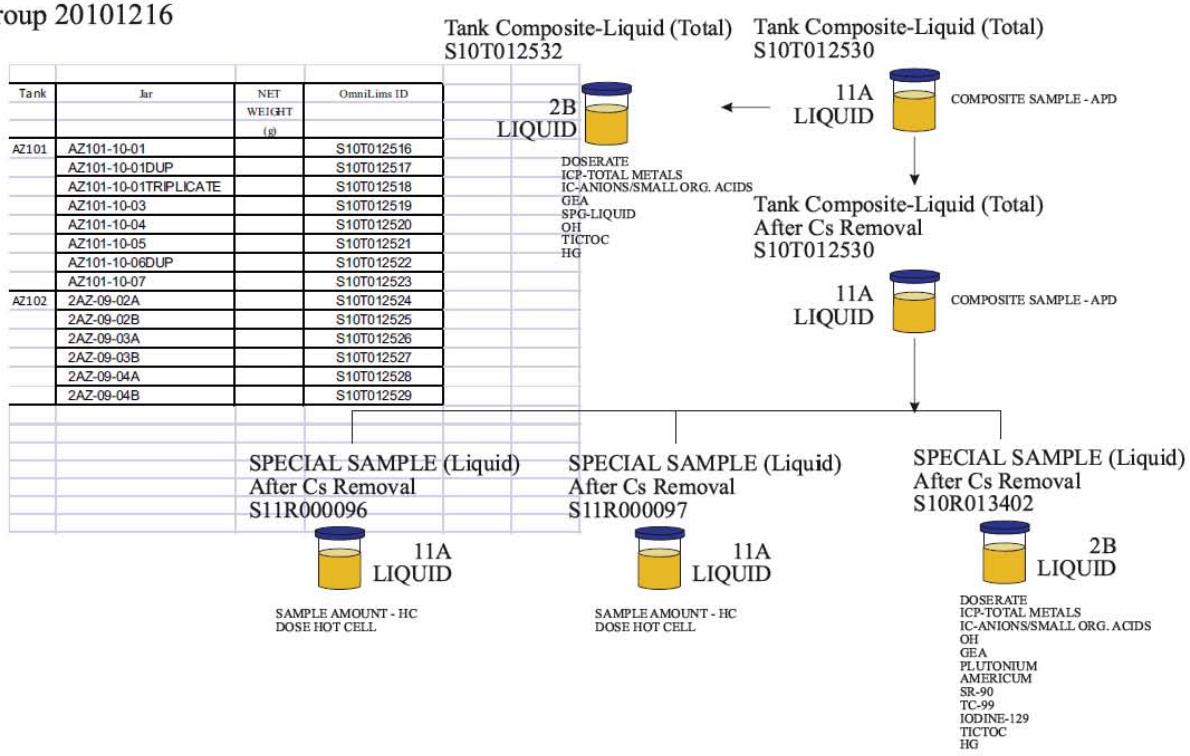
SRS - STEAM REFORMING
Group 20100666

Solid Composite					
Tank	Core	Segment	Jar	NET WEIGHT (g)	OmniLims ID
SX105	229	12	14046	83.1	S10T005119
		7	14196	50.1	S10T005120
		1	14208	46.1	S10T005121
		6R	14227	41.9	S10T005122
		9	14228	86.2	S10T005123
		4R	14229	83.5	S10T005124
		10	14238	90.1	S10T005125
		10	14239	69.9	S10T005126
		6R	14240	40.1	S10T005127
		10	14241	92.6	S10T005128
		12	19061	50	S10T005129
		8	13862	33.1	S10T005130
		3	14199	30.4	S10T005131
		5	13845	27.3	S10T005132



SRS - STEAM REFORMING
Group 20101216

Tank	Jar	NET WEIGHT (g)	OmniLims ID
AZ101	AZ101-10-01		S10T012516
	AZ101-10-01DUP		S10T012517
	AZ101-10-01TRIPLICATE		S10T012518
	AZ101-10-03		S10T012519
	AZ101-10-04		S10T012520
	AZ101-10-05		S10T012521
	AZ101-10-06DUP		S10T012522
	AZ101-10-07		S10T012523
AZ102	2AZ-09-02A		S10T012524
	2AZ-09-02B		S10T012525
	2AZ-09-03A		S10T012526
	2AZ-09-03B		S10T012527
	2AZ-09-04A		S10T012528
	2AZ-09-04B		S10T012529



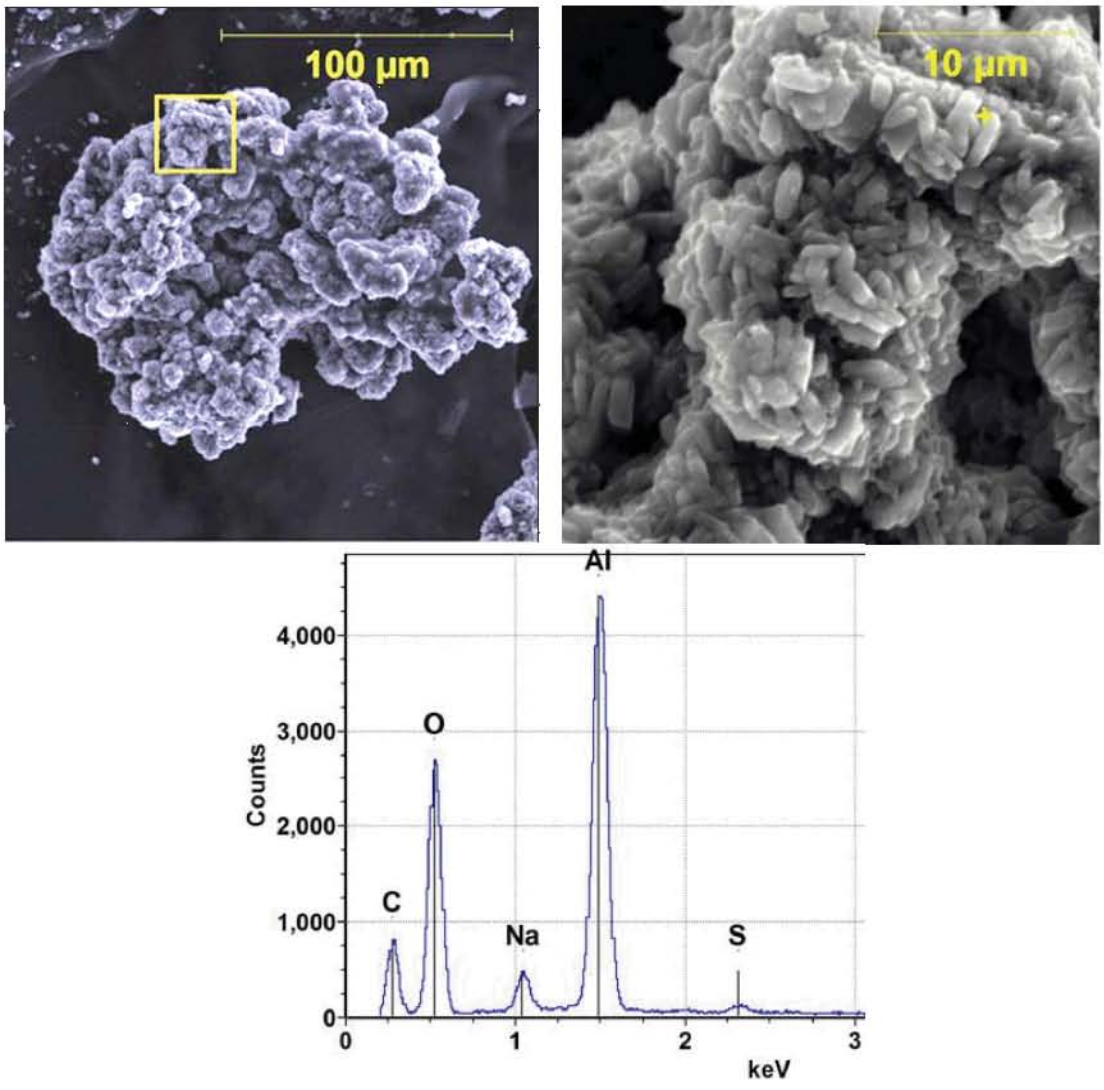
APPENDIX B: MINERALOGY OF PRECIPITATED SOLIDS FROM DISSOLVED 241-AN-103 SALTCAKE SAMPLE BEFORE ION EXCHANGE

APPENDIX B

The SEM images and EDS in Figures B-1 and B-2 were taken from sample S10R000351 (AN-103, post-IX). The XRD spectrum in Figure B-3 identifies the two major phases in this sample. The sample was prepared from the white precipitate that formed overnight in the feed solution of the ion exchange column; it is a daughter sample of S10R000350.

