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ENGINEERING DATA TRANSMITTAL

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ANALYSIS OF WATER FROM K WEST BASIN CANISTERS (SECOND CAMPAIGN)

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Abstract: The barrels of 50 canisters in the K West Basin were sampled for gas and liquid in a sampling campaign during 1996. Analysis of the liquid samples for fission products, uranium, corrosion inhibitor materials and pH was performed at the 222-S Laboratory. The results of these analyses is reported and compared to results from similar samples taken during the first sampling campaign in 1995.

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EXECUTIVE SUMMARY

The water in 50 spent fuel storage canisters in the Hanford K West Basin was sampled and analyzed for fission products, total uranium, corrosion inhibitor, and pH. Cesium-137 was the primary dissolved fission product found with smaller amounts of strontium-90, cesium-134, tritium, plutonium, and cobalt-60. Americium-241 was below detection limits and uranium averaged 350 milligrams per barrel. Corrosion inhibitor in the water, as measured by potassium, ranged from below detection limits (20 μg/mL) to 573 μg/mL. Fifty percent of the 80 barrels evaluated for potassium were below detection limits. The pH of the canister water ranged from 6.3 to 11.8 and averaged 8.6.

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ANALYSIS OF WATER FROM K WEST BASIN CANISTERS (SECOND CAMPAIGN)

1.0 INTRODUCTION

Gas and liquid samples have been obtained from a selection of the approximately 3,820 spent fuel storage canisters in the K West Basin. The samples were taken to characterize the contents of the gas and water in the canisters. The data will provide source term information for two subprojects of the Spent Nuclear Fuel Project (SNFP) (Fulton 1994): the K Basins Integrated Water Treatment System subproject (Ball 1996) and the K Basins Fuel Retrieval System subproject (Waymire 1996).

The barrels of ten canisters were sampled in 1995, and 50 canisters were sampled in a second campaign in 1996. The analysis results for the gas and liquid samples of the first campaign have been reported (Trimble 1995a; Trimble 1995b; Trimble 1996a; Trimble 1996b). An analysis of cesium-137 (^{137}Cs) data from the second campaign samples was reported (Trimble and Welsh 1997), and the gas sample results are documented in Trimble 1997. This report documents the results of all analytes of liquid samples from the second campaign.

The fuel storage canisters consist of two closed and sealed barrels. The barrels are attached at a trunion to make a canister but are otherwise independent. A schematic of a single canister barrel is shown in Figure 1. Each barrel contains up to seven N Reactor fuel element assemblies. When the canisters were loaded and sealed, 10 g of potassium nitrite was added to the water of each barrel providing about 500 ppm of nitrite for a corrosion inhibitor (Trimble 1996b). A gas space of nitrogen was established in the top 2.2 to 2.5 inches (5.6 to 6.4 cm) of each barrel. Many of the fuel elements were damaged allowing the metallic uranium fuel to be corroded by the canister water. The corrosion releases fission products and generates hydrogen gas. The gas passes through the gas trap into the basin water, but the canister water is not allowed to be exchanged with basin water.

The canister selection and sample evaluation were in accordance with data quality objectives provided by Makenas 1996: (1) to help guide subsequent fuel and sludge sampling in the K West Basin by providing information about the condition of the fuel in specific canisters, (2) to provide information for comparison to the fuel and sludge sample examinations, and (3) to provide information to water cleanup and air permits associated with moving the fuel to dry storage. The canisters selected included both canister types, Mark I (MKI) and Mark II (MKII), and all three N Reactor fuel types, Mark IA (1.25% enriched) and Mark IV (0.95% and 0.71% enriched). Canisters containing documented fuel breaks and scrap fuel (chips) were also selected. In addition canisters with a range of discharge-date keys, fuel burnup (^{240}Pu%), and encapsulation dates were sampled. Also several MKII canisters with broken locking bars indicating a leaky lid seal, and a few with grade "D" fuel were among the selections. Grade "D" fuel was stored for a time in the K East Basin before being encapsulated at the N Basin. All other K West Basin fuel have resided only in the N Reactor Basin before being encapsulated and shipped to the K Basin site. Table 1 contains a listing and description of the sampled canisters.

Figure 1. A Mark II Canister Barrel.

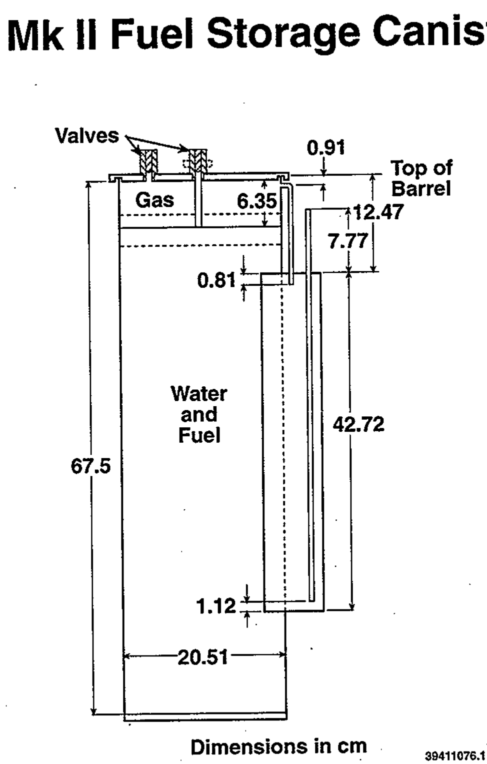

Table 1. K West Basin Canisters Sampled in 1996 (Second Campaign).

CANISTER DESCRIPTION							FUEL DESCRIPTION						
CANISTER		Barrel	ENCAPSULATION		LOCKING	Water	Fuel	Fuel	No. of	Broken			
S.N.	type	Material	Date	YEARS	BARS*	Vol.**(L)	type	model(s)	Assys	Fuel	Grade	Key	%Pu240
0091	MK II	S.S.	Mar-83	13.5		12.06	MIV	BE	14			13858	11.6
0102	MK I	S.S.	Feb-81	15.6		14.63	MIA	AM	14			11806	13.3
0111	MK I	Alum.	Mar-81	15.5		11.70	MIV	BE	14			12852	12.8
0161	MK I	Alum.	Feb-81	15.6		14.63	MIA	AM	14			10832	12.5
0200	MK I	S.S.	Feb-81	15.6		14.63	MIA	AM	14			11806	13.3
0315	MK I	Alum.	Mar-81	15.5		11.70	MIV	BE	14			12852	12.8
0316	MK I	Alum.	Mar-81	15.5		11.70	MIV	BE	14			12852	12.8
0318	MK I	Alum.	Mar-81	15.5		11.70	MIV	BE	14			12852	12.8
0696	MK II	S.S.	Apr-83	13.4		14.80	MIA	AM	14			13686	12.0
0710	MK I	Alum.	May-81	15.3		11.70	MIV	BE	14			12942	12.3
0738	MK II	S.S.	Apr-83	13.4		14.80	MIA	AM	14			13686	12.0
0760	MK I	Alum.	May-81	15.3		15.31	MIV	BC	14			13015	12.7
0943	MK I	Alum.	Sep-81	15.0		11.70	MIV	BE	14	some		12852	12.8
1164	MK I	S.S.	Jul-81	15.2		14.63	MIA	AM	14			12127	13.7
1226	MK I	S.S.	Jun-81	15.3		14.76	MIA	AF+AM	3+11	1 inner		11897	13.8
1265	MK II	S.S.	Oct-82	13.9		14.80	MIA	AM	14	1 inner		12639	12.6
1443	MK II	S.S.	Mar-83	13.5		14.80	MIA	AM	14			13859	11.9
1497	MK I	S.S.	Jul-81	15.2		14.54	MIA	AM+AT	7+7	1 outer		11979	13.7
1512	MK II	S.S.	Mar-83	13.5		12.06	MIV	BE	14			13858	11.6
1556	MK I	S.S.	Aug-81	15.1		14.63	MIA	AM	14			12480	13.3
1560	MK I	Alum.	Sep-81	15.0		11.70	MIV	BE	14	inners&outers		12852	12.8
1599	MK II	S.S.	Feb-83	13.6		15.00	MIA	AM+AT	8+6			13859	11.9
1619	MK I	Alum.	Sep-81	15.0		11.70	MIV	BE	14	pieces		13017	11.0
1730	MK I	S.S.	Aug-81	15.1		14.63	MIA	AM	14			12480	13.3
1740	MK I	Alum.	Sep-81	15.0		11.70	MIV	BE	14	some		12852	12.8
1860	MK I	Alum.	Sep-81	15.0		11.70	NAT	7E	14	inners&outers		13015	11.8
2554	MK I	S.S.	Apr-82	14.4		14.63	MIA	AM	14			12942	12.6
2600	MK I	S.S.	May-82	14.3		16.78	MIA	AF	14			13525	13.0
2660	MK I	S.S.	Apr-82	14.4		14.63	MIA	AM	14			13016	12.8
2667	MK I	S.S.	Apr-82	14.4		14.63	MIA	AM	14			13371	12.5
2775	MK I	S.S.	May-82	14.3		14.63	MIA	AM	14			13525	13.0
2800	MK I	Alum.	Mar-82	14.5		11.70	MIV	BE	14			13524	12.5
5197	MK II	S.S.	unknown			12.06	MIV	BE	14		D	12852	15.9
5744	MK II	S.S.	Jul-84	12.2		14.80	MIA	AM	14	1 inner		11183	12.9
5903	MK II	S.S.	Feb-88	8.5		18.58	MIV	BC+BE+BS	1otr+4+1otr	chips		10001	9.7
6082	MK II	S.S.	Feb-88	8.5	C,U	21.17	MIV	BE+BR	1+1 outer	chips		10001	9.7
6214	MK II	S.S.	unknown		B,U	12.06	MIV	BE	14		D	11540	16.9
6513	MK II	S.S.	Jul-84	12.2		14.80	MIA	AM	14	1 outer		11109	13.2
6603	MK II	S.S.	unknown		C,U	12.06	MIV	BE	14		D	11540	17.0
6641	MK II	S.S.	unknown		B,M	12.06	MIV	BE	14		D	12565	15.4
6743	MK II	S.S.	Sep-84	12.0	B,U	14.80	MIA	AM	14			10982	13.2
6768	MK II	S.S.	Feb-88	8.5		17.69	MIV	BE+BS	6+1 inner	chips		10001	9.7
6889	MK II	S.S.	Dec-89	6.7	B,U	21.06	MIA	AM+AT	2+1 inner	chips		15244	10.4
7102	MK II	S.S.	Oct-84	11.9		14.80	MIA	AM	14	1 outer		10350	10.3
7393	MK II	S.S.	Dec-89	6.7	C,M	19.81	MIA	AF+AM+AT	1+3+1	chips		15347	10.4
7818	MK II	S.S.	Sep-89	7.0	B,M	15.03	MIA	AM+AT	7+7			15459	4.0
7913	MK II	S.S.	Oct-84	11.9		14.80	MIA	AM	14	2 outers		10350	10.3
8119	MK II	S.S.	Dec-89	6.7	B,U	14.80	MIA	AM	14			13016	12.8
9010	MK I	Alum.	Mar-82	14.5		12.50	MIV	BS	14			13372	12.4
9020	MK I	Alum.	Mar-82	14.5		12.54	MIV	BA+BE+BS	11+1+2			13524	12.5

S.N. = serial number, C = cracked, B = broken, M = marked barrel, U = unmarked barrel

* A broken locking bar indicates a leaky barrel lid.

**Flooded barrel condition

2.0 PROCEDURE

The samples were collected and analyzed in accordance with a sampling and analysis plan (SAP) (Harris 1996). Specially designed equipment was used to take the samples (Pitkoff 1994). Laboratory testing was performed to evaluate equipment performance characteristics and acceptability for field use (Prescott and Trimble 1996).

Liquid samples were taken through the canister barrel-lid center valve after venting the gas from the barrel. Venting flooded the barrel with basin water allowing the canister water to be accessed for sampling. The initial water volume was 10.7 to 20.2 L per barrel depending on canister type and loading. Canister flooding increased the water by 10 to 16%. Liquid sampling was performed 24 or more hours after flooding, allowing the canister water to mix with the introduced basin water. Mixing was enhanced by the thermal gradients caused by the decaying fuel (Trimble 1996a).

The samples were drawn into 15 and 20 mL, evacuated glass vials. The vials were potted in stainless steel sleeves to protect against breakage. A characteristic of the sampling equipment was that a small amount of non-canister water was included in the sample. This sample-dilution water consisted of sampler flush water and in-leakage of basin water (Prescott and Trimble 1996). To determine the amount of dilution per sample, 20 mL samples were taken periodically from a reference canister containing yttrium-88 (^{88}Y). This reference sample was evaluated by gamma energy analysis (GEA) and compared to actual concentration of the ^{88}Y in the reference canister, thereby gaining a measure of the sample dilution. An analysis of these data found that the dilution averaged about 5.3 mL per 20 mL sample.