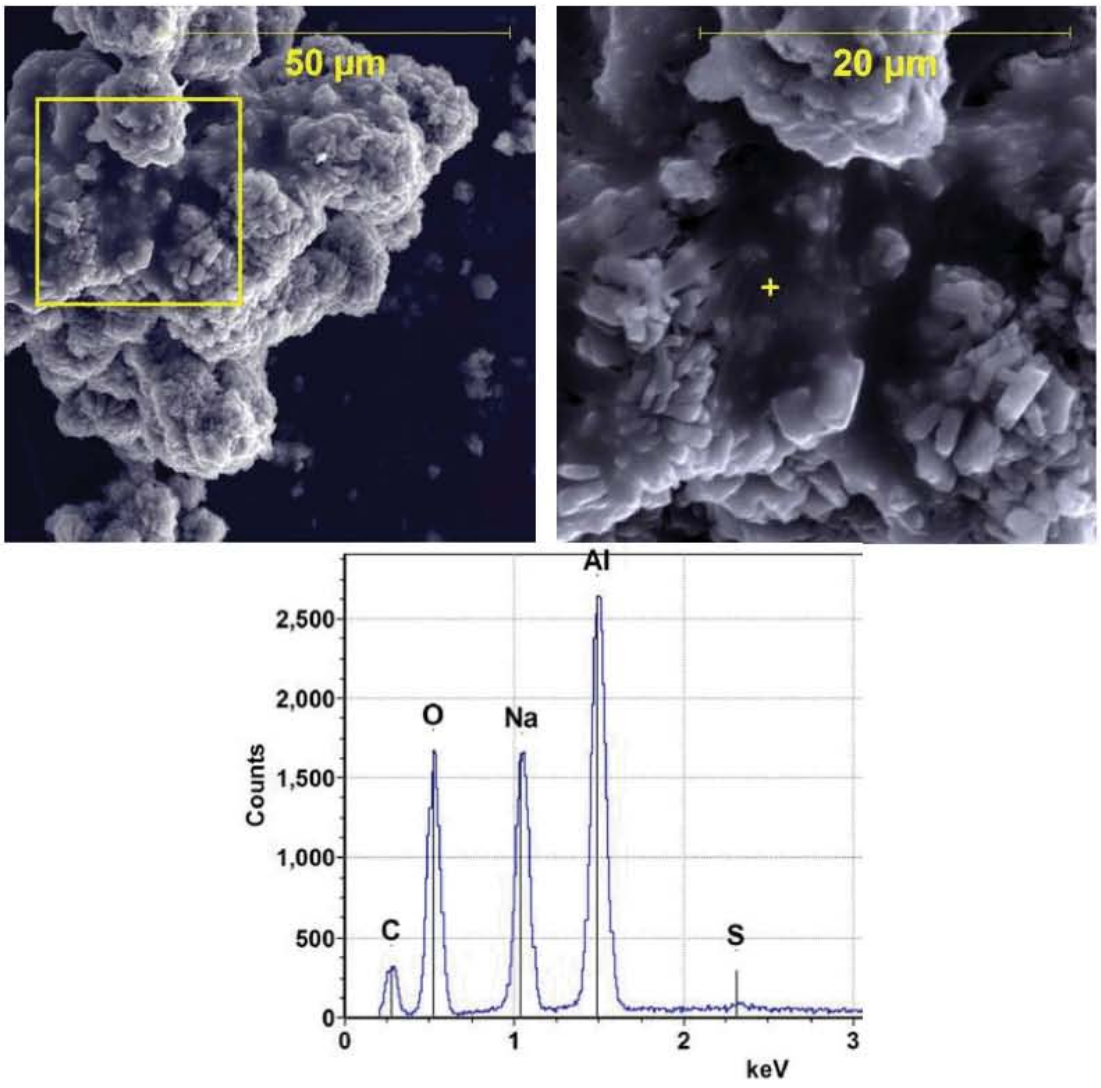
The particle in the images of Figure B-1 is representative of the ones found the morning after the day of saltcake dissolution and filtration with a 0.45-μm filter. The particle is about 100x150 μm large; however, the precipitated crystallites are in the range of 1x2 μm size. The EDS spectrum identifies them as mostly Al-rich material, consistent with gibbsite. The answer to the question of the nature of the material cementing the crystallites was the goal of the SEM and XRD study.

Figure B-1. Representative Aggregate of Gibbsite.



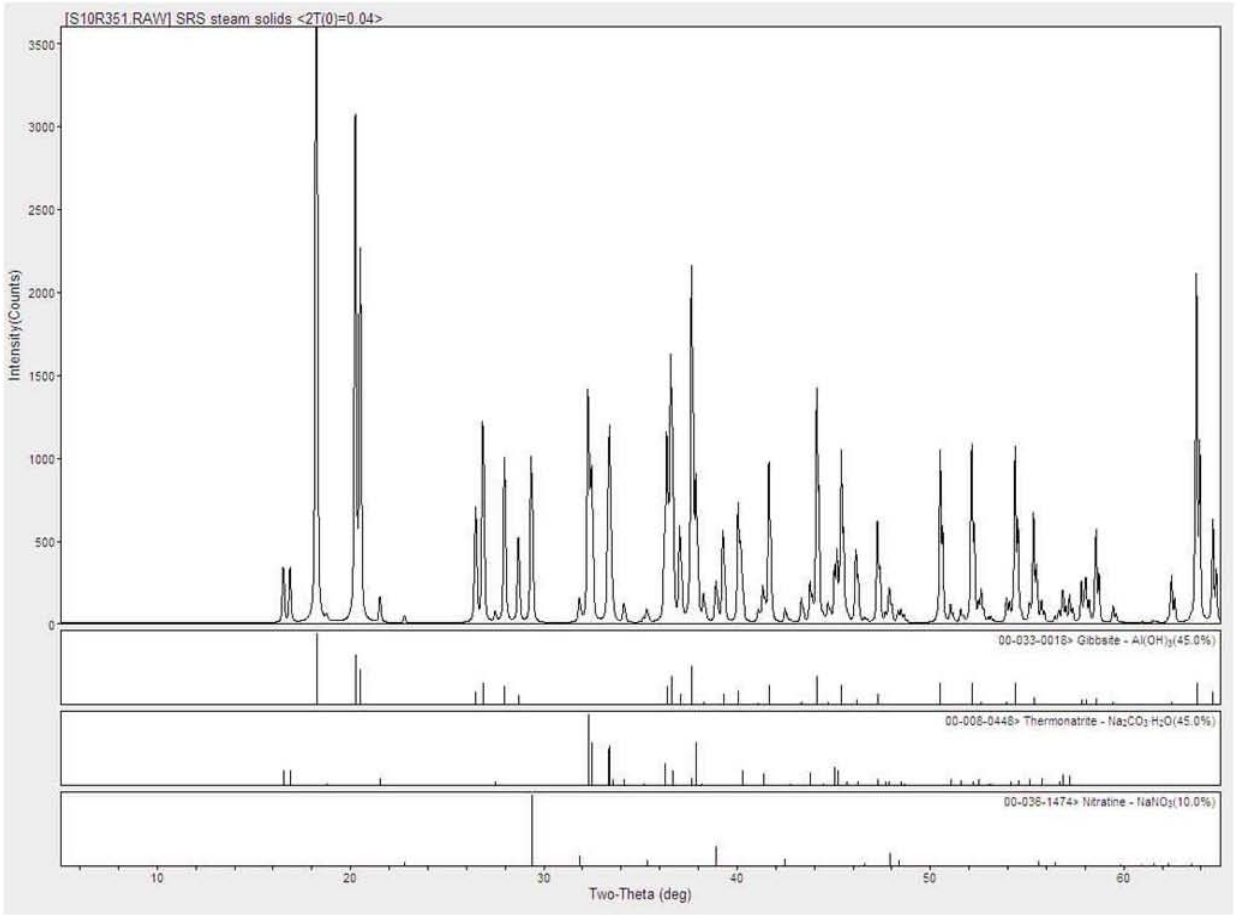
As in Figure B-1, the EDS spectrum in Figure B-2 was taken from the spot marked with the yellow "+" symbol. As opposed to Figure B-1, sodium is nearly always present in these aggregates. One explanation is that the aggregates are cemented with a sodium-rich or sodium-aluminum-rich phase.

Figure B-2. Representative Aggregate of Gibbsite with Sodium-Rich Cement.



In Figure B-3, the XRD spectrum identifies the major phases as gibbsite [$Al(OH)_3$], and thermonatrite [$Na_2CO_3xH_2O$]. Sodium nitrate [$NaNO_3$] was also identified as a minor phase, but was probably crystallized from the interstitial liquid when the sample dried. The approximate weight percentages presented on the diffractogram are estimated using published relative intensity ratios.

Figure B-3. X-ray Diffraction Pattern of Precipitated Aggregate.



In summary, the phase cementing the aggregates to the ~100-μm particles has both chemistry and thin lath-like crystals consistent with thermonatrite ($Na_2CO_3xH_2O$). The aluminum in the EDS spectrum in Figure A-2 probably originates from gibbsite beneath and surrounding the sodium-rich phase. As for interpretations on the precipitation path, the lack of quantitative information on the composition of the interstitial liquid of the original saltcake sample and the fact that the precipitant was not weighed puts two potential scenarios in the area of speculation.

One of these scenarios assumes that the original interstitial liquid was rather high in caustic, causing the dilution during the saltcake dissolution to push the liquid into a gibbsite precipitation regime. The other explanation assumes that the interstitial liquid was actually rather low in caustic with dawsonite as a major component of the solids. Dawsonite, then, would dissolve during saltcake dissolution with the resulting liquid precipitating gibbsite and co-precipitating thermonatrite.

APPENDIX C: CHEMICAL COMPOSITION OF DISSOLVED SALTCAKE FROM TANK AN-103 AFTER FILTRATION AND BEFORE IE-911® CONTACT

(Data Summary of Chemical Analyses as Provided by Advanced Technologies and Laboratories International, Inc.).

ION CHROMATOGRAPH RESULTS (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000348	Fluoride	3.73E+02	µg/mL
S10R000348	Glycolate	<1.04E+02	µg/mL
S10R000348	Acetate	4.91E+02	µg/mL
S10R000348	Formate	2.26E+02	µg/mL
S10R000348	Chloride	2.21E+03	µg/mL
S10R000348	Nitrite	3.66E+04	µg/mL
S10R000348	Sulfate	1.19E+03	µg/mL
S10R000348	Oxalate	6.57E+02	µg/mL
S10R000348	Bromide	<6.44E+01	µg/mL
S10R000348	Nitrate	6.83E+04	µg/mL
S10R000348	Phosphate	8.22E+02	µg/mL
INDUCTIVELY COUPLED PLASMA (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000348	Silver	<5.00	µg/mL
S10R000348	Aluminum[1]	2.22E+03	µg/mL
[1] Some of the supernate precipitated in the sample vial prior to analysis. The 2.22E+03 µg/mL represents analysis from an aliquot taken from the supernate above the precipitated mass in the sample vial. The entire sample was filtered and 3.999 grams of solid were collected on the filter. Of the 3.999 grams collected, the amount of aluminum was calculated to be 0.741 grams. Therefore there is reason to believe that the concentration of Al reported is that of an Al depleted sample. However, since the overall amount of supernate in the sample vial was not measured, a quantitative back calculation cannot be performed. See Appendix B.			
S10R000348	Arsenic	<50.0	µg/mL
S10R000348	Boron	<30.0	µg/mL
S10R000348	Barium	<3.00	µg/mL
S10R000348	Beryllium	<1.00	µg/mL
S10R000348	Bismuth	<100	µg/mL
S10R000348	Calcium	<50.0	µg/mL
S10R000348	Cadmium	<5.00	µg/mL
S10R000348	Cerium	<30.0	µg/mL
S10R000348	Cobalt	<10.0	µg/mL
S10R000348	Chromium	7.72E+00	µg/mL
S10R000348	Copper	<5.00	µg/mL
S10R000348	Europium	<5.00	µg/mL
S10R000348	Iron	<5.00	µg/mL
S10R000348	Potassium	1.92E+03	µg/mL
S10R000348	Lanthanum	<3.00	µg/mL