The samples were weighed and analyzed before being shipped from the K Basin site. The on-site analyses used GEA providing data on cesium in the liquid and krypton-85 (^{85}Kr) in the gas. These analyses were performed by Special Analytical Studies of SGN Eurisys Services Corporation using their nondestructive analysis SAS-NDA truck. The on-site sample weighing and GEA is discussed in Appendix A.

The liquid samples were shipped to the Hanford 222-S Laboratory for more complete analysis for fission products, corrosion inhibitor ions, uranium, pH, and liquid density. Nitrate was included, as it is a possible conversion product from nitrite. A discussion of these analyses is provided in Appendix B.

The gas samples were shipped to the Hanford 325 Building for gas mass spectrography analysis. The results of these analyses were documented in a separate document (Trimble 1997).

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3.0 RESULTS

The laboratory analysis data is included in Appendices A and B. These data were corrected for sample dilution and summarized in Table 2. The corrections assumed 5.3 mL of dilution for samples over 15 mL, and samples with less than 15 mL of liquid were assumed to be proportionally less diluted. Table 2 is sorted by canister, grouping multiple samples obtained from a barrel.

Total fission product content in the canister water was of primary interest for SNFP system designs. Table 3 provides fuel material and fission product isotopes per barrel for each canister barrel sampled. The Table 3 data were calculated using the data in Table 2 and water volumes calculated for each barrel. The water volumes per barrel at the time of sampling were derived using nominal barrel dimensions and available fuel loading information. The highest analyte value was used where multiple samples from a barrel were analyzed. Corrosion inhibitor ions remain as concentrations in Table 3. Table 4 lists the summary statistics for the data in Table 3.

Table 2. K West Canister Liquid Samples and Data.

	canister	Cs-137 (uCi/mL)		Cs-134	Co-60	beta	Sr-90	tritium	alpha	uranium	Pu239/240	Pu-238	Am-241	potassium	nitrite	nitrate	
SAMPLE	barrel	SAS*	222S*	uCi/mL	uCi/mL	uCi/mL	uCi/mL	uCi/mL	uCi/mL	ug/mL	uCi/mL	uCi/mL	uCi/mL	ug/mL	ug/mL	ug/mL	pH
D052	0091M	51	51	0.218	<3.2E-03		5.9		2.26E-03				<0.025	<25			
D192	0091M	49					6.34		<4.6E-04	0.67	<1.3E-04	<1.3E-04					
D050	0091U	47					2.5		9.75E-04								7.11
D171	0102M	42	44	0.035	<1.7E-03		0.095		<2.9E-03		<2.3E-05	<2.3E-05	<0.15	230			10.78
D172	0102U	27							<2.9E-03		2.60E-05	<2.6E-05					
D061	0111M	4.4	4.5	0.009	<1.5E-04				<3.6E-04				<0.014	258			
D062	0111U	1.1					0.002							320			11.46
D123	0161M	68	80	0.030	<7.3E-03			1.34E-01			4.38E-05	<2.7E-05	<0.061	296	1.0	1.4	
D124	0161U	33	38	0.014	<1.0E-03			6.03E-03					<0.094	280	0.3	<0.2	
D120	0200M	19				23.2		2.32E-02	1.75E-03		<2.2E-05	<2.2E-05		343			
D122	0200M	18					0.070		<8.3E-04	0.0007							10.44
D121	0200U	14							8.82E-04					338			10.88
D076	0315M	10	11	0.023	<3.5E-04			1.31E-02					<0.030	334	11	4.7	
D075	0315U	12	13	0.029	<4.0E-04	13.0			<7.1E-03	0.53			<0.032				
D045	0316M	11	10	0.018	<6.7E-04			9.15E-03	5.83E-04				<0.005				
D046	0316U	48	44	0.083	<2.8E-03				3.93E-03		1.33E-04	4.98E-05	<0.021	301			
D063	0318M	9.2						1.88E-02	<3.1E-04		1.06E-04	6.79E-05		156			
D064	0318U	2.0					0.109	1.72E-03						374	71	488	
D161	0696M	5.0				7.3		8.95E-04	<1.6E-03					26			
D162	0696U	36	34	0.098	<2.3E-03			4.09E-03					<0.013	<25			
D092	0710M	0.119						4.05E-04	8.57E-06					<25			
D093	0710U	0.005	0.032	<2.6E-04	<2.3E-04				1.16E-05				<0.002	<25			
D136	0738M	12	11	0.041	<5.2E-04								<0.038	25	1.6	19	
D137	0738U	12							<8.9E-04					36			
D094	0760M	3.6	2.0	0.063	<1.0E-03								<0.058	<25			
D099	0760U	0.027	0.220	<7.7E-04	<8.6E-04								<0.006	<25	<2	<2	
D084	0943M	42							<6.6E-04		9.65E-05	<3.3E-05		257	780	133	
D087	0943M	40				45.5			<2.6E-03								10.35
D086	0943U	75							<3.2E-03					212	<2	2	
D127	1164M	110					7.03		<7.1E-03					<25			
D128	1164U	37						7.36E-03	<3.2-E-03		<2.8E-04	<2.8E-04					
D125	1226M	63							<2.7E-03		3.88E-04	<2.8E-04		<25	<0.2	<0.2	
D126	1226U	10						1.15E-03	<7.2E-04		8.79E-05	<8.7E-05		<25	<8	11	
D163	1265M	27					6.49		<1.7E-03		<1.1E-04	<1.1E-04		<25	<8	11	
D169	1265M	27	22	0.039	<6.6E-04								<0.072				
D164	1265U	47							<1.9E-03		<1.2E-04	<1.2E-04		<25	<8	11	
D170	1265U	38							<2.9E-03		1.96E-04	8.97E-05		<25	<8	11	
D031	1443U	44					2.04		5.52E-03	<0.29	<8.2E-05	<8.2E-05		<25			
D167	1497M	25							<1.7E-03					132	25	9.3	
D168	1497U	278	338	0.266	<9.4E-03	327		2.44E-02	<2.9E-03	0.16			<0.86				8.42
D173	1497U	273					0.044		<1.9E-03		3.10E-04	<6.2E-05		98	<8	12	
D047	1512M	38	22	0.070	<2.8E-03				3.35E-03				<0.014	<25			
D098	1512M	63	58	0.195	<2.3E-03				<2.6E-03				<0.17				
D100**	1512U	6.4	0.004		<1.5E-07								<0.00001				
D131	1556M	8.8							<5.4E-04					<25	<0.2	<0.2	
D130	1556U	8.3	7.6	0.010	<2.3E-04								<0.021	<25	<0.2	<0.2	
D108	1560M	15							9.99E-04					38	<1	1.2	
D112	1560U	106							5.36E-03	<0.03	3.19E-05	<2.7E-05		254	0.9	1.4	
D032	1599M	13	8.1	0.030	<4.1E-03				<3.3E-05	0.21	<4.73-05	<4.73-05	<0.91				
D033	1599U	0.021	0.001	<1.3E-04	6.97E-04	0.006							<0.0002	<25			7.05
D180	1599U	0.028												<25	<8	11	8.72

Table 2. K West Canister Liquid Samples and Data. (Continued)

	canister	Cs-137 (uCi/mL)		Cs-134	Co-60	beta	Sr-90	tritium	alpha	uranium	Pu239/240	Pu-238	Am-241	potassium	nitrite	nitrate	
SAMPLE	barrel	SAS*	222S*	uCi/mL	uCi/mL	uCi/mL	uCi/mL	uCi/mL	uCi/mL	ug/mL	uCi/mL	uCi/mL	uCi/mL	ug/mL	ug/mL	ug/mL	pH
D067	1619M	0.2							<1.3E-04					<25	1.7	5.5	
D065	1619U	1.3				0.7	0.014		<4.9E-05					<25			7.53
D066	1619U	0.8				0.4			<4.9E-05								8.44
D177	1730M	9.4	6.2	0.011	<7.0E-04								<0.039	<25	<1.7	2.4	
D077	1740M	3.4												271	35	341	8.22
D078	1740U	31							1.82E-03	5.6	9.38E-04	1.82E-04		204			
D068	1860M	22					0.0016		<6.2E-04					275			11.50
D069	1860U	78						1.91E-01	<7.1E-03		3.37E-04	<1.4E-04		399	1.4	2.1	
D189	1860U	68				13.2				<0.03							11.85
D028	2554U	13							1.12E-03	0.02				<25			6.65
D186	2600M	5.5	0.005	0.000	4.65E-07			1.42E-03					<0.00002	<25			
D187	2600U	0.16							<1.0E-02					<25			8.05
D117	2660M	191	196	0.378	<9.9E-03			1.22E-01	1.66E-02				<0.084	<25	<1	0.9	
D119	2660M	186				273	47.4		<4.3E-03	<0.03	5.78E-04	<2.4E-04					
D118	2660U	12							5.88E-04					<25			6.44
D041	2667M	314	258	0.418	<8.0E-03			2.58E-01	3.04E-03	4.5	3.84E-04	<2.6E-04	<0.65	<25	<0.2	0.5	6.34
D043	2667M	304	241	0.495	<6.8E-03	344	6.0	2.02E-01	<1.2E-02	5.5			<0.67	<25			
D044	2667U	55					12.9		2.84E-03	2.1							
D183	2667U	48															
D194	2775M	6.9					0.352		<1.8E-03					<25			
D195	2775U	23				33.3			<9.5E-03					<25			
D184	2800M	12						2.81E-02	<5.1E-04					<25			
D185	2800U	0.65							<3.7E-05					<25	<8	11	
D091	5197U	29					0.016	8.99E-02	5.10E-04		8.58E-04	2.35E-04		192			
D133**	5744M	49						7.25E-03	<3.2E-03		6.13E-04	1.32E-04					
D135	5744U	71						7.40E-03						72	<8	11	9.22
D011	5903M	105					0.004		5.85E-03		4.03E-05	3.37E-05		24	<0.2	0.3	
D095	5903M	207	211	<8.7E-05	<7.8E-06	249	0.011		<2.3E-02				<0.0007				
D016**	5903U	75				104			1.27E-02					<18			
D017	5903U	174	154		<3.6E-03				2.35E-03		2.29E-04	4.59E-05	<0.38	<25	<0.2	0.3	
D107	6082M	58				61.9			<2.4E-03					64	<3	3.1	7.72
D115	6082M	30	38	<9.6E-03	<1.4E-03					<0.03			<0.013				
D116	6082M	42					0.004	3.12E-02	2.66E-03	<0.03	4.08E-05	<2.4E-05					
E19**	6082M*	46	43	0.021	<6.8E-03								<0.048				9.03
D024	6214M	10	8.4	0.007	<2.8E-04				<3.2E-04		5.78E-05	2.85E-05	<0.022	<25			
D025	6214U	10					0.0008							84	<0.2	0.2	8.52
D148	6513M	239				44.4	0.443			0.68							7.65
D149	6513M	224				226		1.88E-02	1.12E-02		2.59E-04	8.17E-05		26	<8	13	
D151**	6513M	226									8.84E-04	1.57E-04					8.61
D146	6513U	92						1.08E-02	<3.3E-03		5.64E-04	1.35E-04					
D147	6513U	97				90.6	2.51		8.62E-03					<25			
D079	6603M	59				70.3		1.14E-01	3.40E-03	0.36							
D080	6603M	55						8.86E-02	2.00E-03		5.29E-04	1.71E-04					
D082	6603U	16					0.036	3.60E-02		1.08				106	50	46	
D138**	6641M	6.4							<8.7E-04	<0.25	<2.9E-05	<2.9E-05		242			
E21**	6641M	2.7				28.1			<1.9E-03								7.74
D139**	6641U	7.0					0.111		<7.8E-04								8.65
D140**	6641U	7.1					0.124		<7.1E-04								8.21
D036	6743M	45	38	<1.7E-02	<4.1E-03	63.6			<4.9E-03	0.33	<3.2E-04	<3.2E-04	<0.022	<25			
D037	6743M	54	38	<1.8E-02	<1.7E-03				4.60E-05	0.31			<0.14	<25			
D174	6768M	116					0.211		<1.2E-01		<5.9E-04	<5.9E-04		<25	<8	17	

Table 2. K West Canister Liquid Samples and Data. (Continued)

	canister	Cs-137 (uCi/mL)		Cs-134	Co-60	beta	Sr-90	tritium	alpha	uranium	Pu239/240	Pu-238	Am-241	potassium	nitrite	nitrate	
SAMPLE	barrel	SAS*	222S*	uCi/mL	uCi/mL	uCi/mL	uCi/mL	uCi/mL	uCi/mL	ug/mL	uCi/mL	uCi/mL	uCi/mL	ug/mL	ug/mL	ug/mL	pH
D057	6889M	36							<1.4E-03		<2.4E-05	<2.4E-05		30	0.2	0.3	
D058	6889U	1.9	2.0	0.006	<5.8E-05					239			<0.005	<117	<2	2.6	
D059	6889U	2.1				3.2	0.534	1.77E-03	2.13E-04								8.68
D143**	7028U	24							<1.1E-03					<35			
D150	7102M	1.1												<25	0.9	6.0	7.66
D156	7102M	0.2				0.7			1.88E-02					<48	2.2	7.7	
D158	7102U	28							<1.2E-03		1.30E-04	<2.8E-05		36	0.3	0.6	
D060	7393M	27	33	0.151	<3.5E-03		0.402		<1.4E-03		6.94E-05	<2.6E-05	<0.19	24			
D055	7393U	19					0.017	1.80E-02	<1.4-E03	0.06	4.17E-04	5.16E-05		49	0.2	0.3	
D196	7818M	0.23				0.5			1.25E-04	0.07	1.24E-04	<2.9E-05		573			
D197	7818U	0.13							2.57E-05					362	131	421	7.91
D159	7913M	23							<1.3E-03					94	<0.2	<0.2	
D160	7913U	67						4.36E-03	<1.3E-03		3.07E-04	<2.6E-04		<25			
D035	8119M	11							6.27E-03		3.70E-03	8.72E-04					
D039	8119M	11	8.5	0.021	<5.3E-04			3.41E-02	4.80E-03				<0.033	89			
D040	8119M	12				11.7	0.351			46							
D113	9010M	4.6				3.8	0.195		<1.0E-04	<0.03							
D114	9010U	3.5	3.1	0.007	9.46E-04				1.39E-04				<0.002	<25			
D022**	9020M	0.06							<5.56E-06								6.59
D023	9020U	4.5	2.5	0.007	<4.8E-04	4			1.07E-04				<0.017	<25			6.67

*SAS = Special Analytical Studies, SGN Eurisys Services Corp., NDA truck laboratory.
222S = Hanford 222S Laboratory
**Samples of less than 15 mL liquid. D016, D022, D023, D100, and D143 contained 4.7 to 6.8 mL liquid; all others were more than 8 mL liquid.

Table 3. Total Contents of K West Canister Water.

canister	Cs137 (mCi/barrel)		Cs-134	Co-60	Sr-90	tritium	beta	uranium	Pu239/240	Pu238	Am-241	alpha	potassium	nitrite	nitrate	pH
barrel	SAS-NDA	222S	mCi/barrel	mCi/barrel	mCi/barrel	mCi/barre	mCi/barrel	mg/barrel	uCi/barrel	uCi/barrel	uCi/barrel	uCi/barrel	ug/mL	ug/mL	ug/mL	
0091M	614	620	2.63	<0.039	76		4.63	8.0	<1.6	<0.11	<300	27	<25			
0091U	571				30							12				7.11
0102M	623	641	0.51	<0.025	1.4				<0.33	<0.33	<2120	<43	230			10.78
0102U	395								0.38	<0.38		<28				
0111M	52	53	0.11	<0.0017							<159	<4	258			
0111U	13				0.02								320			11.46
0161M	999	1172	0.43	<0.11		1.44			0.64	<0.40	<897		296	1.0	1.4	
0161U	486	558	0.21	<0.015		0.065					<1370		280	0.3	<0.2	
0200M	273				1.0	0.34	340	0.01	<0.31	<0.31		26	343			10.44
0200U	206											13	338			10.88
0315M	119	128	0.27	<0.0041		0.15					<350		334	11	4.7	
0315U	142	150	0.33	<0.0047			152	6.15			<378	<3				
0316M	126	121	0.22	<0.0079		0.11					<58	7				
0316U	558	510	0.97	<0.032					1.6	0.58	<240	46	301			
0318M	108					0.22			1.2	0.79		<4	156			
0318U	23				1.3	0.020							374	71	488	
0696M	74					0.013	108					<6	26			
0696U	531	496	1.45	<0.034		0.06					<1860		<25			
0710M	1.4					0.005						0.10	<25			
0710U	0.06	0.37		<0.0027							<21	0.14	<25			
0738M	175	170	0.61	<0.0078							<557		25	1.6	19	
0738U	177											<13	36			
0760M	55	31		<0.47							<4320		<25			
0760U	0.41	3.4		<0.013							<85		<25	<2	<2	
0943M	494						534		1.1	<0.38		<31	257	780	133	10.4
0943U	881											<37	212	<2	2.3	
1164M	1607				103							<104	<25			
1164U	538					0.11			<4	<4		<46				
1226M	927								5.7	<4		<40	<25	<0.2	<0.2	
1226U	152					0.017			1.3	<1.3		<11	<25	<8	11	
1265M	402	319	0.57	<0.0092	96.1				<2	<1.6	<1020	<26	<25	<8	11	
1265U	703								2.9	1.3		<43	<25	<8	11	
1443M	nd															
1443U	646				30.2			<4.3	<1.2	<1.2		81.7	<25			
1497M	358											<39	132	25	9	
1497U	4046	4919	3.86	<0.14	0.63	0.35	4753	2.39	4.4	<0.89	<12500	<2000	98	<8	12	8.42
1512M	765	698	2.35	<0.028							<1990	40.7	<25			
1512U	246	0.044	0.0001	<0.000002							<0.13					
1556M	129											<8	<25	<0.2	<0.2	
1556U	122	112	0.14	<0.0033							<300		<25	<0.2	<0.2	
1560M	179											11.7	38	<1	1.2	
1560U	1242							<0.30	0.37	<0.32		62.7	254	0.9	1.4	
1599M	196	122	0.46	<0.061				3.21	<0.71	<0.71	<1370	<0.5				
1599U	0.41	0.018		0.010			0.087				<3		<25	<8	11.2	7.87
1619M	2.2											<0.9	<25	1.7	5.5	
1619U	15				0.16		8.59					<0.6	<25			7.99
1730M	138	91	0.16	<0.010							<571		<25	<2	2.4	
1730U	nd															
1740M	40												271	35	341	8.22
1740U	366							65.5	11.0	2.1		21.3	204			
1860M	254				0.02							<7	275			11.50
1860U	914					2.23	154.4	<0.30	3.9	<1.6		<83	399	1.4	2.1	11.85
2554M	nd															
2554U	185							<0.38				16.4	<25			6.65

Table 3. Total Contents of K West Canister Water. (Continued)

canister	Cs137 (mCi/barrel)		Cs-134	Co-60	Sr-90	tritium	beta	uranium	Pu239/240	Pu238	Am-241	alpha	potassium	nitrite	nitrate	pH
barrel	SAS-NDA	222S	mCi/barrel	mCi/barrel	mCi/barrel	mCi/barre	mCi/barrel	mg/barrel	uCi/barrel	uCi/barrel	uCi/barrel	uCi/barrel	ug/mL	ug/mL	ug/mL	
2600M	92	0.081	0.0002	0.00001		0.024					<0.24		<25			
2600U	2.6											<174	<25			8.05
2660M	2801	3287	6.34	<0.16	795	2.05	4588	<0.42	9.7	<4	<1400	278	<25	<1	0.9	
2660U	171											8.61	<25			6.44
2667M	3558	3550	6.11	<0.12	88.1	3.78	5032	65.7	5.6	<4	<9550	44.5	<25	<0.2	0.5	6.34
2667U	804				188			30.1				41.5				
2775M	101				5.1							<26	<25			
2775U	340						488					<140	<25			
2800M	146					0.33						<6	<25			
2800U	7.6											<0.4	<25	<8	11	
5197M	nd															
5197U	349				0.19	1.08			10.3	2.8		6.15	192			
5744M	725					0.079			9.1	2.0		<50				
5744U	1051					0.11							72	<8	11	9.22
5903M	3849	3920		<0.52	0.21		4621		0.78	0.65	<27300	113	24	<0.2	0.3	
5903U	3247	2858		<0.068			1932		4.2	0.85	<6210	47.9	<25	<0.2	0.3	
6082M	1232	804		<0.030	0.08	0.66	1288	<0.53	0.87	<0.51	<273	56.6	64	<3	3.1	7.72
6082U	nd															
6214M	117	101	0.08	<0.0033					0.70	0.34	<262	<4	<25			
6214U	120				0.010								84	<0.2	0.2	8.52
6513M	3546				6.55	0.28	3348	10.0	13.1	2.3		166	26	<8	13	8.13
6513U	1444				37.2	0.16	1341	3.94	8.3	2.0		128	<25			
6603M	662					1.38	848	4.33	6.4	2.1		41.0				
6603U	195				0.43	0.43		13					106	50	46	
6641M	77						339	<4.4	<0.39	<0.39		<10	242			7.74
6641U	86				1.50											8.43
6743M	807	559		<0.060			941	4.83	<4.7	<5	<325	0.68	<25			
6743U	nd															
6768M	2055				3.7				<10	<10			<25	<8	17	
6768U	nd															
6889M	753								<0.5	<0.5		<28	30	0.2	0.3	
6889U	43	42	0.13	<0.0012	11.2	0.037	66.4	5044			<98	4.48	<117	<2	2.6	8.68
7028M	nd															
7028U*	290											<15	<35			
7102M	17						10.1					280	<25	2.2	7.7	7.66
7102U	415								1.9	<0.41		<18	36	0.3	0.6	
7393M	537	652	2.99	<0.069	8.0				1.4	<0.53	<3660	<28	24			
7393U	378				0.34	0.36		1.28	8.3	1.0		<28	49	0.2	0.3	
7818M	3.5						8.2	1.09	1.9	<0.43		1.87	573			
7818U	2											0.39	362	131	421	7.91
7913M	345											<19	94	<0.2	<0.2	
7913U	989					0.065			4.5	<3.8		<24	<25			
8119M	174	127	0.31	<0.0079	5.1	0.50	172	683	56.6	13.3	<474	95.7	89			
8119U	nd															
9010M	57				2.4		47.7	<0.32				<1				
9010U	44	39	0.09	0.012							<20	1.74	<25			
9020M	nd											<0.1				6.59
9020U	56	32	0.09	<0.00597			45.1				<216	1.34	<25			6.67

*Data reliability questionable due to small sample size.

Table 4. Summary Statistics for K West Canister Water Analytes.

Analyte	Units	Minimum Value Observed*	Maximum Value Observed*	N	Mean	Median	Standard Deviation	RSD (%)
Cs-137 by SAS-NDA	mCi/barrel	0.060	4046	91	585	246	883	151
Cs-137 by 222S	mCi/barrel	0.018	4919	35	768	150	1279	166
Cs-134	mCi/barrel	0.00015	6.3	27	1.16	0.33	1.78	153
Co-60	mCi/barrel	<0.000002	<0.52	3	0.00728	0.0100	0.0064	87
Sr-90	mCi/barrel	0.010	795	30	49.8	3.08	147	296
Tritium	mCi/barrel	0.0047	3.8	30	0.549	0.19	0.854	156
Total Beta	mCi/barrel	0.087	5032	26	1199	339.5	1718	143
U-total	mg/barrel	0.011	5044	17	350	6.15	1221	349
Pu-239/240	uCi/barrel	<0.31	57	29	6.15	3.94	10.39	169
Pu-238	uCi/barrel	<0.11	13	14	2.30	1.64	3.26	142
Am-241	uCi/barrel	<0.13	<27300	NA	NA	NA	NA	NA
Total Alpha	uCi/barrel	0.10	<2000	33	50.9	25.6	71.4	140
Potassium	ug/mL	24	573	40	188	198	137	73
Nitrite	ug/mL	0.173	780	17	65.4	1.69	187	286
Nitrate	ug/mL	<0.2	488	35	45.8	5.50	119	260
pH		6.34	11.85	27	8.58	8.13	1.66	19
Density	g/mL	0.964	0.970	2	0.967	0.967	0.0042	0.44

N = number of observations above detection limit.
RSD = Relative Standard Deviation, 100*S.D./mean.
*The detection limit is shown when it was lower/higher than the minimum/maximum observation.

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4.0 DISCUSSION

The following is a summary discussion of the liquid sample results from the second campaign of gas/liquid sampling. The results are compared to data from the first gas/liquid sampling campaign, where available (Trimble 1996b).

4.1 CESIUM

Cesium-137 was the primary fission product isotope found in the samples. The 222-S Laboratory GEA for this isotope confirmed the analyses by SAS-NDA except for a few results near the detection limits, where accuracy can sometimes be a problem (Figure 2). The sample mean for ^{137}Cs was 586 mCi/barrel for the data from SAS-NDA. However, the data distribution was determined to be lognormal (a logarithmic transformation of the data displayed a normal distribution rather than the data itself) (Trimble and Welsh 1997). From an analysis assuming the sample indicated lognormal distribution, it was estimated that the water of the average K West Basin canister (sum of both barrels) contained 2,100 mCi of ^{137}Cs (Trimble and Welsh 1997).

Cesium-134, in the 27 samples evaluated by 222-S, averaged 1.2 mCi/barrel. The samples from the first gas/liquid sampling campaign averaged 0.94 mCi/barrel of ^{134}Cs.