S10R000348	Lithium	<3.00	µg/mL
S10R000348	Magnesium	<50.0	µg/mL
S10R000348	Manganese	<3.00	µg/mL
S10R000348	Molybdenum	20.1	µg/mL
S10R000348 Reanalyzed 8/27/2011	Sodium	1.32E+05	µg/mL
S10R000348	Neodymium	<10.0	µg/mL
S10R000348	Nickel	<20.0	µg/mL
S10R000348	Phosphorus	6.36E+01	µg/mL
S10R000348	Lead	<50.0	µg/mL
S10R000348	Sulfur	2.44E+02	µg/mL
S10R000348	Antimony	<50.0	µg/mL
S10R000348	Selenium	<100	µg/mL
S10R000348	Samarium	<50.0	µg/mL
S10R000348	Strontium	<50.0	µg/mL
S10R000348	Thorium	<3.00	µg/mL
S10R000348	Titanium	<50.0	µg/mL
S10R000348	Thallium	<5.00	µg/mL
S10R000348	Uranium	<100	µg/mL
S10R000348	Vanadium	<100	µg/mL
S10R000348	Yttrium	<5.00	µg/mL
S10R000348	Zinc	<2.00	µg/mL
S10R000348	Zirconium	<5.00	µg/mL
GAMMA ENERGY ANALYSIS (GEA) (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000348	Beryllium-7	<0.876	µCi/mL
S10R000348	Sodium-22	<6.77E-03	µCi/mL
S10R000348	Sodium-24	<5.81E-03	µCi/mL
S10R000348	Aluminum-28	<0.182	µCi/mL
S10R000348	Chlorine-38	<0.0455	µCi/mL
S10R000348	Potassium-40	<0.148	µCi/mL
S10R000348	Argon-41	<0.0108	µCi/mL
S10R000348	Scandium-46	<8.04E-03	µCi/mL
S10R000348	Chromium-51	<0.617	µCi/mL
S10R000348	Manganese-54	<6.71E-03	µCi/mL
S10R000348	Cobalt-56	<6.09E-03	µCi/mL
S10R000348	Manganese-56	<8.48E-03	µCi/mL
S10R000348	Cobalt-57	<0.0518	µCi/mL
S10R000348	Cobalt-58	<6.40E-03	µCi/mL
S10R000348	Iron-59	<0.0113	µCi/mL
S10R000348	Cobalt-60	<6.22E-03	µCi/mL

S10R000348	Copper-64	<1.36	µCi/mL
S10R000348	Zinc-65	<0.0156	µCi/mL
S10R000348	Copper-66	<1.57	µCi/mL
S10R000348	Selenium-75	<0.0894	µCi/mL
S10R000348	Selenium-79	<14.9	µCi/mL
S10R000348	Krypton-85	<16.1	µCi/mL
S10R000348	Strontium-85	<0.0698	µCi/mL
S10R000348	Yttrium-88	<5.07E-03	µCi/mL
S10R000348	Yttrium-91	<2.31	µCi/mL
S10R000348	Niobium-94	<6.80E-03	µCi/mL
S10R000348	Zirconium/Niobium-95	<0.0126	µCi/mL
S10R000348	Ruthenium-103	<0.0836	µCi/mL
S10R000348	Ruthenium/Rhodium-106	<1.09	µCi/mL
S10R000348	Silver-108	<7.62E-03	µCi/mL
S10R000348	Silver-110	<0.461	µCi/mL
S10R000348	Tin-113	<0.118	µCi/mL
S10R000348	Tellurium-123	<0.0495	µCi/mL
S10R000348	Antimony-124	<0.0551	µCi/mL
S10R000348	Antimony-125	<0.296	µCi/mL
S10R000348	Tellurium-125	<114	µCi/mL
S10R000348	Antimony-126	<7.44E-03	µCi/mL
S10R000348	Tin-126	<0.134	µCi/mL
S10R000348	Iodine-129	<99.7	µCi/mL
S10R000348	Iodine-131	<0.0873	µCi/mL
S10R000348	Xenon-131	<2.14	µCi/mL
S10R000348	Barium-133	<0.109	µCi/mL
S10R000348	Cesium-134	<0.0553	µCi/mL
S10R000348	Cesium-136	<6.08E-03	µCi/mL
S10R000348	Cesium-137	122	µCi/mL
S10R000348	Cesium-138	<0.0257	µCi/mL
S10R000348	Cerium-139	<0.0523	µCi/mL
S10R000348	Barium-140	<0.246	µCi/mL
S10R000348	Lanthanum-140	<5.32E-03	µCi/mL
S10R000348	Cerium-141	<0.0869	µCi/mL
S10R000348	Cerium-144	<0.387	µCi/mL
S10R000348	Cerium/Praseodymium-144	<0.774	µCi/mL
S10R000348	Europium-152	<0.0291	µCi/mL
S10R000348	Europium-154	<0.0197	µCi/mL
S10R000348	Europium-155	<0.217	µCi/mL
S10R000348	Hafnium-181	<0.104	µCi/mL

S10R000348	Tantalum-182	<0.0230	µCi/mL
S10R000348	Gold-198	<0.0864	µCi/mL
S10R000348	Mercury-203	<0.0699	µCi/mL
S10R000348	Bismuth-207	<9.22E-03	µCi/mL
S10R000348	Thallium-208	<0.0618	µCi/mL
S10R000348	Lead-210	<16.9	µCi/mL
S10R000348	Bismuth-212	<0.0595	µCi/mL
S10R000348	Lead-212	<0.120	µCi/mL
S10R000348	Bismuth-214	<0.117	µCi/mL
S10R000348	Lead-214	<0.174	µCi/mL
S10R000348	Radium-224	<1.36	µCi/mL
S10R000348	Radium-226	<1.56	µCi/mL
S10R000348	Actinium-228	<0.0282	µCi/mL
S10R000348	Thorium-228	<5.20	µCi/mL
S10R000348	Thorium-229	<0.443	µCi/mL
S10R000348	Uranium-232	<95.8	µCi/mL
S10R000348	Protactinium-233	<0.155	µCi/mL
S10R000348	Uranium/Thorium-233	<48.4	µCi/mL
S10R000348	Protactinium-234	<0.938	µCi/mL
S10R000348	Thorium-234	<4.04	µCi/mL
S10R000348	Uranium-235	<0.0942	µCi/mL
S10R000348	Neptunium-237	<0.507	µCi/mL
S10R000348	Uranium-237	<0.196	µCi/mL
S10R000348	Neptunium-238	<0.0239	µCi/mL
S10R000348	Neptunium-239	<0.209	µCi/mL
S10R000348	Plutonium-239	<695	µCi/mL
S10R000348	Americium-241	<0.463	µCi/mL
S10R000348	Americium-243	<0.146	µCi/mL
NON GEA RADIONUCLIDE ANALYSIS (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000348	Thorium-229	<4.50E-05	µg/mL
S10R000348	Thorium-230	<3.50E-05	µg/mL
S10R000348	Protactinium-231	<3.50E-05	µg/mL
S10R000348	Thorium-232	<2.50E-03	µg/mL
S10R000348	Uranium-233	3.72E-03	µg/mL
S10R000348	Uranium-234	2.97E-04	µg/mL
S10R000348	Uranium-235	0.0325	µg/mL
S10R000348	Uranium-236	2.15E-03	µg/mL
S10R000348	Neptunium-237	<5.00E-04	µg/mL
S10R000348	Uranium-238	4.46	µg/mL
S10R000348	Plutonium-239	<2.50E-03	µg/mL

S10R000348	Plutonium-240	<2.50E-05	µg/mL
S10R000348	Americium-241	<1.00E-03	µg/mL
S10R000348	Plutonium-242	3.50E-05	µg/mL
S10R000348	Americium-243	<2.50E-05	µg/mL
S10R000348	Plutonium-244	<4.50E-05	µg/mL
S10R000348	Strontium-89/90	1.93E-05	µCi/mL
S10R000348	Technetium-99	0.0368	µCi/mL
TOTAL INORGANIC CARBON (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000348	TIC	Not Done	
HYDROXIDE (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000348	Hydroxide	3.84E+04	µg/mL

APPENDIX D: CHEMICAL COMPOSITION OF DISSOLVED SALTCAKE FROM TANK AN-103 AFTER FILTRATION AND AFTER IE-911® CONTACT

(Data Summary of Chemical Analyses as Provided by Advanced Technologies and Laboratories International, Inc.).