4.2 COBALT-60

Thirty-five barrels were evaluated for ^{60}Co. Three of the results were above detection limits for this analyte. The values ranged from 1E-05 to 0.012 mCi/barrel. For those results below the detection limit, the detection limits ranged from 2E-06 to 0.5 mCi/barrel with a median 0.015 mCi/barrel.

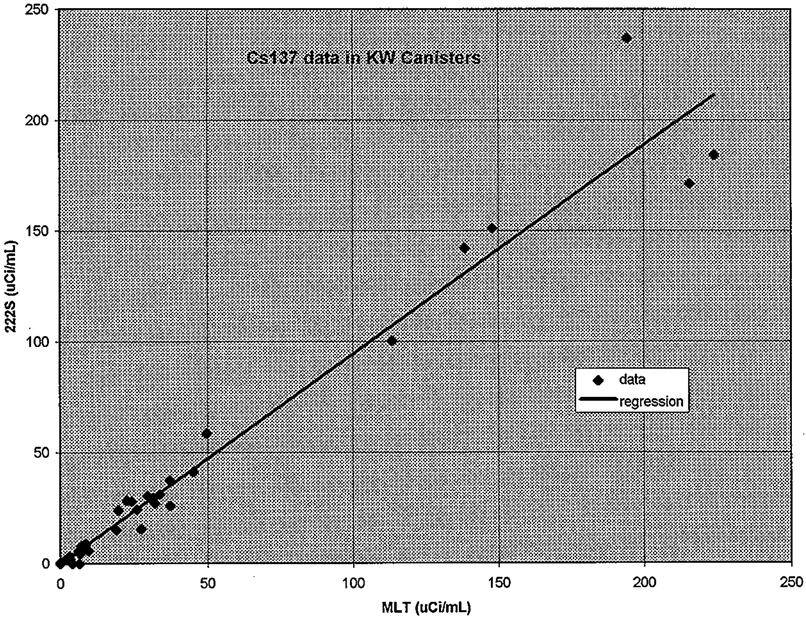
4.3 STRONTIUM-90

Thirty barrels were evaluated for ^{90}Sr all of which were above detection limits for this analyte. The results ranged from 0.01 to 795 mCi/barrel with a mean 50 mCi/barrel. Only three of the barrels evaluated for ^{90}Sr contained more than 100 mCi/barrel. The first gas/liquid sampling campaign found an average 10 mCi/barrel.

4.4 TRITIUM

Thirty barrels were evaluated for tritium, all of which were above detection limits for this analyte. The results ranged from 0.005 to 3.8 mCi/barrel with a mean 0.55 mCi/barrel. This is compared to a mean 0.26 mCi/barrel from the first gas/liquid sampling campaign.

Figure 2. Comparing Cesium-137 Data from Two Laboratories.



4.5 PLUTONIUM

Forty barrels were evaluated for $^{239/240}Pu$ and ^{238}Pu. Twenty-nine of the results for $^{239/240}Pu$ were above detection limits ranging from 0.4 to 57 µCi/barrel and averaging 6.2 µCi/barrel. Fourteen barrels were above detection limits for ^{238}Pu, ranging from 0.3 to 13 µCi/barrel and averaging 2.3 µCi/barrel. The median detection limit for these analytes was 1.2 µCi/barrel. The first gas/liquid sampling campaign yielded one result above detection limits. It was for $^{239/240}Pu$ with 11 µCi/barrel.

4.6 AMERICIUM-241

Thirty-six barrels were evaluated for ^{241}Am all of which were below detection limits for this analyte. The median detection limit was 378 µCi/barrel.

4.7 ALPHA ACTIVITY

Seventy-three barrels were evaluated for total alpha activity, and 33 barrels were above detection limits for this analyte. The sample values for alpha ranged from 0.10 µCi/barrel to 280 µCi/barrel with a mean 51 µCi/barrel. The median detection limit was 22 µCi/barrel.

4.8 BETA ACTIVITY

Twenty-six barrels were evaluated for total beta activity all of which were above detection limits for this analyte. The sample values ranged from 0.09 to 5,032 mCi/barrel of beta with a mean 340 mCi/barrel.

4.9 CORROSION INHIBITOR

Eighty barrels were evaluated for potassium, 40 of which were above detection limits for this analyte. The sample values ranged from 24 to 573 µg/mL with a mean 188 µg/mL. The detection limits for potassium were generally 25 µg/mL.

Forty-one barrels were evaluated for nitrite and nitrate, 17 of which were above detection limits for nitrite and 35 for nitrate. The nitrite values ranged from 0.2 to 780 µg/mL with a mean 65 µg/mL. The detection limits for nitrite ranged from 0.2 to 8 µg/mL with a median 2 µg/mL. The nitrate values ranged from 0.2 to 488 µg/mL with a mean 46 µg/mL. The detection limits for nitrate were generally 0.2 µg/mL.

The first gas/liquid sampling campaign data ranged from <30 to 63 µg/mL for potassium, from <0.1 to 3 µg/mL for nitrite, and from <0.1 to 72 µg/mL for nitrate.

4.10 TOTAL URANIUM

Twenty-five barrels were evaluated for total uranium. Seventeen values were above detection limits ranging from 0.01 to 5,044 mg/barrel and with a mean 350 μg/barrel. For the barrels below detection limits, the detection limits ranged 0.3 to 4.4 mg/barrel with a median 0.4 mg/mL. The first gas/liquid sampling campaign data for uranium ranged from 10 to 59 mg/barrel and averaged 23 μg/mL.

4.11 pH

Twenty-seven barrels were evaluated for pH. Values ranged from 6.3 to 11.8 with a mean 8.6. The pH data from the first gas/liquid sampling campaign ranged from 7.2 to 9.3 and averaged 7.9.

4.12 DENSITY

Sample liquid density (specific gravity) was measured for two canister barrels: 2667U and 6513M. Measurement values were 0.970 g/mL and 0.964 g/mL.

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APPENDIX A

LETTER REPORT (EXCLUDING APPENDIX A) BY SGN EURISYS SERVICES CORPORATION "RADIONUCLIDE CHARACTERIZATION OF 105-K WEST SPENT FUEL STORAGE CANISTER SAMPLES," NHC/SAS-9751059, FEBRUARY 5, 1997

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NHC
Numatec Hanford Corporation
An SGN/Cogema, Inc. Company

February 5, 1997

NHC/SAS-9751059

Mr. R. P. Omberg, Manager/Executive
SNF Evaluations
DE&S Hanford Inc.
2940 George Washington Way
MISN HO-40
Richland, Washington 99352-2940

Dear Mr. Omberg:

RADIONUCLIDE CHARACTERIZATION OF 105-KW SPENT FUEL STORAGE CANISTER SAMPLES

Attached is the report "Radionuclide Characterization of 105-KW Spent Fuel Storage Canister Samples," requested in work orders #E50602 and #E50608.

Special Analytical Support looks forward to performing future work for your group.

If you should have any further questions, please call myself at 373-4771 or E. Fred Riedel at 373-2190.

Very truly yours,

L. L. Lockrem, Manager
Special Analytical Support
Numatec Hanford Corporation

sir

Attachments 3

NHC/SAS-9751059

ATTACHMENT 1

RADIONUCLIDE CHARACTERIZATION OF 105-KW SPENT FUEL STORAGE CANISTER SAMPLES

Consisting of 14

SUMMARY

Gamma-ray energy measurements have been made on a large number of aqueous and gaseous samples taken from the underwater spent fuel storage canisters located in the 100-KW Basin. The measurements were undertaken to characterize the radionuclides present within the canisters. Two radioisotopes were of most interest: cesium-137 (^{137}Cs) in the aqueous samples and krypton-85 (^{85}Kr) in the gas samples. The data show that the most common radionuclide found in the canisters is ^{137}Cs. The radionuclide ^{85}Kr was found to be present in some of the gas samples. A reference canister containing a known quantity of the radionuclide yttrium-88 (^{88}Y) was also prepared and analyzed. Specific results are presented and discussed in the main body of this report.

1.0 BACKGROUND

The 105-KW Fuel Storage Basins were constructed as a part of the 100-K Production Reactor project between 1952 and 1954. The KW Basin is used for the storage of encapsulated spent fuel primarily from the 100-N reactor. At the east side of the basin pool is the "Weasel Pit" where the fuel canisters were sampled. Each canister consists of two barrels, and each barrel contains up to seven N-Reactor fuel assemblies. Canisters are of two designs, the MK I and the MK II.

Fuel was loaded into the canisters at 100-N, the lid installed, potassium nitrite added, and nitrogen gas added before the canisters were sealed. For this campaign, canisters were moved to the Weasel Pit before sampling. All sampling was performed under water. Separate liquid and gas samples were taken from different ports on each canister. All work other than the sample analyses was performed by Operations Personnel. Samples were analyzed by Special Analytical Studies (SAS) personnel from SGN Eurisys Services Corp.

Normal radiation work practices were used to meet Westinghouse Hanford Company (WHC) and Fluor Daniel Hanford, Inc. (FDH) requirements. All sampling requirements were directed by the letter of instruction (LOI) (Reference 1) from Spent Nuclear Fuel Evaluation (SNFE) and the Sampling and Analysis Plan (SAP) (Reference 2). Work was performed under work orders #E50602, and #E50608 issued by SNFE to SAS.

2.0 CALCULATIONS

A gamma ray spectrum has been collected for each sample. These spectra are recorded and analyzed for the photopeaks of interest. The quantities of the radioisotopes for the photopeaks of interest are then calculated as follows:

$$Q = P * E * G * F * Br$$

where Q = quantity of radionuclide detected, in the desired units
P = peak area of the photopeak of interest, where P = T - B
T = total counts contained in the photopeak region of interest (ROI)
B = total counts contained in the background that corresponds to the photopeak ROI
E = detector efficiency
G = geometry correction factor
F = gamma ray attenuation factor
Br = branching ratio for the specific energy photopeak of the radionuclide being quantified

STANDARD DEVIATION:

The standard deviation associated with each photopeak is obtained using the following:

$$\sigma_i = \sqrt{\left[\frac{\sigma_p}{E \times Br}\right]^2 + [\sigma_{ee} \times Q]^2}$$

$$\sigma_P = \sqrt{\frac{T_s + B_s}{LT_s} + \frac{T_b + B_b}{LT_b}}$$

where

σ_i = the standard deviation associated with the i[th] photopeak
σ_p = the standard deviation associated with the net counts in a photopeak
σ_{ee} = relative standard deviation corresponding to the additional estimated error
LT = live time for the counts
Subscript s = refers to the sample being counted
Subscript b = refers to the background that corresponds to the sample being counted

3.0 INSTRUMENTATION AND MEASUREMENT METHODOLOGY

The gamma-ray spectroscopy system consisted of a detector and a set of nuclear spectroscopy electronics. The detector used was a shielded 30% P-type high purity intrinsic germanium (HPGe) detector.

Two different sets of nuclear spectroscopy electronics were used. In set one, an EG&G ORTEC NOMAD-Plus[1] portable spectroscopic system was used. The NOMAD-Plus unit contained the detector bias power supply, the signal amplifier, and the multichannel analyzer (MCA). An MCA forms a histogram from analog signals from the detector. The histogram spectrum whose photopeaks and other counting distributions correspond to signals of specific gamma-ray energies recorded by the detector.

In the other set, an electronic system consisting of an equivalent array of NIM electronics which functioned identically to the NOMAD-Plus system was used. For both sets of electronics, the gamma energy spectra were obtained using a combination of the software packages MAESTRO[2] and APTEC's OSQ+[3] along with a spreadsheet.

An integrated spectrometer, the EG&G ORTEC NOMAD-Plus portable spectroscopic system with a 486-66 computer was initially used for data collection and data reduction. After a problem with the NOMAD-Plus, NIM based electronics replaced the NOMAD and were then used, with the same data reduction 486-66 computer and data reduction software. The two systems are frequently interchanged by SAS personnel. An SAS batch file was used to automate and speed data reduction and reporting. WINBATCH[4] software was used for this purpose. The EG&G ORTEC program MAESTRO was used for all data collection. The APTEC program OSQ+ was used for all data reduction. Final spectral results for each sample were tabulated and reported in the form of a spreadsheet shortly after each sample was analyzed.

A set of standard geometries were established for data collection. Because high activity samples were a possibility, parameters were established for lead shielding. Results were modeled using the program Microshield, and compared with actual laboratory measurements for parameters such as lead shielding, distance, and the steel sleeve. Results of these comparisons proved to be within the standard errors of the measurements.

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[1]NOMAD-Plus is a trademark of EG&G ORTEC Company, Oakridge, TN.

[2]MAESTRO is a trademark of the EG&G ORTEC Company, Oakridge, TN.

[3]OSQ+ is a trademark of APTEC Nuclear Inc., Lewiston, NY.

[4]WINBATCH is a trademark of Wilson WindowWare, Inc., Seattle, WA.