ION CHROMATOGRAPH RESULTS (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000304	Fluoride	3.50E+02	µg/mL
S10R000304	Glycolate	<1.04E+01	µg/mL
S10R000304	Acetate	4.60E+02	µg/mL
S10R000304	Formate	2.16E+02	µg/mL
S10R000304	Chloride	2.10E+03	µg/mL
S10R000304	Nitrite	3.46E+04	µg/mL
S10R000304	Sulfate	1.11E+03	µg/mL
S10R000304	Oxalate	5.52E+02	µg/mL
S10R000304	Bromide	<6.44E+01	µg/mL
S10R000304	Nitrate	6.32E+04	µg/mL
S10R000304	Phosphate	7.39E+02	µg/mL
INDUCTIVELY COUPLED PLASMA (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000304	Silver	<5.00	µg/mL
S10R000304	Aluminum	1.19E+04	µg/mL
S10R000304	Arsenic	<50.0	µg/mL
S10R000304	Boron	<30.0	µg/mL
S10R000304	Barium	<3.00	µg/mL
S10R000304	Beryllium	<1.00	µg/mL
S10R000304	Bismuth	<1.00E+02	µg/mL
S10R000304	Calcium	<50.0	µg/mL
S10R000304	Cadmium	<5.00	µg/mL
S10R000304	Cerium	<30.0	µg/mL
S10R000304	Cobalt	<10.0	µg/mL
S10R000304	Chromium	19.2	µg/mL
S10R000304	Copper	<5.00	µg/mL
S10R000304	Europium	<5.00	µg/mL
S10R000304	Iron	<5.00	µg/mL
S10R000304	Potassium	3.48E+03	µg/mL
S10R000304	Lanthanum	<3.00	µg/mL
S10R000304	Lithium	<3.00	µg/mL
S10R000304	Magnesium	<50.0	µg/mL
S10R000304	Manganese	<3.00	µg/mL
S10R000304	Molybdenum	26.8	µg/mL
S10R000304	Sodium	1.19E+05	µg/mL
S10R000304	Neodymium	<10.0	µg/mL
S10R000304	Nickel	<20.0	µg/mL
S10R000304	Phosphorus	7.39E+02	µg/mL

S10R000304	Lead	<50.0	µg/mL
S10R000304	Sulfur	4.85E+02	µg/mL
S10R000304	Antimony	<50.0	µg/mL
S10R000304	Selenium	<100.0	µg/mL
S10R000304	Samarium	<50.0	µg/mL
S10R000304	Strontium	<3.00	µg/mL
S10R000304	Thorium	<50.0	µg/mL
S10R000304	Titanium	<5.00	µg/mL
S10R000304	Thallium	<100.0	µg/mL
S10R000304	Uranium	<100.0	µg/mL
S10R000304	Vanadium	<5.00	µg/mL
S10R000304	Yttrium	<2.00	µg/mL
S10R000304	Zinc	<5.00	µg/mL
S10R000304	Zirconium	<5.00	µg/mL
GAMMA ENERGY ANALYSIS (GEA) (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000304	Beryllium-7	<3.25E-04	µCi/mL
S10R000304	Sodium-22	<3.50E-05	µCi/mL
S10R000304	Sodium-24	<2.97E-05	µCi/mL
S10R000304	Aluminum-28	<1.10E-03	µCi/mL
S10R000304	Chlorine-38	<2.35E-04	µCi/mL
S10R000304	Potassium-40	<7.57E-04	µCi/mL
S10R000304	Argon-41	<5.46E-05	µCi/mL
S10R000304	Scandium-46	<3.92E-05	µCi/mL
S10R000304	Chromium-51	<2.73E-04	µCi/mL
S10R000304	Manganese-54	<3.21E-05	µCi/mL
S10R000304	Cobalt-56	<3.09E-05	µCi/mL
S10R000304	Manganese-56	<4.29E-05	µCi/mL
S10R000304	Cobalt-57	<2.49E-05	µCi/mL
S10R000304	Cobalt-58	<2.98E-05	µCi/mL
S10R000304	Iron-59	<5.45E-05	µCi/mL
S10R000304	Cobalt-60	<4.44E-05	µCi/mL
S10R000304	Copper-64	<7.18E-03	µCi/mL
S10R000304	Zinc-65	<8.03E-05	µCi/mL
S10R000304	Copper-66	<7.49E-03	µCi/mL
S10R000304	Selenium-75	<3.91E-05	µCi/mL
S10R000304	Selenium-79	<7.24E-03	µCi/mL
S10R000304	Krypton-85	<8.44E-03	µCi/mL
S10R000304	Strontium-85	<3.66E-05	µCi/mL
S10R000304	Yttrium-88	<3.11E-05	µCi/mL
S10R000304	Yttrium-91	<0.0112	µCi/mL

S10R000304	Niobium-94	<2.96E-05	µCi/mL
S10R000304	Zirconium/Niobium-95	<6.13E-05	µCi/mL
S10R000304	Ruthenium-103	<3.44E-05	µCi/mL
S10R000304	Ruthenium/Rhodium-106	<6.18E-04	µCi/mL
S10R000304	Silver-108	<3.76E-05	µCi/mL
S10R000304	Silver-110	<1.08E-04	µCi/mL
S10R000304	Tin-113	<4.72E-05	µCi/mL
S10R000304	Tellurium-123	<2.42E-05	µCi/mL
S10R000304	Antimony-124	<3.15E-05	µCi/mL
S10R000304	Antimony-125	<1.13E-04	µCi/mL
S10R000304	Tellurium-125	<0.0550	µCi/mL
S10R000304	Antimony-126	1.47E-04	µCi/mL
S10R000304	Tin-126	<8.72E-05	µCi/mL
S10R000304	Iodine-129	<0.0467	µCi/mL
S10R000304	Iodine-131	<3.51E-05	µCi/mL
S10R000304	Xenon-131	<1.03E-03	µCi/mL
S10R000304	Barium-133	<4.92E-05	µCi/mL
S10R000304	Cesium-134	<3.47E-05	µCi/mL
S10R000304	Cesium-136	<2.87E-05	µCi/mL
S10R000304	Cesium-137	1.14E-03	µCi/mL
S10R000304	Cesium-138	<1.36E-04	µCi/mL
S10R000304	Cerium-139	<2.54E-05	µCi/mL
S10R000304	Barium-140	<1.16E-04	µCi/mL
S10R000304	Lanthanum-140	<2.96E-05	µCi/mL
S10R000304	Cerium-141	<4.16E-05	µCi/mL
S10R000304	Cerium-144	<1.83E-04	µCi/mL
S10R000304	Cerium/Praseodymium-144	<3.66E-04	µCi/mL
S10R000304	Europium-152	<1.37E-04	µCi/mL
S10R000304	Europium-154	<1.02E-04	µCi/mL
S10R000304	Europium-155	<1.10E-04	µCi/mL
S10R000304	Hafnium-181	<4.10E-05	µCi/mL
S10R000304	Tantalum-182	<1.13E-04	µCi/mL
S10R000304	Gold-198	<4.70E-05	µCi/mL
S10R000304	Mercury-203	<3.22E-05	µCi/mL
S10R000304	Bismuth-207	<3.89E-05	µCi/mL
S10R000304	Thallium-208	<3.87E-05	µCi/mL
S10R000304	Lead-210	<7.70E-03	µCi/mL
S10R000304	Bismuth-212	<2.68E-04	µCi/mL
S10R000304	Lead-212	<5.74E-05	µCi/mL
S10R000304	Bismuth-214	<7.80E-05	µCi/mL

S10R000304	Lead-214	<8.10E-05	µCi/mL
S10R000304	Radium-224	<6.57E-04	µCi/mL
S10R000304	Radium-226	<7.08E-04	µCi/mL
S10R000304	Actinium-228	<1.33E-04	µCi/mL
S10R000304	Thorium-228	<2.83E-03	µCi/mL
S10R000304	Thorium-229	<2.20E-04	µCi/mL
S10R000304	Uranium-232	<0.0478	µCi/mL
S10R000304	Protactinium-233	<6.88E-05	µCi/mL
S10R000304	Uranium/Thorium-233	<0.0231	µCi/mL
S10R000304	Protactinium-234	<4.76E-03	µCi/mL
S10R000304	Thorium-234	<2.16E-03	µCi/mL
S10R000304	Uranium-235	<4.27E-05	µCi/mL
S10R000304	Neptunium-237	<3.23E-04	µCi/mL
S10R000304	Uranium-237	<9.70E-05	µCi/mL
S10R000304	Neptunium-238	<1.21E-04	µCi/mL
S10R000304	Neptunium-239	<1.06E-04	µCi/mL
S10R000304	Plutonium-239	<0.322	µCi/mL
S10R000304	Americium-241	<2.45E-04	µCi/mL
S10R000304	Americium-243	<7.73E-05	µCi/mL
NON GEA RADIONUCLIDE ANALYSIS (AN-103)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000304	Iodine-129	1.22E-04	µCi/mL
S10R000304	Thorium-229	n/a	µg/mL
S10R000304	Thorium-230	n/a	µg/mL
S10R000304	Protactinium-231	n/a	µg/mL
S10R000304	Thorium-232	2.30E-03	µg/mL
S10R000304	Uranium-233	1.74E-03	µg/mL
S10R000304	Uranium-234	1.88E-04	µg/mL
S10R000304	Uranium-235	0.0166	µg/mL
S10R000304	Uranium-236	1.21E-03	µg/mL
S10R000304	Neptunium-237	n/a	µg/mL
S10R000304	Uranium-238	2.27	µg/mL
S10R000304	Plutonium-239	n/a	µg/mL
S10R000304	Plutonium-240	n/a	µg/mL
S10R000304	Americium-241	n/a	µg/mL
S10R000304	Plutonium-242	n/a	µg/mL
S10R000304	Americium-243	n/a	µg/mL
S10R000304	Plutonium-244	n/a	µg/mL
S10R000304	Strontium-89/90	n/a	µCi/mL
S10R000304	Technetium-99	n/a	µCi/mL
TOTAL INORGANIC CARBON (AN-103)			

SAMPLE	ANALYTE	RESULT	UNIT
S10R000304	TIC	3.33E+03	µg/mL
HYDROXIDE (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000304	OH	3.6E+04	µg/mL

APPENDIX E: CHEMICAL COMPOSITION OF DISSOLVED SALTCAKE FROM TANK SX-105 AFTER FILTRATION AND BEFORE IE-911® CONTACT

(Data Summary of Chemical Analyses as Provided by Advanced Technologies and Laboratories International, Inc.).

ION CHROMATOGRAPH RESULTS (SX-105)			
SAMPLE	ANALYTE	RESULTS	UNIT
S10R000350	Fluoride	7.30E+01	µg/mL
S10R000350	Glycolate	<1.99E+01	µg/mL
S10R000350	Acetate	3.87E+02	µg/mL
S10R000350	Formate	4.99E+02	µg/mL
S10R000350	Chloride	2.34E+03	µg/mL
S10R000350	Nitrite	3.64E+04	µg/mL
S10R000350	Sulfate	5.25E+03	µg/mL
S10R000350	Oxalate	5.61E+02	µg/mL
S10R000350	Bromide	<1.23E+02	µg/mL
S10R000350	Nitrate	1.40E+05	µg/mL
S10R000350	Phosphate	7.88E+03	µg/mL
INDUCTIVELY COUPLED PLASMA (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000350	Silver	<5.00	µg/mL
S10R000350	Aluminum	9.78E+03	µg/mL
S10R000350	Arsenic	<50.0	µg/mL
S10R000350	Boron	30.1	µg/mL
S10R000350	Barium	<3.00	µg/mL
S10R000350	Beryllium	<1.00	µg/mL
S10R000350	Bismuth	<100	µg/mL
S10R000350	Calcium	<50.0	µg/mL
S10R000350	Cadmium	<5.00	µg/mL
S10R000350	Cerium	<30.0	µg/mL
S10R000350	Cobalt	<10.0	µg/mL
S10R000350	Chromium	9.21E+02	µg/mL
S10R000350	Copper	<5.00	µg/mL
S10R000350	Europium	<5.00	µg/mL
S10R000350	Iron	<5.00	µg/mL
S10R000350	Potassium	7.85E+02	µg/mL
S10R000350	Lanthanum	<3.00	µg/mL
S10R000350	Lithium	<3.00	µg/mL
S10R000350	Magnesium	<50.0	µg/mL
S10R000350	Manganese	<3.00	µg/mL
S10R000350	Molybdenum	3.23E+01	µg/mL
S10R000350	Sodium	1.16E+05	µg/mL
S10R000350	Neodymium	<10.0	µg/mL
S10R000350	Nickel	<20.0	µg/mL
S10R000350	Phosphorus	2.43E+03	µg/mL
S10R000350	Lead	<50.0	µg/mL

S10R000350	Sulfur	1.92E+03	µg/mL
S10R000350	Antimony	<50.0	µg/mL
S10R000350	Selenium	<100	µg/mL
S10R000350	Samarium	1.12E+02	µg/mL
S10R000350	Strontium	<50.0	µg/mL
S10R000350	Thorium	<3.00	µg/mL
S10R000350	Titanium	<50.0	µg/mL
S10R000350	Thallium	<5.00	µg/mL
S10R000350	Uranium	<100	µg/mL
S10R000350	Vanadium	<100	µg/mL
S10R000350	Yttrium	<5.00	µg/mL
S10R000350	Zinc	<2.00	µg/mL
S10R000350	Zirconium	14.6	µg/mL
GAMMA ENERGY ANALYSIS (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000350	Beryllium-7	<8.13E-03	µCi/mL
S10R000350	Sodium-22	<7.19E-05	µCi/mL
S10R000350	Sodium-24	<6.86E-05	µCi/mL
S10R000350	Aluminum-28	<2.28E-03	µCi/mL
S10R000350	Chlorine-38	<4.85E-04	µCi/mL
S10R000350	Potassium-40	<1.64E-03	µCi/mL
S10R000350	Argon-41	<1.01E-04	µCi/mL
S10R000350	Scandium-46	<8.76E-05	µCi/mL
S10R000350	Chromium-51	<5.71E-03	µCi/mL
S10R000350	Manganese-54	<6.48E-05	µCi/mL
S10R000350	Cobalt-56	<6.43E-05	µCi/mL
S10R000350	Manganese-56	<8.94E-05	µCi/mL
S10R000350	Cobalt-57	<4.79E-04	µCi/mL
S10R000350	Cobalt-58	<6.13E-05	µCi/mL
S10R000350	Iron-59	<1.21E-04	µCi/mL
S10R000350	Cobalt-60	<6.28E-05	µCi/mL
S10R000350	Copper-64	<0.0157	µCi/mL
S10R000350	Zinc-65	<1.70E-04	µCi/mL
S10R000350	Copper-66	<0.0148	µCi/mL
S10R000350	Selenium-75	<8.27E-04	µCi/mL
S10R000350	Selenium-79	<0.137	µCi/mL
S10R000350	Krypton-85	<0.150	µCi/mL
S10R000350	Strontium-85	<6.49E-04	µCi/mL
S10R000350	Yttrium-88	<6.08E-05	µCi/mL
S10R000350	Yttrium-91	<0.0224	µCi/mL
S10R000350	Niobium-94	<6.10E-05	µCi/mL

S10R000350	Zirconium/Niobium-95	<1.40E-04	µCi/mL
S10R000350	Ruthenium-103	<7.75E-04	µCi/mL
S10R000350	Ruthenium/Rhodium-106	<0.0101	µCi/mL
S10R000350	Silver-108	<7.44E-05	µCi/mL
S10R000350	Silver-110	<4.26E-03	µCi/mL
S10R000350	Tin-113	<1.09E-03	µCi/mL
S10R000350	Tellurium-123	<4.58E-04	µCi/mL
S10R000350	Antimony-124	<5.11E-04	µCi/mL
S10R000350	Antimony-125	<2.74E-03	µCi/mL
S10R000350	Tellurium-125	<1.04	µCi/mL
S10R000350	Antimony-126	<6.84E-05	µCi/mL
S10R000350	Tin-126	<1.24E-03	µCi/mL
S10R000350	Iodine-129	<0.922	µCi/mL
S10R000350	Iodine-131	<8.08E-04	µCi/mL
S10R000350	Xenon-131	<0.0198	µCi/mL
S10R000350	Barium-133	<1.01E-03	µCi/mL
S10R000350	Cesium-134	<5.12E-04	µCi/mL
S10R000350	Cesium-136	<6.43E-05	µCi/mL
S10R000350	Cesium-137	0.954	µCi/mL
S10R000350	Cesium-138	<2.76E-04	µCi/mL
S10R000350	Cerium-139	<4.84E-04	µCi/mL
S10R000350	Barium-140	<2.28E-03	µCi/mL
S10R000350	Lanthanum-140	<5.19E-05	µCi/mL
S10R000350	Cerium-141	<8.00E-04	µCi/mL
S10R000350	Cerium-144	<3.58E-03	µCi/mL
S10R000350	Cerium/Praseodymium-144	<7.15E-03	µCi/mL
S10R000350	Europium-152	<3.29E-04	µCi/mL
S10R000350	Europium-154	<2.09E-04	µCi/mL
S10R000350	Europium-155	<2.01E-03	µCi/mL
S10R000350	Hafnium-181	<9.62E-04	µCi/mL
S10R000350	Tantalum-182	<2.56E-04	µCi/mL
S10R000350	Gold-198	<8.04E-04	µCi/mL
S10R000350	Mercury-203	<6.47E-04	µCi/mL
S10R000350	Bismuth-207	<9.91E-05	µCi/mL
S10R000350	Thallium-208	<5.68E-04	µCi/mL
S10R000350	Lead-210	<0.157	µCi/mL
S10R000350	Bismuth-212	<5.58E-04	µCi/mL
S10R000350	Lead-212	<1.11E-03	µCi/mL
S10R000350	Bismuth-214	<1.08E-03	µCi/mL
S10R000350	Lead-214	<1.61E-03	µCi/mL

S10R000350	Radium-224	<0.0125	µCi/mL
S10R000350	Radium-226	<0.0145	µCi/mL
S10R000350	Actinium-228	<2.54E-04	µCi/mL
S10R000350	Thorium-228	<0.0480	µCi/mL
S10R000350	Thorium-229	<4.11E-03	µCi/mL
S10R000350	Uranium-232	<0.882	µCi/mL
S10R000350	Protactinium-233	<1.43E-03	µCi/mL
S10R000350	Uranium/Thorium-233	<0.447	µCi/mL
S10R000350	Protactinium-234	<0.0107	µCi/mL
S10R000350	Thorium-234	<0.0374	µCi/mL
S10R000350	Uranium-235	<8.75E-04	µCi/mL
S10R000350	Neptunium-237	<4.69E-03	µCi/mL
S10R000350	Uranium-237	<1.81E-03	µCi/mL
S10R000350	Neptunium-238	<2.48E-04	µCi/mL
S10R000350	Neptunium-239	<1.93E-03	µCi/mL
S10R000350	Plutonium-239	<6.44	µCi/mL
S10R000350	Americium-241	<4.26E-03	µCi/mL
S10R000350	Americium-243	<1.36E-03	µCi/mL
NON GEA RADIONUCLIDE ANALYSIS (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000350	Thorium-229	<2.25E-05	µg/mL
S10R000350	Thorium-230	<1.75E-05	µg/mL
S10R000350	Protactinium-231	<1.75E-05	µg/mL
S10R000350	Thorium-232	<1.25E-03	µg/mL
S10R000350	Uranium-233	1.17E-04	µg/mL
S10R000350	Uranium-234	7.89E-05	µg/mL
S10R000350	Uranium-235	0.0106	µg/mL
S10R000350	Uranium-236	2.28E-04	µg/mL
S10R000350	Neptunium-237	4.34E-04	µg/mL
S10R000350	Uranium-238	1.68	µg/mL
S10R000350	Plutonium-239	1.75E-03	µg/mL
S10R000350	Plutonium-240	1.22E-04	µg/mL
S10R000350	Americium-241	<5.00E-04	µg/mL
S10R000350	Plutonium-242	<1.00E-05	µg/mL
S10R000350	Americium-243	<1.25E-05	µg/mL
S10R000350	Plutonium-244	<2.25E-05	µg/mL
S10R000350	Strontium-90	0.0284	µCi/mL
S10R000350	Technetium-99	0.0800	µCi/mL
TOTAL INORGANIC CARBON (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000350	TIC	Not Analyzed	

HYDROXIDE (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000350	Hydroxide	8.75E+03	µg/mL

APPENDIX F: CHEMICAL COMPOSITION OF DISSOLVED SALTCAKE FROM TANK 241-SX-105 AFTER FILTRATION AND AFTER IE-911® CONTACT

(Data Summary of Chemical Analyses as Provided by Advanced Technologies and Laboratories International, Inc.).