3.1 GAMMA-RAY ASSAY

All data were collected using an EG&G Ortec 30% high-purity germanium detector approximately 2 inches in diameter. The detector was cooled with liquid nitrogen, and was contained in a PopTop®[5] capsule with an all-attitude cryostat. The detector was uncollimated. Lead bricks were placed around the detector to shield it from as much background radiation as possible. The lead bricks were placed on both sides of the detector and also behind the cryostat (adding shielding between the detector and the basin).

3.2 CALIBRATION METHODOLOGY

Aqueous radiological standards produced by Amersham Corporation were measured, and the spectral data collected were used to determine the efficiency of the detector and counting electronics used for the KW-Basin measurements. Three different standards were measured, each of which contained several different isotopes. Thirteen separate spectral photopeak energy values were obtained from these isotopes. These isotopes ranged in energy from a low value of 59.5 kev up to a high of 1836 kev.[6] The total energy range of these isotopes were representative of the total energy range of the isotopes actually measured at KW Basin. All results from these data agreed within a total error of less than 4%. All these data were fitted to a fifth order log-log polynomial equation by the method of least squares. The efficiency calibration created from the summation of these spectral measurements was used in the calculation of total activity for all sample tubes measured at KW-Basin. The standards were measured at a distance of eight inches from the detector.

Two other aqueous test tube standards were prepared by the 222-SA Standards Laboratory for calibration purposes. Both tubes contained aliquots of the certified ^{137}Cs standard solution. One tube was housed in a stainless steel sleeve (prototypic of the sample tubes used for actual sampling) and was supplied by SNFE. The other matching glass test tube had no outer stainless steel sleeve. Both test tubes were measured individually, at the same distance from the detector. The difference in ^{137}Cs values obtained for the two standards yielded the attenuation value caused by the stainless steel sleeving. This value was 9%, and was factored into all measurements at the basin to negate the effects of sample attenuation caused by the stainless steel sleeving. This value also agreed with Microshield computer modeling that was performed as a cross-check for this value.

The ^{137}Cs test tube standards were also measured at various distances away from the detector to determine the correct distance-to-count-rate correction factor that was used for samples whose activities exceeded the operating range of the system to be properly measured at the eight inch initial calibration distance. These correction factors were applied as appropriate to normalize all reported results back to the initial eight inch calibration distance. Samples were counted at one of the following distances

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[5] PopTop is a trademark of the EG&G ORTEC Company, Oakridge, TN.

[6] The isotopes of most interest for this study were cesium-137 with a photopeak at 661.7 kev and krypton-85 with a photopeak at 514.0 kev.

Cesium Summary

Sample Number	Activity uCi/total	Distance inches	Sample Number	Activity uCi/total	Distance inches
D011	1593	48	D130	125	16
D014	12.8	4	D130d	126	16
D016	509	8	D131	131	8
D017	1752	48	D132	0.79	24
D020	0.09	4	D133	246	8
D021	0.28	4	D134	2.2	48
D022	0.33	8	D135	1043	16
D023	69	48	D136	166	16
D024	134	8	D136d	167	16
D025	154	8	D137	147	24
D027	0.48	4	D138	48.8	8
D028	173	8	D139	39.3	8
D029	0.134	8	D140	53.3	8
D030	0.115	8	D141	0.062	8
D031	527	24	D142	0.042	24
D032	171	16	D143	112	16
D033	0.24	8	D143d	114	16
D034	0.088	8	D143dd	113	8
D035	149	16	D143ddd	111	24
D036	601	24	D144	0.005	8
D037	631	24	D145	60.8	8
D038	0.19	4	D146	1297	24
D039	137	16	D147	1383	24
D040	139	16	D148	3130	48
D041	4141	48	D149	3265	48
D042	5.71	4	D150	16.3	8
D043	3934	48	D151	980	48
D044	629	48	D154	0.72	8
D045	143	16	D156	3.38	8
D046	619	16	D157	432	16
D046	619	16	D157d	425	24
D047	518	8	D158	441	16
D048	64.3	8	D159	317	16
D049	9.8	4	D160	878	24
D050	537	24	D161	74	8
D051	12.4	4	D162	499	16
D052	740	48	D163	410	16
D053	1.8	4	D164	529	8
D054	9.3	4	D165	0.76	8
D055	271	16	D166	0.78	48
D056	0.51	4	D167	426	24
D057	511	24	D167d	432	16
D058	31.4	8	D167dd	429	24
D059	32.9	8	D168	3440	48
D060	387	24	D169	337.4	24
D061	56.3	8	D169d	337	16
D062	14.2	8	D170	473	16

Cesium Summary

Sample Number	Activity uCi/total	Distance inches	Sample Number	Activity uCi/total	Distance inches
D063	107	16	D171	516	16
D064	21.4	4	D172	329	24
D065	16.3	8	D172d	328	48
D066	10.7	8	D172dd	324	48
D067	2.2	8	D173	3217	48
D068	247	24	D174	1242	8
D069	996	48	D175	66.4	8
D070	LT	8	D176	67.8	16
D071	0.02	8	D177	119	8
D071d	0.6	4	D178	0.96	24
D071dd	1.85	8	D179	164	8
D072	LT	8	D180	0.36	8
D073	LT	4	D181	4.11	8
D074	LT	8	D182	0.32	24
D075	156	16	D183	693	16
D076	132	16	D183d	653	48
D077	39.1	8	D183dd	686	8
D078	404	24	D184	192	8
D079	864	24	D185	9.6	8
D080	726	24	D186	81.6	8
D081	0.96	8	D187	2.3	16
D082	192	8	D188	247	16
D083	0.93	8	D188d	246	24
D083d	0.93	8	D189	1007	16
D084	524	24	D189d	911	48
D085	0.95	8	D189dd	1049	8
D086	1011	48	D190	0.75	8
D087	501	24	D191	0.75	48
D089	LT	4	D192	703	24
D090	0.05	8	D192d	701	24
D091	400	24	D193	491	8
D092	1.7	8	D194	97.9	16
D093	0.08	8	D194d	100	24
D094	55	8	D194dd	99.2	48
D095	2756	48	D194ddd	104	24
D096	26.8	8	D195	352	8
D097	2.3	8	D196	3.4	8
D098	836	48	D197	1.85	4
D099	0.39	8	E001	0.27	4
D100	29.9	4	E002	0.1	4
D101	42.8	8	E003	0.09	4
D102	LT	8	E009	0.24	4
D103	0.081	8	E011	0.01	4
D104	0.002	8	E012	0.01	4
D105	0.02	8	E013	0.01	4
D106	0.016	8	E014	LT	4
D107	838	24	E015	0.002	4

Cesium Summary

Sample Number	Activity uCi/total	Distance inches	Sample Number	Activity uCi/total	Distance inches
D108	230	8	E016	LT	8
D109	345	8	E018	0.003	8
D110	317	8	E019	451	4
D111	0.673	8	E020	LT	4
D112	1513	48	E021	25.5	4
D113	64.8	16	E022	LT	4
D114	53.2	8	E025	0.01	4
D114d	52.8	8	E026	0.004	4
D115	470	8	E027	0.09	4
D116	663	16	E028	0.14	4
D117	2668	48	E029	0.06	4
D118	168	16	E030	0.08	4
D119	2835	48	E032	0.004	4
D120	276	24	E033	0.1	4
D121	208	16	E034	0.29	4
D122	277	24	E036	0.02	4
D123	980	48	E037	0.05	4
D124	478	24	E038	0.12	4
D125	916	48	E039	0.14	8
D126	159	16	E040	0.74	4
D127	1672	48	E041	22.1	4
D128	559	24	E042	0.8	4
D129	5.77	8	E049	0.02	4
D129d	5.9	16			

Table 2

Krypton Summary					
Sample Number	Activity uCi/total	Distance inches	Sample Number	Activity uCi/total	Distance inches
D014	10	4	E006	29.6	8
D019	14.6	8	E009	30.4	4
D020	12	4	E011	33.9	4
D021	11	4	E012	60	4
D022	13	8	E013	38	4
D026	37	8	E014	LT	4
D027	38	4	E015	LT	4
D029	18	8	E016	7.56	8
D030	21	8	E018	14.5	8
D034	8.6	8	E020	3.95	4
D049	17.9	4	E021	LT	4
D071	23.4	8	E022	4.6	4
D072	5.2	8	E025	1.33	4
D074	LT	8	E026	1.28	4
D096	19	8	E027	9.83	4
D097	21	8	E028	29	4
D101	30	8	E029	29.5	4
D102	52	8	E030	LT	4
D103	85	8	E032	LT	4
D104	2.4	8	E033	14.4	4
D165	58	8	E034	7.31	4
D166	50	8	E036	43.5	4
D175	94	8	E037	46.3	4
D176	98	8	E038	38	4
D178	74	8	E039	30.5	4
D181	50	8	E040	32.3	8
D182	58	8	E041	15.8	4
E001	11.2	4	E042	40.5	4
E002	1.41	4	E049	LT	4
E003	LT	4			

Table 3

QA DATA			
Date	^{241}Am	^{137}Cs	^{60}Co
August 22	15100	2910	1240
August 23	15154	3289	1253
August 28	20906	3587	1281
August 29	16660	3278	1247
August 30	19690	3754	1221
September 3	19446	3515	1229
September 4	18983	3623	1248
September 5 (am)	19054	2581	1261
September 5 (pm)	19050	3586	1243
Septembr 10	15278	3636	1254
September 11	15762	3458	1236
September 16	14701	3845	1248
September 17	15372	3251	1242
September 18	15888	3188	1250
September 19	14824	3243	1261
September 23	15023	2994	1187
September 25	15997	2590	1249
September 26	14501	2897	1253
September 30	14255	3169	1211
October 1	14136	3129	1191
October 2	14733	3137	1253
October 4	14460	3205	1197
October 7	14603	2977	1180
October 8	15750	2997	1213
October 9	15306	2979	1197
October 10	14783	3022	1245
Total	419415	83840	32090
Average	16131	3225	1234
Standard Deviation	2003	330	26
Percent Deviation	12.4%	10.2%	2.1%
Maximum Value	20906	3845	1281
Minimum Value	14136	2581	1180

Table 4

Summary of Duplicate Analyses

Sample Number	Activity uCi/total	Distance inches	% Error stdev/avg	Sample Number	Activity uCi/total	Distance inches	% Error stdev/avg
D071	0.02	8		D169	337.4	24	
D071d	0.6	4		D169d	337	24	
D071dd	1.85	8		AVG/STDEV	337.20	0.2	0.1%
AVG/STDEV	0.82	0.76	92.7%	D172	324	48	
D083	0.93	8		D172d	328	24	
D083d	0.93	8		D172dd	329	16	
AVG/STDEV	0.93	0.00	0.0%	AVG/STDEV	327.00	2.16	0.7%
D114	53.2	8		D183	686	48	
D114d	52.8	8		D183d	693	24	
AVG/STDEV	53.00	0.2	0.4%	D183dd	653	16	
D129	5.9	24		AVG/STDEV	677.33	17.44	2.6%
D129d	5.77	8		D188	246.9	16	
AVG/STDEV	5.84	0.07	1.1%	D188d	245.9	16	
D130	125	16		AVG/STDEV	246.40	0.5	0.2%
D130d	126	16		D189	1049	48	
AVG/STDEV	125.50	0.5	0.4%	D189d	1007	24	
D136	166	16		D189dd	911	16	
D136d	167	16		AVG/STDEV	989.00	57.76	5.8%
AVG/STDEV	166.50	0.5	0.3%	D192	701	24	
D143	112	24		D192d	703	48	
D143d	114	16		AVG/STDEV	702.00	1.00	0.1%
D143dd	113	16		D194	104	48	
D143ddd	111	8		D194d	97.9	8	
AVG/STDEV	112.50	1.12	1.0%	D194dd	100	16	
D157	432	24		D194ddd	99.2	24	
D157d	425	16		AVG/STDEV	100.28	2.54	2.5%
AVG/STDEV	428.50	3.5	0.8%				
D167	426	48					
D167d	432	24					
D167dd	429	16					
AVG/STDEV	429.00	2.45	0.6%				

from the detector: 2-, 4-, 8-, 16-, 24-, or 48-inches. The percent correction factors are included in all the results shown in Table 1 and on the data sheets contained in Appendix A. The ^{85}Kr results are shown in Table 2.

It was decided to combine the two factors into a single correction factor. This method was used for all samples measured.

A filter paper check-source was counted on the end cap of the detector at least once a day to measure any possible shift in detection system efficiency. Measurement of the check-source was also done in conjunction with all calibration measurements for the same reason. Measured values throughout the project agreed very closely and showed no significant changes in detection system efficiency (see Table 3).

3.3 BALANCE

Sample tubes were weighed on an electronic top loading balance capable of weighing to the nearest 0.01 gram. All test tubes were first tared with their associated plastic sleeves, and then, weighed with the sample when delivered by K Basin operations personnel. A large number of tie straps were weighed and an average weight per tie strap was calculated. Twice this value was added to the tare weights. Calibration of the balance was checked daily using a set of calibrated standardized weights.

All samples weighed between 100 and 125 grams. The applied calibration range was from 50 grams to 150 grams in 50 gram intervals. Calibration of the balance was normally checked in the morning, but never less than once a day. The error never exceeded 0.02 grams. Results were reported to the nearest 0.01 gram. By direction from SNFE, the corrected net weight is the net weight minus 0.50 gram. The 0.50 gram was to correct for water trapped between the vial and the vial sleeve during the immersion in the basin water.

3.4 STANDARD GEOMETRIES

All samples were received in rubber stoppered test tubes that were jacketed with a stainless steel sleeve. The tubes were of two sizes. The smaller tubes were capable of holding slightly over 16 milliliters of sample solution. The larger tubes were capable of holding slightly over 20 milliliters of sample solution. After basin operations filled the tubes with either solution or gas, they were double bagged in plastic sleeving with each bag individually sealed.

For counting purposes inside the Special Analytical Studies-nondestructive analysis SAS-NDA truck, a holder was constructed for gripping the test tubes. This holder was used for both sample positioning reproducibility and to hold the test tubes securely in an upright position for analyses.

Corrections for lead shielding were established using actual measurements and also using calculations. Lead thicknesses of 0.5-, 1-, and 2-inches were used. For this group of samples, no lead shielding was required for any measurements.

Standard distances of 2 inches, 4 inches, 8 inches, 16 inches, 24 inches, and 48 inches were established for measurement of samples. All analyses were performed at one of these distances. The distance selected for counting was chosen so as to keep the counting dead time[7] below 50%. Since none of the samples were too active not to be counted at the maximum distance of 48 inches, no lead shielding was required to lower the dead time. The 8 inch distance was selected as the standard distance and all other measurements were corrected to this distance.

Correction for absorption of the steel was determined experimentally and this attenuation was verified by modeling using the program Microshield. The attenuation due to the sleeving was calculated to be 9% for cesium-137 only. This factor was combined with the distance correction factor into a single correction factor. All results were corrected in this manner.

All samples were centered in front of the detector face both horizontally and vertically. Allowances for differences in sample volumes were taken into account by centering sample tubes in front of the detector relative to the amount of sample present. The sample holder was calibrated for height and these marks were used for this centering activity. A reference table of sample volume (weight) verses heights was constructed and used for all measurements.

4.0 RESULTS

The results obtained are summarized in Table 1 and presented in detail in Appendix A. Results are presented in the units of microcuries of activity per total sample (μCi/total). Errors are given at the two sigma level for all analytes found. The analyte list presented represents those radionuclides commonly found around the Hanford Site. All spectra were examined to determine if any other radionuclides were present (none were). Corrected net sample weights (in grams) are also presented. Net sample weight is defined as gross tube weight with sample as received by the mobile laboratory truck (MLT), minus tube tare weight, minus one-half gram.

The individual report sheets show the factor used to correct that distance back to the standard distance of eight inches, as well as the tare weight, the sample weight, and the net sample weight. The customer identification is also listed on the sheet. In Table 2, the sample identification is by the customer identification which consists of a letter and a series of numbers.

Check standard results are summarized in Table 3. This check standard contained americium-241, cesium-137, and cobalt-60. The quality assurance check is identified by a QA and the date on which it was measured.

Results showed that the tubes containing gas (those tubes with low net weight) were usually active with ^{85}Kr while the liquid samples (those tubes with high net weight) were usually active with ^{137}Cs, as was expected.

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7 Dead time is the time when the electronics (ADC/MCA) are saturated and are not capable of counting. The MCA electronics and software are capable of handling dead times in excess of 95%.

The SAP required that 10% duplicates be run. A total of 235 samples were analyzed for radioisotope content. Of the 235 samples that were analyzed, 210 were actually different samples with the rest being duplicate runs. Thus, the 10% requirement was met. Some duplicates were analyzed immediately after the initial analysis while others were analyzed on a different day and at a different distance. Some of the more active samples were analyzed at four different distances (e.g. see the results for D194), while many were analyzed at two or three different distances. Results of the duplicate analyses are summarized in Table 4.

The duplicate results show very good internal agreement. Of the twenty-five duplicate analyses performed, sixteen of them show 1% or better agreement. Only one set of analyses (sample number D071) shows significant errors and that set has very low activities (0.02 µCi/total to 1.85 µCi/total with an average activity of 0.82 µCi/total and 92% error). For all duplicate analysis the average deviation is 6.8% but if sample D071 is deleted from the set, the average deviation is only 1.1%. Errors are larger for samples that were measured at different distances when compared to those that were measured at the same distance.

4.1 ERRORS

All errors are reported at the two sigma level. This means that the correct (or true) value should be within the reported limits 95.5% of the time.

The reported errors come from three sources. Two of these are mathematically calculated and the third is scientifically estimated, in other words, a scientific best guess.

The first source of error is derived from counting statistics. This number is the square root of the total peak counts (that is peak area plus background) plus the background counts. (Background is actually added in twice, but it is also measured twice.) Thus, this number is always dependent on the total number of counts observed in the photopeak.

The second source of error is associated with the least squares fit of the efficiency calibration. Data is collected on a number of standards and is fit using the least squares technique to a fifth order polynomial. This type of error is dependent on the photopeak energy, and this error is not a linear function of the energy. In this case the error associated with the ^{137}Cs photopeak is 1.62% while that associated with the ^{85}Kr photopeak is 1.65%.

The third source of error is all the other uncertainties associated with the data collection activities. This error is estimated by the scientist, in other words it is a best scientific guess. It is referred to as σ_{ee} in Section 2 of this document. In general the factors which contribute to this error include the following:

- Geometry--how repeatable is the measurement, due to factors such as positioning and distance.
- Reported uncertainties in the standards used for calibration.
- Errors associated with the sampling process.

- Estimate of the overall uncertainties in the reported nuclear properties such as the branching ratio and the actual energy of the gamma ray that is emitted. This information is available in the literature.

For this specific example, the principle contributions are from the geometric effects and the uncertainties in the standards used for calibration.

Errors one and two are calculated by the software. For these data measurements a value of 5% was used for the third type of error.

5.0 CONCLUSION

The techniques used in this project resulted in rapid presentation of analyte activities to SNFE at K-Basin. This methodology should be useful in similar future operations involving the fuel casks.

A number of the samples were analyzed by the 222-S Laboratory. Field results should be compared to the laboratory results.

Some of the samples were very low in activity and it is possible that basin liquid was collected rather than the desired material. If a radioactive tracer were added to a single container it would be possible to determine if the sampling device was working correctly.

This problem was attacked by using a reference canister that contained yttrium-88, an isotope that is not present in the basin. It was initially hoped that addition of this isotope to the canister would ameliorate the problems experienced by the sampling device and any possibility of leakage. Results were not as reliable as hoped, although they were definitely beneficial.

6.0 REFERENCES

1. LOI, "Instruction for Gamma Energy Analysis of K West Basin Canister Samples During the 1996 Sampling Campaign," D. J. Trimble, August 5, 1996.

2. SAP: "Sampling and Analysis Plan for Canister Liquid and Gas Sampling at 105-K West Fuel Storage Basin," WHC-SD-SNF-PLN-004, Rev 1, Westinghouse Hanford Company, Richland, Washington, Harris, R. A and Trimble, D. J.

3. "Data Analysis of Gas and Liquid from K West Basin Fuel Canisters; 1995 Samples," WHC-SD-SNF-ANAL-008, Rev. 0, Westinghouse Hanford Company, Richland, Washington, Trimble, D. J.

4. "Desk Instructions for KW-Basin On-site Sample Analysis", SAS-75745-96-065

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APPENDIX B

TABLE OF CONTENTS, NARRATIVE, AND SAMPLE DATA SUMMARY FROM HNF-SD-WM-DP-221, REV. 0A, "ANALYSIS OF K WEST CANISTER LIQUID SAMPLES, CAMPAIGN II," G. L. MILLER, RUST FEDERAL SERVICES OF HANFORD

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HNF-SD-WM-DP-221, Rev. 0A

Analysis of K West Basin Canister Liquid Samples, Campaign II

George L. Miller
Rust Federal Services of Hanford, Inc., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

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TRADEMARKS:

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NARRATIVE

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ANALYSIS OF K WEST BASIN CANISTER LIQUID SAMPLES, CAMPAIGN II

CASE NARRATIVE

INTRODUCTION

Project Documentation and Direction

Analytical direction for this project was provided in the following references.

1. Trimble, D. J., WHC-SD-SNF-PLN-004, Rev. 1, ECN 168159, "Sampling and Analysis Plan for Canister Liquid and Gas Sampling at 105 KW Fuel Storage Basin", released August 9, 1996, Westinghouse Hanford Company, Richland, Washington.

2. Trimble, D. J., Internal Memo to G. L. Miller, August 2, 1996, Westinghouse Hanford Company, "Instructions for Analysis of K West Basin Canister Liquid Samples".

3. Meznarich, H.K., WHC-SD-CP-QAPP-016, Rev. 1, "222-S Laboratory Quality Assurance Plan", released July 31, 1995, Westinghouse Hanford Company, Richland, Washington.

Sample Collection

For the second campaign, 127 water samples were collected from 105-K West Basin fuel canisters between August 27 and October 18, 1996. A Letter of Instruction accompanying each shipment indicated the weight of each sample. Sample weights ranged from 4.7 to 22.7 grams.

Sample Receipt

The samples were received in nine shipments by the 222-S Laboratory to be analyzed for inorganic and radiochemical parameters. All samples were logged into the laboratory using the LABCORE laboratory information management system (LIMS).

Quality Control

The Letter of Instruction accompanying each shipment specified which samples should be evaluated for precision and accuracy. This project met the quality control criteria as specified in the 222-S Laboratory Quality Assurance Plan, Reference 3. Control limits for precision or accuracy were specified by the program in Reference 1. To determine analytical precision, analyses were performed in duplicate for all analytes except for specific gravity, which was added to the analytical suite by the program via a request by telephone. To determine analytical accuracy, samples were spiked for the following analytes:

- $^{239/240}Pu$
- ^{90}Sr
- tritium
- total uranium
- total alpha
- total beta
- potassium
- nitrate
- nitrite.

Samples which were spiked were the same as those for which replicate precision determinations were performed.

No criteria were specified by the program for maximum sample holding time.

Acid dilutions were performed on the samples prior to analysis of total uranium, total alpha, total beta, ^{238}Pu, $^{239/240}Pu$, ^{241}Am and potassium.

Because of the small original volume of some of the samples, it was necessary to use less than the optimum analytical aliquot for some of the analyses, causing the practical quantitation limits (PQL) to be greater than that specified in the Sampling and Analysis Plan (SAP), Reference 1.

SAMPLE IDENTIFICATION

Upon receipt of samples at 222-S Laboratory, new sample numbers were assigned to the samples. Using LABCORE (the laboratory's computerized database) to log in the samples, each sample was given a new laboratory sample number. Additional laboratory sample numbers were assigned to the acid dilution subsets of samples. Table 1 relates the sample identifications assigned by the laboratory to those of the program.

Table 1. Sample Identification

Program Sample Identification	Lab Sample ID (direct analysis)	Lab Sample ID (acid dilution)	Sample Collection Date/Time	Lab Receipt of Sample Date/Time
D011	S96K000026	S96K000027	8/27/96, 1018	8/29/96, 1355
D017	S96K000028	S96K000029	8/27/96, 2138	8/29/96, 1355
D015	S96K000030	n/a	8/27/96, 1905	9/5/96, 1430
D016	S96K000031	S96K000032	8/28/96, 1919	9/5/96, 1430
D022	S96K000033	S96K000034	8/28/96, 1320	9/5/96, 1430
D023	S96K000035	S96K000036	8/28/96, 1401	9/5/96, 1430
D024	S96K000038	S96K000039	8/28/96, 1442	9/5/96, 1430
D025	S96K000040	S96K000041	8/28/96, 1458	9/5/96, 1430
D032	S96K000042	S96K000043	8/29/96, 1042	9/5/96, 1430
D037	S96K000044	S96K000045	9/3/96, 1052	9/5/96, 1430
D039	S96K000046	S96K000047	9/3/96, 1417	9/5/96, 1430
D041	S96K000048	S96K000049 S96K000316	9/3/96, 1818	9/5/96, 1430
D043	S96K000050	S96K000051	9/3/96, 1902	9/5/96, 1430
D047	S96K000052	S96K000053	9/3/96, 2228	9/5/96, 1430
D028	S96K000054	S96K000055	8/28/96, 2207	9/12/96, 1405
D031	S96K000056	S96K000057	8/29/96, 1011	9/12/96, 1410
D033	S96K000058	S96K000059	8/29/96, 1836	9/12/96, 1410
D035	S96K000060	S96K000061	8/29/96, 2205	9/12/96, 1410
D036	S96K000062	S96K000063	9/3/96, 1035	9/12/96, 1414
D040	S96K000064	S96K000065	9/3/96, 1440	9/12/96, 1414
D044	S96K000066	S96K000067	9/3/96, 1915	9/12/96, 1414
D045	S96K000068	S96K000069	9/3/96, 2154	9/12/96, 1405
D046	S96K000070	S96K000071	9/3/96, 2208	9/12/96, 1405
D050	S96K000072	S96K000073	9/4/96, 0940	9/12/96, 1405
D052	S96K000074	S96K000075	9/9/96, 2236	9/12/96, 1405