ION CHROMATOGRAPH RESULTS (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000305	Fluoride	6.98E+02	µg/mL
S10R000305	Glycolate	<1.99E+02	µg/mL
S10R000305	Acetate	3.90E+02	µg/mL
S10R000305	Formate	5.03E+02	µg/mL
S10R000305	Chloride	2.35E+03	µg/mL
S10R000305	Nitrite	3.62E+04	µg/mL
S10R000305	Sulfate	5.27E+03	µg/mL
S10R000305	Oxalate	5.67E+02	µg/mL
S10R000305	Bromide	<1.23E+02	µg/mL
S10R000305	Nitrate	1.39E+05	µg/mL
S10R000305	Phosphate	7.95E+03	µg/mL
INDUCTIVELY COUPLED PLASMA (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000305	Silver	<5.00	µg/mL
S10R000305	Aluminum	1.01E+04	µg/mL
S10R000305	Arsenic	<50.0	µg/mL
S10R000305	Boron	3.19E+01	µg/mL
S10R000305	Barium	<3.00	µg/mL
S10R000305	Beryllium	<1.00	µg/mL
S10R000305	Bismuth	<100	µg/mL
S10R000305	Calcium	<50.0	µg/mL
S10R000305	Cadmium	<5.00	µg/mL
S10R000305	Cerium	<30.0	µg/mL
S10R000305	Cobalt	<10.0	µg/mL
S10R000305	Chromium	9.33E+02	µg/mL
S10R000305	Copper	<5.00	µg/mL
S10R000305	Europium	<5.00	µg/mL
S10R000305	Iron	<5.00	µg/mL
S10R000305	Potassium	556	µg/mL
S10R000305	Lanthanum	<3.00	µg/mL
S10R000305	Lithium	<3.00	µg/mL
S10R000305	Magnesium	<50.0	µg/mL
S10R000305	Manganese	<3.00	µg/mL
S10R000305	Molybdenum	<20.0	µg/mL
S10R000305	Sodium	1.18E+05	µg/mL
S10R000305	Neodymium	<10.0	µg/mL
S10R000305	Nickel	<20.0	µg/mL
S10R000305	Phosphorus	2.73E+03	µg/mL
S10R000305	Lead	<50.0	µg/mL

S10R000305	Sulfur	1.84E+03	µg/mL
S10R000305	Antimony	<50.0	µg/mL
S10R000305	Selenium	<100	µg/mL
S10R000305	Samarium	<50.0	µg/mL
S10R000305	Strontium	<3.00	µg/mL
S10R000305	Thorium	<50.0	µg/mL
S10R000305	Titanium	<5.00	µg/mL
S10R000305	Thallium	<100	µg/mL
S10R000305	Uranium	<100	µg/mL
S10R000305	Vanadium	<5.00	µg/mL
S10R000305	Yttrium	<2.00	µg/mL
S10R000305	Zinc	7.00	µg/mL
S10R000305	Zirconium	<5.00	µg/mL
GAMMA ENERGY ANALYSIS (GEA) (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000305	Beryllium-7	<2.79E-04	µCi/mL
S10R000305	Sodium-22	<3.18E-05	µCi/mL
S10R000305	Sodium-24	<2.93E-05	µCi/mL
S10R000305	Aluminum-28	<9.98E-04	µCi/mL
S10R000305	Chlorine-38	<2.23E-04	µCi/mL
S10R000305	Potassium-40	<7.58E-04	µCi/mL
S10R000305	Argon-41	<5.06E-05	µCi/mL
S10R000305	Scandium-46	<3.84E-05	µCi/mL
S10R000305	Chromium-51	<2.39E-04	µCi/mL
S10R000305	Manganese-54	<3.00E-05	µCi/mL
S10R000305	Cobalt-56	<2.98E-05	µCi/mL
S10R000305	Manganese-56	<4.13E-05	µCi/mL
S10R000305	Cobalt-57	<2.27E-05	µCi/mL
S10R000305	Cobalt-58	<2.86E-05	µCi/mL
S10R000305	Iron-59	<5.28E-05	µCi/mL
S10R000305	Cobalt-60	<3.13E-05	µCi/mL
S10R000305	Copper-64	<6.78E-03	µCi/mL
S10R000305	Zinc-65	<7.64E-05	µCi/mL
S10R000305	Copper-66	<6.96E-03	µCi/mL
S10R000305	Selenium-75	<3.73E-05	µCi/mL
S10R000305	Selenium-79	<6.61E-03	µCi/mL
S10R000305	Krypton-85	<8.67E-03	µCi/mL
S10R000305	Strontium-85	<3.76E-05	µCi/mL
S10R000305	Yttrium-88	<2.29E-05	µCi/mL
S10R000305	Yttrium-91	<0.0108	µCi/mL
S10R000305	Niobium-94	<2.81E-05	µCi/mL

S10R000305	Zirconium/Niobium-95	<5.74E-05	µCi/mL
S10R000305	Ruthenium-103	<3.21E-05	µCi/mL
S10R000305	Ruthenium/Rhodium-106	<5.77E-04	µCi/mL
S10R000305	Silver-108	<3.56E-05	µCi/mL
S10R000305	Silver-110	<7.26E-05	µCi/mL
S10R000305	Tin-113	<4.27E-05	µCi/mL
S10R000305	Tellurium-123	<2.25E-05	µCi/mL
S10R000305	Antimony-124	<3.02E-05	µCi/mL
S10R000305	Antimony-125	<9.87E-05	µCi/mL
S10R000305	Tellurium-125	<0.0530	µCi/mL
S10R000305	Antimony-126	1.67E-04	µCi/mL
S10R000305	Tin-126	<7.11E-05	µCi/mL
S10R000305	Iodine-129	<0.0441	µCi/mL
S10R000305	Iodine-131	<3.35E-05	µCi/mL
S10R000305	Xenon-131	<9.33E-04	µCi/mL
S10R000305	Barium-133	<4.28E-05	µCi/mL
S10R000305	Cesium-134	<3.41E-05	µCi/mL
S10R000305	Cesium-136	<2.84E-05	µCi/mL
S10R000305	Cesium-137	3.88E-04	µCi/mL
S10R000305	Cesium-138	<1.28E-04	µCi/mL
S10R000305	Cerium-139	<2.28E-05	µCi/mL
S10R000305	Barium-140	<1.06E-04	µCi/mL
S10R000305	Lanthanum-140	<2.68E-05	µCi/mL
S10R000305	Cerium-141	<3.85E-05	µCi/mL
S10R000305	Cerium-144	<1.71E-04	µCi/mL
S10R000305	Cerium/Praseodymium-144	<3.43E-04	µCi/mL
S10R000305	Europium-152	<1.56E-04	µCi/mL
S10R000305	Europium-154	<9.24E-05	µCi/mL
S10R000305	Europium-155	<1.01E-04	µCi/mL
S10R000305	Hafnium-181	<3.66E-05	µCi/mL
S10R000305	Tantalum-182	<1.09E-04	µCi/mL
S10R000305	Gold-198	<4.50E-05	µCi/mL
S10R000305	Mercury-203	<2.85E-05	µCi/mL
S10R000305	Bismuth-207	<3.92E-05	µCi/mL
S10R000305	Thallium-208	<3.35E-05	µCi/mL
S10R000305	Lead-210	<7.60E-03	µCi/mL
S10R000305	Bismuth-212	<2.54E-04	µCi/mL
S10R000305	Lead-212	<5.28E-05	µCi/mL
S10R000305	Bismuth-214	<7.38E-05	µCi/mL
S10R000305	Lead-214	<7.11E-05	µCi/mL

S10R000305	Radium-224	<5.98E-04	µCi/mL
S10R000305	Radium-226	<6.32E-04	µCi/mL
S10R000305	Actinium-228	<1.25E-04	µCi/mL
S10R000305	Thorium-228	<2.78E-03	µCi/mL
S10R000305	Thorium-229	<2.04E-04	µCi/mL
S10R000305	Uranium-232	<0.0445	µCi/mL
S10R000305	Protactinium-233	<6.15E-05	µCi/mL
S10R000305	Uranium/Thorium-233	<0.0210	µCi/mL
S10R000305	Protactinium-234	<4.81E-03	µCi/mL
S10R000305	Thorium-234	<2.01E-03	µCi/mL
S10R000305	Uranium-235	<3.85E-05	µCi/mL
S10R000305	Neptunium-237	<2.63E-04	µCi/mL
S10R000305	Uranium-237	<8.88E-05	µCi/mL
S10R000305	Neptunium-238	<1.16E-04	µCi/mL
S10R000305	Neptunium-239	<9.43E-05	µCi/mL
S10R000305	Plutonium-239	<0.322	µCi/mL
S10R000305	Americium-241	<2.17E-04	µCi/mL
S10R000305	Americium-243	<7.21E-05	µCi/mL
NON GEA RADIONUCLIDE ANALYSIS (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000305	Iodine-129	8.12E-05	µCi/mL
S10R000305	Thorium-229	<9.00E-06	µg/mL
S10R000305	Thorium-230	<7.00E-06	µg/mL
S10R000305	Protactinium-231	<7.00E-06	µg/mL
S10R000305	Thorium-232	1.03E-03	µg/mL
S10R000305	Uranium-233	1.87E-05	µg/mL
S10R000305	Uranium-234	2.48E-05	µg/mL
S10R000305	Uranium-235	2.28E-03	µg/mL
S10R000305	Uranium-236	5.21E-05	µg/mL
S10R000305	Neptunium-237	<1.00E-04	µg/mL
S10R000305	Uranium-238	0.362	µg/mL
S10R000305	Plutonium-239	<5.00E-04	µg/mL
S10R000305	Plutonium-240	1.46E-05	µg/mL
S10R000305	Americium-241	<2.00E-04	µg/mL
S10R000305	Plutonium-242	<4.00E-06	µg/mL
S10R000305	Americium-243	<5.00E-06	µg/mL
S10R000305	Plutonium-244	<9.00E-06	µg/mL
S10R000305	Strontium-89/90	1.59E-04	µCi/mL
S10R000305	Technetium-99	0.0719	µCi/mL
TOTAL INORGANIC CARBON (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT

S10R000305	TIC	4.92E+03	µg/mL
HYDROXIDE (SX-105)			
SAMPLE	ANALYTE	RESULT	UNIT
S10R000305	OH	9.2E+03	µg/mL

APPENDIX G: CHEMICAL COMPOSITION OF SUPERNATE FROM COMPOSITE OF TANKS AZ-101/102 AFTER FILTRATION BEFORE IE-911® CONTACT

(Data Summary of Chemical Analyses as Provided by Advanced Technologies and Laboratories International, Inc.).