Program Sample Identification	Lab Sample ID (direct analysis)	Lab Sample ID (acid dilution)	Sample Collection Date/Time	Lab Receipt of Sample Date/Time
D055	S96K000076	S96K000077	9/10/96, 1122	9/12/96, 1405
D057	S96K000078	S96K000079	9/10/96, 1338	9/12/96, 1405
D058	S96K000080	S96K000081	9/10/96, 1400	9/20/96, 1130
D059	S96K000082	S96K000083	9/10/96, 1418	9/20/96, 1130
D060	S96K000084	S96K000085	9/12/96, 1149	9/20/96, 1130
D061	S96K000086	S96K000087	9/12/96, 1418	9/20/96, 1130
D062	S96K000088	S96K000089	9/12/96, 1435	9/20/96, 1130
D063	S96K000090	S96K000091	9/12/96, 1505	9/20/96, 1130
D064	S96K000092	S96K000093	9/12/96, 1518	9/20/96, 1130
D065	S96K000094	S96K000095	9/12/96, 2124	9/20/96, 1130
D067	S96K000096	S96K000097	9/12/96, 2151	9/20/96, 1130
D068	S96K000098	S96K000099	9/12/96, 2211	9/20/96, 1130
D069	S96K000100	S96K000101	9/12/96, 2222	9/20/96, 1130
D075	S96K000102	S96K000103	9/16/96, 1330	9/20/96, 1130
D076	S96K000104	S96K000105	9/16/96, 1340	9/20/96, 1130
D077	S96K000106	S96K000107	9/16/96, 1401	9/20/96, 1130
D078	S96K000108	S96K000109	9/16/96, 1413	9/20/96, 1130
D066	S96K000110	S96K000111	9/12/96, 2137	9/27/96, 1135
D079	S96K000112	S96K000113	9/18/96, 0932	9/27/96, 1135
D080	S96K000114	S96K000115	9/18/96, 0947	9/27/96, 1140
D082	S96K000116	S96K000117	9/18/96, 1021	9/27/96, 1135
D084	S96K000118	S96K000119	9/18/96, 1719	9/27/96, 1135
D086	S96K000120	S96K000121	9/18/96, 1738	9/27/96, 1145
D087	S96K000122	S96K000123	9/18/96, 1757	9/27/96, 1140
D091	S96K000124	S96K000125	9/18/96, 1913	9/27/96, 1140
D092	S96K000126	S96K000127	9/19/96, 1027	9/27/96, 1135
D093	S96K000128	S96K000129	9/19/96, 1044	9/27/96, 1145

Program Sample Identification	Lab Sample ID (direct analysis)	Lab Sample ID (acid dilution)	Sample Collection Date/Time	Lab Receipt of Sample Date/Time
D094	S96K000130	S96K000131 S96K000317	9/19/96, 1100	9/27/96, 1145
D095	S96K000132	S96K000133 S96K000318	9/19/96, 1412	9/27/96, 1135
D098	S96K000134	S96K000135	9/19/96, 1500	9/27/96, 1135
D099	S96K000136	S96K000137	9/19/96, 1257	9/27/96, 1135
D100	S96K000138	n/a	9/19/96, 1812	9/27/96, 1135
D107	S96K000139	S96K000140	9/24/96, 1424	10/4/96, 1500
D108	S96K000141	S96K000142	9/24/96, 1447	10/4/96, 1500
D112	S96K000143	S96K000144	9/25/96, 1331	10/4/96, 1500
D113	S96K000145	S96K000146	9/25/96, 1433	10/4/96, 1500
D114	S96K000147	S96K000148	9/25/96, 1446	10/4/96, 1500
D115	S96K000149	S96K000150	9/25/96, 1511	10/4/96, 1500
D116	S96K000151	S96K000152	9/25/96, 1522	10/4/96, 1500
D117	S96K000153	S96K000154	9/26/96, 0936	10/4/96, 1500
D118	S96K000155	S96K000156	9/26/96, 0953	10/4/96, 1500
D119	S96K000157	S96K000158	9/26/96, 1010	10/4/96, 1500
D120	S96K000159	S96K000160	9/26/96, 1057	10/4/96, 1500
D121	S96K000161	S96K000162	9/26/96, 1108	10/4/96, 1500
D122	S96K000163	S96K000164	9/26/96, 1328	10/4/96, 1500
D123	S96K000165	S96K000166	9/26/96, 1349	10/4/96, 1500
E19	S96K000167	n/a	9/24/96, 1411	10/4/96, 1500
D127	S96K000168	S96K000169	9/26/96, 2151	10/11/96, 1351
D147	S96K000170	S96K000171	10/3/96, 1730	10/11/96, 1351
D149	S96K000172	S96K000173	10/3/96, 1800	10/11/96, 1351
D156	S96K000174	S96K000175	10/3/96, 1839	10/11/96, 1351
D162	S96K000176	S96K000177	10/4/96, 1027	10/11/96, 1351
D163	S96K000178	S96K000179	10/4/96, 2104	10/11/96, 1351

Program Sample Identification	Lab Sample ID (direct analysis)	Lab Sample ID (acid dilution)	Sample Collection Date/Time	Lab Receipt of Sample Date/Time
D164	S96K000180	S96K000181	10/4/96, 2113	10/11/96, 1351
D170	S96K000182	S96K000183	10/7/96, 0958	10/11/96, 1351
D171	S96K000184	S96K000185	10/7/96, 1018	10/11/96, 1351
D173	S96K000186	S96K000187	10/7/96, 1309	10/11/96, 1351
D174	S96K000188	S96K000189	10/7/96, 1432	10/11/96, 1351
D177	S96K000190	S96K000191	10/7/96, 1823	10/11/96, 1351
D185	S96K000192	S96K000193	10/8/96, 1003	10/11/96, 1351
D186	S96K000194	S96K000195	10/8/96, 1027	10/11/96, 1351
D187	S96K000196	S96K000197	10/18/96, 1043	10/11/96, 1351
D167	S96K000208	S96K000209	10/7/96, 0904	10/21/96, 1137
D169	S96K000210	n/a	10/7/96, 0945	10/21/96, 1137
D172	S96K000211	S96K000212	10/17/96, 1031	10/21/96, 1137
D194	S96K000213	S96K000214	10/18/96, 1920	10/21/96, 1137
D195	S96K000215	S96K000216	10/18/96, 1936	10/21/96, 1137
D124	S96K000217	S96K000218	9/26/96, 1401	10/21/96, 1137
D125	S96K000219	S96K000220	9/26/96, 2122	10/21/96, 1137
D126	S96K000221	S96K000222	9/26/96, 2139	10/21/96, 1137
D128	S96K000223	S96K000224	9/26/96, 2205	10/21/96, 1137
D130	S96K000225	S96K000226	9/26/96, 1907	10/21/96, 1137
D131	S96K000227	S96K000228	9/26/96, 1854	10/21/96, 1137
D135	S96K000229	S96K000230	9/30/96, 1356	10/21/96, 1137
D136	S96K000231	S96K000232	9/30/96, 1421	10/21/96, 1137
D137	S96K000233	S96K000234	9/30/96, 1433	10/21/96, 1137
D138	S96K000235	S96K000236	9/30/96, 1451	10/21/96, 1137
D139	S96K000237	S96K000238	9/30/96, 1503	10/21/96, 1137
D140	S96K000239	S96K000240	9/30/96, 1514	10/21/96, 1137
D133	S96K000241	S96K000242	9/30/96, 1134	10/30/96, 1220

Program Sample Identification	Lab Sample ID (direct analysis)	Lab Sample ID (acid dilution)	Sample Collection Date/Time	Lab Receipt of Sample Date/Time
D143	S96K000243	S96K000244	10/2/96, 1424	10/30/96, 1220
D146	S96K000245	S96K000246	10/3/96, 1454	10/30/96, 1220
D148	S96K000247	S96K000248	10/3/96, 1746	10/30/96, 1215
D150	S96K000249	S96K000250	10/3/96, 1825	10/30/96, 1215
D151	S96K000251	S96K000252	10/2/96, 1522	10/30/96, 1215
D158	S96K000253	S96K000254	10/3/96, 1908	10/30/96, 1215
D159	S96K000255	S96K000256	10/4/96, 0945	10/30/96, 1215
D160	S96K000257	S96K000258	10/4/96, 0957	10/30/96, 1100
D161	S96K000259	S96K000260	10/4/96, 1017	10/30/96, 1100
D168	S96K000261	S96K000262	10/4/96, 0921	10/30/96, 1100
D180	S96K000263	S96K000264	10/7/96, 2150	10/30/96, 1215
D184	S96K000265	S96K000266	10/8/96, 0949	10/30/96, 1215
D189	S96K000267	S96K000268	10/8/96, 1408	10/30/96, 1215
D192	S96K000269	S96K000270	10/8/96, 1833	10/30/96, 1215
D196	S96K000271	S96K000272	10/8/96, 0906	10/30/96, 1215
D197	S96K000273	S96K000274	10/9/96, 0919	10/30/96, 1215
E21	S96K000275	S96K000276	9/27/96, 1745	10/30/96, 1215
D157	S96K000277	n/a	10/3/96, 1854	10/30/96, 1215
D159	S96K000278	n/a	10/7/96, 2139	10/30/96, 1215
D183	S96K000279	n/a	10/7/96, 2237	10/30/96, 1215
D188	S96K000280	n/a	10/8/96, 1347	10/30/96, 1215
D193	S96K000281	n/a	10/8/96, 1848	10/30/96, 1215

RESULTS OF ANALYSIS

Report Format

Interim data were provided to the program prior to completing the collection of all samples. These data were tentative and subject to change pending review of data correctness, completeness, and pending possible reruns to satisfy program quality control requirements. These reports were generated using a standard report format from the LABCORE system. LABCORE's reported values are slightly different than the originally derived data for several parameters because it rounds the values, makes additional computations, and then rounds the data again. Although these systematic errors are known and understood, they are not currently able to be fixed because they are part of the software developer's proprietary source code.

For this final report, all analytical data were downloaded from LABCORE as an ASCII file, then reformatted using Excel™, a computer spreadsheet program, to provide summary data tables. In this format, the data for all samples are presented by analyte. For the final report, data not downloaded from the LABCORE database were added to generate a complete report. Because there was control over the format and contents of these tables, they accurately represent the true and complete analytical data.

Discussion of Results

Specific Gravity

Two samples were analyzed for specific gravity on direct samples using procedure LA-510-112, revision C-3, on November 24, 1996. These analyses were not requested in the project's documentation, but were analyzed by verbal request of the program. No procedural anomalies occurred during the analyses and there were no technical difficulties. Sample results ranged from 0.964 to 0.970. Specific gravity is a unitless value.

The program requested that no quality control analyses be performed for this analyte.

pH Analysis by Ion Selective Electrode

Samples were analyzed for pH on direct samples using procedure LA-212-106, revision B-0, on November 11, 14 an 15, 1996. No procedural anomalies occurred during the analyses of pH, and there were no technical difficulties.

Sample values ranged from a pH of 6.34 to 11.85.

Analytical accuracy was determined on the basis of a control standard. The deviations of the observed control standard values from the actual value ranged from 0.01 to 0.03 pH units, and were within the program's specified control limits of ±0.4 pH units. The spiking of samples for pH is technically not possible, consequently no spiked analyses were performed.

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Analytical precision was evaluated on three samples, where the analyses were performed in duplicate. The precision results were quite good, ranging from 0.0 to 0.9 RPD, however no control limits were specified by the program.

Nitrate by Ion Chromatography

Samples were analyzed for nitrate on direct samples using procedures LA-533-105, revision D-1 and LA-533-101, revision G-0. The latter procedure was not specified in Reference 1 (SAP) as a program approved procedure, however it is technically equivalent to the former procedure but is performed on a different ion chromatography instrument. Analyses were performed on the direct samples on October 1, 2, 3, 17, 1996; November 8, 17 through 19, and 22 through 24, 1996; and December 8 and 9, 1996. No procedural anomalies occurred during the analyses. Except for sample D067 no technical difficulties were noted. For sample D067, the cognizant chemist stated,

> "Since no sample is left of S96K000096, we can't rerun it even though the Dup and Spike for Cl and SO4 are bad -- could be non-homogeneity."

Samples results ranged from less than the detection limit to 330 μg/ml. The required maximum practical quantitation limit (PQL) of 30 μg/ml was met for all samples.

Analytical accuracy was determined on the basis of spiked samples. Seven of the 8 spike percent recoveries were within the program's specified control limits of 100 ±20 percent recovery, and ranged from 82.7 to 99.4. Although one of the spike recoveries failed to meet the criteria with a recovery of 79.8, it was close to being within the limits. Nitrate control standards performed well, with results ranging from 93.3 to 107.6 percent recovery.