ION CHROMATOGRAPHY RESULTS (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T012532	Fluoride	1.19E+03	µg/mL
S10T012532	Glycolate	56.7	µg/mL
S10T012532	Acetate	176	µg/mL
S10T012532	Formate	284	µg/mL
S10T012532	Chloride	1.08E+03	µg/mL
S10T012532	Nitrite	5.78E+04	µg/mL
S10T012532	Sulfate	1.37E+04	µg/mL
S10T012532	Oxalate	1.33E+03	µg/mL
S10T012532	Bromide	<64.4	µg/mL
S10T012532	Nitrate	6.96E+04	µg/mL
S10T012532	Phosphate	2.03E+03	µg/mL
INDUCTIVELY COUPLED PLASMA (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T012532	Silver	<2.50	µg/mL
S10T012532	Aluminum	5.92E+03	µg/mL
S10T012532	Arsenic	<25.0	µg/mL
S10T012532	Boron	<15.0	µg/mL
S10T012532	Barium	<1.50	µg/mL
S10T012532	Beryllium	<0.500	µg/mL
S10T012532	Bismuth	<50.0	µg/mL
S10T012532	Calcium	<25.0	µg/mL
S10T012532	Cadmium	4.02	µg/mL
S10T012532	Cerium	<15.0	µg/mL
S10T012532	Cobalt	<5.00	µg/mL
S10T012532	Chromium	726	µg/mL
S10T012532	Copper	<2.50	µg/mL
S10T012532	Europium	<2.50	µg/mL
S10T012532	Iron	11.8	µg/mL
S10T012532	Potassium	3.72E+03	µg/mL
S10T012532	Lanthanum	<1.50	µg/mL
S10T012532	Lithium	<1.50	µg/mL
S10T012532	Magnesium	<25.0	µg/mL
S10T012532	Manganese	<1.50	µg/mL
S10T012532	Molybdenum	67.9	µg/mL
S10T012532	Sodium	9.49E+04	µg/mL
S10T012532	Neodymium	<5.00	µg/mL
S10T012532	Nickel	<10.0	µg/mL
S10T012532	Niobium	<15.0	µg/mL
S10T012532	Phosphorus	736	µg/mL
S10T012532	Lead	<25.0	µg/mL
S10T012532	Palladium	<50.0	µg/mL
S10T012532	Praseodymium	<5.00	µg/mL
S10T012532	Rubidium	<500	µg/mL
S10T012532	Rhodium	<25.0	µg/mL
S10T012532	Ruthenium	<15.0	µg/mL

S10T012532	Sulfur	4.69E+03	µg/mL
S10T012532	Antimony	<25.0	µg/mL
S10T012532	Selenium	<50.0	µg/mL
S10T012532	Silicon	61.9	µg/mL
S10T012532	Samarium	<10.0	µg/mL
S10T012532	Tin	29.1	µg/mL
S10T012532	Strontium	<1.50	µg/mL
S10T012532	Tantalum	<25.0	µg/mL
S10T012532	Tellurium	<50.0	µg/mL
S10T012532	Thorium	<25.0	µg/mL
S10T012532	Titanium	<2.50	µg/mL
S10T012532	Thallium	<50.0	µg/mL
S10T012532	Uranium	<50.0	µg/mL
S10T012532	Vanadium	<2.50	µg/mL
S10T012532	Tungsten	<100	µg/mL
S10T012532	Yttrium	<1.00	µg/mL
S10T012532	Zinc	<2.50	µg/mL
S10T012532	Zirconium	<2.50	µg/mL
GAMMA ENERGY ANALYSIS (GEA) (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T012532	Beryllium-7	<2.84	µCi/mL
S10T012532	Sodium-22	<0.0122	µCi/mL
S10T012532	Sodium-24	<9.92E-03	µCi/mL
S10T012532	Aluminum-28	<0.355	µCi/mL
S10T012532	Chlorine-38	<0.0696	µCi/mL
S10T012532	Potassium-40	<0.235	µCi/mL
S10T012532	Argon-41	<0.0167	µCi/mL
S10T012532	Scandium-46	<0.0222	µCi/mL
S10T012532	Chromium-51	<1.98	µCi/mL
S10T012532	Manganese-54	<0.0191	µCi/mL
S10T012532	Cobalt-56	<0.0208	µCi/mL
S10T012532	Manganese-56	<0.0293	µCi/mL
S10T012532	Cobalt-57	<0.133	µCi/mL
S10T012532	Cobalt-58	<0.0192	µCi/mL
S10T012532	Iron-59	<0.0369	µCi/mL
S10T012532	Cobalt-60	<1.07E-02	µCi/mL
S10T012532	Copper-64	<2.11	µCi/mL
S10T012532	Zinc-65	<0.0437	µCi/mL
S10T012532	Copper-66	<4.21	µCi/mL
S10T012532	Selenium-75	<0.302	µCi/mL
S10T012532	Selenium-79	<29.7	µCi/mL
S10T012532	Krypton-85	<54.0	µCi/mL
S10T012532	Strontium-85	<0.234	µCi/mL
S10T012532	Yttrium-88	<8.18E-03	µCi/mL
S10T012532	Yttrium-91	<4.81	µCi/mL
S10T012532	Niobium-94	<0.0198	µCi/mL
S10T012532	Zirconium/Niobium-95	<0.0371	µCi/mL
S10T012532	Ruthenium-103	<0.269	µCi/mL

S10T012532	Ruthenium/Rhodium-106	<2.93	µCi/mL
S10T012532	Silver-108	<0.0216	µCi/mL
S10T012532	Cadmium-109	<2.07	µCi/mL
S10T012532	Silver-110	<1.48	µCi/mL
S10T012532	Tin-113	<0.355	µCi/mL
S10T012532	Tellurium-123	<0.157	µCi/mL
S10T012532	Antimony-124	<0.149	µCi/mL
S10T012532	Antimony-125	<0.950	µCi/mL
S10T012532	Tellurium-125	<0.0775	µCi/mL
S10T012532	Antimony-126	<0.0407	µCi/mL
S10T012532	Tin-126	<0.219	µCi/mL
S10T012532	Iodine-129	<0.127	µCi/mL
S10T012532	Iodine-131	<0.263	µCi/mL
S10T012532	Xenon-131	<6.80	µCi/mL
S10T012532	Barium-133	<0.347	µCi/mL
S10T012532	Cesium-134	<0.149	µCi/mL
S10T012532	Cesium-136	<0.0194	µCi/mL
S10T012532	Cesium-137	8.37E+02	µCi/mL
S10T012532	Cesium-138	<0.0372	µCi/mL
S10T012532	Cerium-139	<0.166	µCi/mL
S10T012532	Barium-140	<0.809	µCi/mL
S10T012532	Lanthanum-140	<9.84E-03	µCi/mL
S10T012532	Cerium-141	<0.249	µCi/mL
S10T012532	Cerium-144	<1.06	µCi/mL
S10T012532	Cerium/Praseodymium-144	<2.12	µCi/mL
S10T012532	Europium-152	<0.0448	µCi/mL
S10T012532	Europium-154	<0.0355	µCi/mL
S10T012532	Europium-155	<0.478	µCi/mL
S10T012532	Hafnium-181	<0.334	µCi/mL
S10T012532	Tantalum-182	<0.0634	µCi/mL
S10T012532	Gold-198	<0.263	µCi/mL
S10T012532	Mercury-203	<0.238	µCi/mL
S10T012532	Bismuth-207	<0.0243	µCi/mL
S10T012532	Thallium-208	<0.176	µCi/mL
S10T012532	Lead-210	<2.35	µCi/mL
S10T012532	Bismuth-212	<0.165	µCi/mL
S10T012532	Lead-212	<0.396	µCi/mL
S10T012532	Bismuth-214	<0.315	µCi/mL
S10T012532	Lead-214	<0.555	µCi/mL
S10T012532	Radium-224	<4.51	µCi/mL
S10T012532	Radium-226	<7.64	µCi/mL
S10T012532	Actinium-228	<0.0718	µCi/mL
S10T012532	Thorium-228	<6.36	µCi/mL
S10T012532	Thorium-229	<0.906	µCi/mL
S10T012532	Uranium-232	<45.2	µCi/mL
S10T012532	Protactinium-233	<0.497	µCi/mL
S10T012532	Uranium/Thorium-233	<162	µCi/mL

S10T012532	Protactinium-234	<2.73	µCi/mL
S10T012532	Thorium-234	<2.36	µCi/mL
S10T012532	Uranium-235	<0.464	µCi/mL
S10T012532	Neptunium-237	<0.622	µCi/mL
S10T012532	Uranium-237	<0.407	µCi/mL
S10T012532	Neptunium-238	<0.0631	µCi/mL
S10T012532	Neptunium-239	<0.465	µCi/mL
S10T012532	Plutonium-239	<1.87E+03	µCi/mL
S10T012532	Americium-241	<0.251	µCi/mL
S10T012532	Americium-243	<0.132	µCi/mL
NON GEA RADIONUCLIDE ANALYSIS (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
Not Carried out on the Pre-IX sample			
TOTAL INORGANIC CARBON (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T012532	TIC	8.16E+03	µg/mL
HYDROXIDE (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T012532	OH	9.2E+03	µg/mL

APPENDIX H: CHEMICAL COMPOSITION OF AZ-101/102 COMPOSITE AFTER IE-911® CONTACT

(Data Summary of Chemical Analyses as Provided by Advanced Technologies and Laboratories International, Inc.).

ION CHROMATOGRAPH RESULTS (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T013402	Fluoride	1.38E+03	µg/mL
S10T013402	Glycolate	57.8	µg/mL
S10T013402	Acetate	173	µg/mL
S10T013402	Formate	314	µg/mL
S10T013402	Chloride	1.10E+03	µg/mL
S10T013402	Nitrite	6.14E+04	µg/mL
S10T013402	Sulfate	1.55E+04	µg/mL
S10T013402	Oxalate	1.41E+03	µg/mL
S10T013402	Bromide	<58.0	µg/mL
S10T013402	Nitrate	7.74E+04	µg/mL
S10T013402	Phosphate	2.37E+03	µg/mL
INDUCTIVELY COUPLED PLASMA (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T013402	Silver	<5.00	µg/mL
S10T013402	Aluminum	6.20E+03	µg/mL
S10T013402	Arsenic	<50.0	µg/mL
S10T013402	Boron	<30.0	µg/mL
S10T013402	Barium	<3.00	µg/mL
S10T013402	Beryllium	<1.00	µg/mL
S10T013402	Bismuth	<100	µg/mL
S10T013402	Calcium	<50.0	µg/mL
S10T013402	Cadmium	<5.00	µg/mL
S10T013402	Cerium	<30.0	µg/mL
S10T013402	Cobalt	<10.0	µg/mL
S10T013402	Chromium	768	µg/mL
S10T013402	Copper	<5.00	µg/mL
S10T013402	Europium	<5.00	µg/mL
S10T013402	Iron	8.09	µg/mL
S10T013402	Potassium	3.66E+03	µg/mL
S10T013402	Lanthanum	<3.00	µg/mL
S10T013402	Lithium	<3.00	µg/mL
S10T013402	Magnesium	<50.0	µg/mL
S10T013402	Manganese	<3.00	µg/mL
S10T013402	Molybdenum	62.1	µg/mL
S10T013402	Sodium	1.13E+05	µg/mL
S10T013402	Neodymium	<10.0	µg/mL
S10T013402	Nickel	<20.0	µg/mL
S10T013402	Niobium	51.2	µg/mL
S10T013402	Phosphorus	791	µg/mL
S10T013402	Lead	<50.0	µg/mL
S10T013402	Palladium	<100	µg/mL
S10T013402	Praseodymium	<10.0	µg/mL
S10T013402	Rubidium	<1.00E+03	µg/mL
S10T013402	Rhodium	<50.0	µg/mL
S10T013402	Ruthenium	<30.0	µg/mL
S10T013402	Sulfur	4.87E+03	µg/mL

S10T013402	Antimony	<50.0	µg/mL
S10T013402	Selenium	<100	µg/mL
S10T013402	Silicon	56.7	µg/mL
S10T013402	Samarium	<20.0	µg/mL
S10T013402	Tin	32.4	µg/mL
S10T013402	Strontium	<3.00	µg/mL
S10T013402	Tantalum	<50.0	µg/mL
S10T013402	Tellurium	<100	µg/mL
S10T013402	Thorium	<50.0	µg/mL
S10T013402	Titanium	6.44	µg/mL
S10T013402	Thallium	<100	µg/mL
S10T013402	Uranium	<100	µg/mL
S10T013402	Vanadium	<5.00	µg/mL
S10T013402	Tungsten	<200	µg/mL
S10T013402	Yttrium	<2.00	µg/mL
S10T013402	Zinc	<5.00	µg/mL
S10T013402	Zirconium	6.25	µg/mL
S10T013402	Mercury	0.0102	µg/mL
GAMMA ENERGY ANALYSIS (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T013402	Curium-243/244	<1.71E-06	µCi/mL
S10T013402	Americium-241	3.02E-05	µCi/mL
S10T013402	Curium-242	<1.71E-06	µCi/mL
S10T013402	Beryllium-7	<3.93E-04	µCi/mL
S10T013402	Sodium-22	<3.73E-05	µCi/mL
S10T013402	Sodium-24	<3.31E-05	µCi/mL
S10T013402	Aluminum-28	<8.58E-04	µCi/mL
S10T013402	Chlorine-38	<2.23E-04	µCi/mL
S10T013402	Potassium-40	<7.80E-04	µCi/mL
S10T013402	Argon-41	<5.26E-05	µCi/mL
S10T013402	Scandium-46	<3.99E-05	µCi/mL
S10T013402	Chromium-51	<3.32E-04	µCi/mL
S10T013402	Manganese-54	<3.44E-05	µCi/mL
S10T013402	Cobalt-56	<3.58E-05	µCi/mL
S10T013402	Manganese-56	<4.96E-05	µCi/mL
S10T013402	Cobalt-57	<4.15E-05	µCi/mL
S10T013402	Cobalt-58	<3.28E-05	µCi/mL
S10T013402	Iron-59	<7.01E-05	µCi/mL
S10T013402	Cobalt-60	1.88E-04	µCi/mL
S10T013402	Copper-64	<7.18E-03	µCi/mL
S10T013402	Zinc-65	<8.21E-05	µCi/mL
S10T013402	Copper-66	<8.48E-03	µCi/mL
S10T013402	Selenium-75	<5.17E-05	µCi/mL
S10T013402	Selenium-79	<0.0125	µCi/mL
S10T013402	Krypton-85	<1.01E-02	µCi/mL
S10T013402	Strontium-85	<4.38E-05	µCi/mL
S10T013402	Yttrium-88	<2.03E-05	µCi/mL
S10T013402	Yttrium-91	<0.0110	µCi/mL

S10T013402	Niobium-94	<3.76E-05	µCi/mL
S10T013402	Zirconium/Niobium-95	<6.91E-05	µCi/mL
S10T013402	Ruthenium-103	<4.46E-05	µCi/mL
S10T013402	Ruthenium/Rhodium-106	<7.37E-04	µCi/mL
S10T013402	Silver-108	<4.58E-05	µCi/mL
S10T013402	Cadmium-109	<1.81E-03	µCi/mL
S10T013402	Silver-110	<7.62E-05	µCi/mL
S10T013402	Tin-113	<5.80E-05	µCi/mL
S10T013402	Tellurium-123	<3.66E-05	µCi/mL
S10T013402	Antimony-124	<3.72E-05	µCi/mL
S10T013402	Antimony-125	<1.38E-04	µCi/mL
S10T013402	Tellurium-125	<0.0890	µCi/mL
S10T013402	Antimony-126	<2.91E-05	µCi/mL
S10T013402	Tin-126	1.09E-03	µCi/mL
S10T013402	Iodine-129	<0.0731	µCi/mL
S10T013402	Iodine-131	<4.53E-05	µCi/mL
S10T013402	Xenon-131	<1.58E-03	µCi/mL
S10T013402	Barium-133	<5.73E-05	µCi/mL
S10T013402	Cesium-134	<3.93E-05	µCi/mL
S10T013402	Cesium-136	<3.69E-05	µCi/mL
S10T013402	Cesium-137	3.79E-04	µCi/mL
S10T013402	Cesium-138	<1.30E-04	µCi/mL
S10T013402	Cerium-139	<3.84E-05	µCi/mL
S10T013402	Barium-140	<1.39E-04	µCi/mL
S10T013402	Lanthanum-140	<2.76E-05	µCi/mL
S10T013402	Cerium-141	<6.25E-05	µCi/mL
S10T013402	Cerium-144	<2.88E-04	µCi/mL
S10T013402	Cerium/Praseodymium-144	<5.75E-04	µCi/mL
S10T013402	Europium-152	<1.51E-04	µCi/mL
S10T013402	Europium-154	<1.08E-04	µCi/mL
S10T013402	Europium-155	<1.82E-04	µCi/mL
S10T013402	Hafnium-181	<4.99E-05	µCi/mL
S10T013402	Tantalum-182	<1.12E-04	µCi/mL
S10T013402	Gold-198	<8.35E-05	µCi/mL
S10T013402	Mercury-203	<3.97E-05	µCi/mL
S10T013402	Bismuth-207	<5.09E-05	µCi/mL
S10T013402	Thallium-208	<4.06E-05	µCi/mL
S10T013402	Lead-210	<0.0124	µCi/mL
S10T013402	Bismuth-212	<3.04E-04	µCi/mL
S10T013402	Lead-212	<7.30E-05	µCi/mL
S10T013402	Bismuth-214	<8.08E-05	µCi/mL
S10T013402	Lead-214	<9.32E-05	µCi/mL
S10T013402	Radium-224	<8.41E-04	µCi/mL
S10T013402	Radium-226	<9.93E-04	µCi/mL
S10T013402	Actinium-228	<1.57E-04	µCi/mL
S10T013402	Thorium-228	<5.36E-03	µCi/mL
S10T013402	Thorium-229	<3.76E-04	µCi/mL
S10T013402	Uranium-232	<0.0764	µCi/mL

S10T013402	Protactinium-233	<8.63E-05	µCi/mL
S10T013402	Uranium/Thorium-233	<0.0301	µCi/mL
S10T013402	Protactinium-234	<5.53E-03	µCi/mL
S10T013402	Thorium-234	<3.50E-03	µCi/mL
S10T013402	Uranium-235	<6.07E-05	µCi/mL
S10T013402	Neptunium-237	<5.42E-04	µCi/mL
S10T013402	Uranium-237	<1.65E-04	µCi/mL
S10T013402	Neptunium-238	<1.38E-04	µCi/mL
S10T013402	Neptunium-239	<1.76E-04	µCi/mL
S10T013402	Plutonium-239	<0.529	µCi/mL
S10T013402	Americium-241	<3.82E-04	µCi/mL
S10T013402	Americium-243	<1.31E-04	µCi/mL
NON GEA RADIONUCLIDE ANALYSIS (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T013402	Curium-243/244	<1.71E-06	µCi/mL
S10T013402	Americium-241	3.02E-05	µCi/mL
S10T013402	Curium-242	<1.71E-06	µCi/mL
S10T013402	Plutonium-239/240	4.79E-04	µCi/mL
S10T013402	Plutonium-238	5.12E-05	µCi/mL
S10T013402	Strontium-89/90	5.73E-05	µCi/mL
S10T013402	Technetium-99	2.42E-01	µCi/mL
S10T013402	Iodine-129	4.30E-05	µCi/mL
TOTAL INORGANIC CARBON (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T013402	TIC	8.18E+03	µg/mL
HYDROXIDE (AZ-101/102)			
SAMPLE	ANALYTE	RESULT	UNIT
S10T013402	OH	9.6E+03	µg/mL

Electronically Approved by:

UserName: Duncan, James (h0079048)
Title: APD Chemist
Date: Friday, 08 April 2011, 01:51 PM Pacific Time
Meaning: Approved by the author or delegate
==========

UserName: Swanberg, David (h0033921)
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Date: Monday, 11 April 2011, 03:52 PM Pacific Time
Meaning: Approved by the customer or delegate
==========

UserName: Seidel, Cary (h0009079)
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Date: Thursday, 14 April 2011, 08:43 AM Pacific Time
Meaning: Approved by the APD Manager or delegate
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