Analytical precision was evaluated on 9 samples, where the analyses were performed in duplicate. The precision results ranged from 0.0 to 13.2 RPD, which were within the program's specified control limits of ±20 RPD.

No contamination was observed in any of the reagent blanks. One reagent blank was analyzed with each batch of samples.

Nitrite by Ion Chromatography

Samples were analyzed for nitrite on direct samples using procedures LA-533-105, revision D-1 and LA-533-101, revision G-0. The latter procedure was not specified in Reference 1 (SAP) as a program approved procedure, however it is technically equivalent to the former procedure but is performed on a different ion chromatography instrument. Analyses were performed on the direct samples on October 1, 2, 3, 17, 1996; November 8, 17 through 19, and 22 through 24, 1996; and December 8 and 9, 1996. No procedural anomalies occurred during the analyses. Except for sample D067 no technical difficulties were noted. For sample D067, the cognizant chemist stated, "Since no sample is left of S96K000096, we can't rerun it even though the Dup and Spike for Cl and SO_4 are bad -- could be non-homogeneity."

Sample results ranged from less than the detection limit to 547 µg/ml. The required PQL of 30 µg/ml was met for all samples.

Analytical accuracy was determined on the basis of spiked samples. The spike percent recoveries ranged from 92.8 to 101.9, and were within the program's specified control limits of 100 ±20 percent recovery. Nitrite control standards performed well, with results ranging from 90.9 to 101.9 percent recovery.

Analytical precision was evaluated on 9 samples, where the analyses were performed in duplicate. The calculable precision results ranged from 1.3 to 10.3 RPD, and were within the program's specified control limits of ±20 RPD. Precision RPD was not able to be calculated for five of the samples because the results were less than the detection limit.

No contamination was observed in any of the reagent blanks. One reagent blank was analyzed in each batch of samples.

Potassium by Inductively Coupled Plasma/Optical Emission Spectroscopy

Samples were diluted in acid to solubilize the analyte and then analyzed using procedure LA-505-161, revision B-1. Analyses were performed on November 13, 18 and 19, 1996, and on December 4 and 18, 1996 . No procedural anomalies occurred during the preparations or analyses, and there were no technical difficulties. For a few samples, including D058 and D067, the program specified PQL of 30 µg/ml was not able to be obtained, due the an insufficient amount of sample, as noted by the chemist. Sample results ranged from less than the detection limit to 421 µg/ml.

Analytical accuracy was determined on the basis of 10 spiked samples. The spike percent recoveries ranged from 78.2 to 111.0. Nine of the 10 spiked results were within the program's specified control limits of 100 ±20 percent recovery. Potassium control standards performed well, with results ranging from 91.8 to 106.0 percent recovery.

Analytical precision was evaluated on 23 samples, where the analyses were performed in duplicate. The calculable precision results ranged from 3.4 to 17.9 RPD, which were within the program's specified control limits of ±25 RPD. Precision RPD was not able to be calculated for many of the samples because one or more of the results for each sample was less than the detection limit.

No contamination was observed in any of the preparation blanks. One blank was analyzed in each batch of samples.

Uranium by Laser-Induced Kinetic Phosphorescence

Samples were analyzed for uranium using procedure LA-925-009, revision A-1, on November 11, and 23, 1996, and December 11, 16, 18, 20, and 23, 1996. No procedural anomalies occurred during the analyses, and there were no technical difficulties. Sample results ranged from less than the detection limit to 180 μg/ml. The required PQL of 1 μg/ml was met for all samples.

Analytical accuracy was determined on the basis of spiked samples. The spike percent recoveries ranged from 108.6 to 132.6, where two of the four spikes were within the program's specified control limits of 100 ±20 percent recovery. The consistency of the positive spike bias tended to indicate that background interference was present in the samples. No attempt was made to determine or resolve the interference. Uranium control standards performed well, with results ranging from 98.1 to 114.9 percent recovery.

Analytical precision was evaluated on three samples, where the analyses were performed in duplicate. The calculable precision results were 0.7 and 4.2 RPD, which were within the program's specified control limits of ±20 RSD. One of the duplicate samples had a concentration that was less than the detection limit, preventing the calculation of an RPD.

Except for samples D138, D148 and D189, no contamination was observed in the reagent blanks. For those samples, the blank was seen to be significantly contaminated, however the analytical results for the samples did not appear to be affected because they were at or less than the detection limit. One reagent blank was analyzed in each batch of samples.

Tritium by Lachat Micro-Distillation/Liquid Scintillation Counting

Samples were analyzed for tritium using procedure LA-218-114, revisions A-4 and B-0, on direct samples on October 10, November 12 and 15, and December 14 and 28, 1996. No procedural anomalies occurred during the analyses. There were no technical difficulties or anomalies. Sample results ranged from 0.000304 to 0.184 μCi/ml. The required PQL of 0.001 μCi/ml was met for all samples.

Analytical accuracy was determined on the basis of four spiked samples. The spike percent recoveries ranged from 84.7 to 174.0, where one of the four spikes was outside of the program's specified control limits of 100 ±20 percent recovery. The chemist noted for sample D184,

> "The spike recovery is still out of control limits, however there is no remaining sample for further reruns. The data will be accepted."

Tritium control standards performed well, with results ranging from 91.2 to 106.8 percent recovery.

Analytical precision was evaluated on four samples, where the analyses were performed in duplicate. The precision results ranged from 0.4 to 6.5 RPD, which were all within the program's specified control limits of ±40 RPD.

No contamination was observed in any of the reagent blanks. One reagent blank was analyzed in each batch of samples.

Total Alpha

Samples were diluted in acid to solubilize the analyte, and then were analyzed for total alpha activity using procedure LA-505-101, revision E-1. Analyses were performed on November 9, 15, 17, 19, 21, 22 and 24; and December 2 through 6, 12, 13, 16, 17, 20, 23, and 27, 1996. No procedural anomalies occurred during the analyses, and there were no technical difficulties. Sample results ranged from less than the detection limit to 0.0138 μCi/ml. The program's required PQL of 0.001 μCi/ml was not able to be met for 28 of the 93 samples analyzed.

Analytical accuracy was determined on the basis of spiked samples. The spike percent recoveries ranged from 65.5 to 91.1, where seven of the 13 spikes were within the program's specified control limits of 100 ±20 percent recovery. In general the spikes appeared to be biased low, however as was noted by the chemist for sample D137, which had the lowest spike recovery, "Spike recovery is within method control limits for the standard", meaning that the spike recovery can not be any better statistically than the recovery of the standard.

The control standards also tended to be biased low although acceptable, with results ranging from 69.1 to 94.8 percent recovery.

Analytical precision was evaluated on 13 samples, where the analyses were performed in duplicate. The precision results ranged from 2.7 to 70.1 RPD, where three were within the program's specified control limits of ±40 RPD, and eight were not able to be calculated because one or both of the duplicate values was less than the detection limit. For the two samples, D011 and D078, which failed to meet the QC limit, the chemist noted that the results were not valid because the sample values were very near the detection limit.

No contamination was observed in any of the reagent blanks. One reagent blank was analyzed in each batch of samples.

Total Beta

Samples were diluted in acid to solubilize the analyte, and then were analyzed for total beta activity using procedure LA-505-101, revision E-1. Analyses were performed on November 9, 15, 17, 19, 21, 22 and 24; and December 2 through 6, 12, 13, 16, 17, 20, 23, and 27, 1996. No procedural anomalies occurred during the analyses, and there were no technical difficulties.

Sample results ranged from 0.00396 to 244 µCi/ml. The program did not specify a required PQL for total beta.

Analytical accuracy was determined on the basis of spiked samples. The spike percent recoveries ranged from 98.7 to 104.0, where all four of the spikes were within 100 ±20 percent recovery. The program did not specify accuracy acceptance limits for total beta. Recovery of the control standards was good, with results ranging from 93.6 to 107.4 percent.

Analytical precision was evaluated on four samples, where the analyses were performed in duplicate. The precision results were very good, ranging from 1.2 to 9.7 RPD. The program did not specify precision acceptance limits for total beta.

No contamination was observed in any of the reagent blanks. One reagent blank was analyzed in each batch of samples.

Cesium-137 by Gamma Energy Analysis (GEA)

Samples were diluted in acid to solubilize the analyte, and then were analyzed for ^{137}Cs using procedure LA-548-121, revision E-0, on October 2, 27, 28 and 29; November 28; December 2, 1996; and January 11, 1997. No procedural anomalies occurred during the analyses, and there were no technical difficulties.

The program requested that three samples (D041, D094 and D095) be rerun because the data were inconsistent relative to GEA data collected in the field at the time of sample collection. The rerun results for sample D041 were approximately the same as the original results (within experimental error). The rerun results for samples D094 and D095, however were significantly different from the original results, differing for ^{137}Cs by factors of 15.2 and 932, respectively. Although ^{134}Cs, ^{60}Co and ^{241}Am were analyzed simultaneously with ^{137}Cs in the original run and rerun, the detected activities for these nuclides were generally less than their detection limits, making any correlations difficult if not impossible. It should be noted that the detection limits for all nuclides for D095 were different between the two runs by three orders of magnitude. It would be tempting to speculate that the original run was in error because correct sample dilution factors were not applied, however this can not be verified by the validation process. An inspection of the original data did not appear to the reviewer to be flawed. Because it appeared that there was significant error for the samples in question, the program requested a data review to determine whether any of the 222-S Laboratory's GEA data were reliable. While this question cannot be answered categorically, a discussion of relative errors is useful. The definitive measure to determine the validity of GEA data would be to rerun all of the samples to provide estimates of correlation between the two sets of data. In practice, however, reruns need only be performed for a statistically significant number of samples. The expectation is that if high correlations existed between the two sets of data, then random errors (such as incorrectly applied sample dilution factors) were not a factor. This process could not, however, reveal the existence of non-random (systematic) errors. For most analytes, spiked samples provide an estimate of the bias in results from the true values. No spikes were performed for the gamma energy analysis as directed in the procedure, consequently a direct evaluation of bias is not possible. GEA is not spiked because that technique is essentially free from sample matrix interference. In addition, because these gamma energy analyses did not require special sample preparations (such as acid digestion or fusion), but were performed on direct samples, there was a smaller probability of occurrence of random error. Historically, the incidence at the 222-S Laboratory of reporting erroneous data because of improperly applied dilution factors has been very low. In the absence of rerun evidence to the contrary, the reported set of GEA data are believed to be usable and reliable.

Sample results ranged from 0.000808 to 237 μCi/ml. The program specified PQL of 0.1 μCi/ml was met for all samples.

Analytical accuracy was determined on the basis of a ^{137}Cs control standard. The percent recoveries of the control standard ranged from 98.0 to 105.3. The program did not specify accuracy acceptance control limits. The spiking of samples for GEA analytes is unnecessary because interference in insignificant with this procedure, consequently no spiked analyses were performed.

Analytical precision was evaluated on six samples, where the analyses were performed in duplicate. The precision results ranged from 0.0 to 3.4 RPD, which were within the program's specified control limits of ±35 RPD.

No contamination was observed in any of the reagent blanks. One reagent blank was analyzed in each batch of samples.

Cesium-134 by Gamma Energy Analysis (GEA)

Samples were diluted in acid to solubilize the analyte, and then were analyzed for ^{134}Cs using procedure LA-548-121, revision E-0, on October 2, 27, 28 and 29; November 28; December 2, 1996; and January 11, 1997. No procedural anomalies occurred during the analyses, and there were no technical difficulties. Sample results ranged from less than the detection limit to 0.366 μCi/ml. The program did not specify a PQL for this analyte.

Analytical accuracy was determined on the basis of a ^{137}Cs control standard. The percent recoveries of the control standard ranged from 98.0 to 105.3. The program did not specify accuracy acceptance control limits. The spiking of samples for GEA analytes is unnecessary because interference in insignificant with this procedure, consequently no spiked analyses were performed.

Analytical precision was evaluated on five samples, where the analyses were performed in duplicate. The precision results ranged from 0.0 to 4.2 RPD. The program did not specify control limits for this analyte.

No contamination was observed in any of the reagent blanks. One reagent blank was analyzed in each batch of samples.

Cobalt-60 by Gamma Energy Analysis (GEA)

Samples were diluted in acid to solubilize the analyte, and then were analyzed for ^{60}Co using procedure LA-548-121, revision E-0, on October 2, 27, 28 and 29; November 28; December 2, 1996; and January 11, 1997. No procedural anomalies occurred during the analyses, and there were no technical difficulties. Sample results ranged from less than the detection limit to 0.000700 μCi/ml. The program specified PQL of 0.1 μCi/ml was met for all samples.

Analytical accuracy was determined on the basis of a ^{60}Co control standard. The percent recoveries of the control standard ranged from 96.8 to 103.4. The program did not specify accuracy acceptance control limits. The spiking of samples for GEA analytes is unnecessary because interference in insignificant with this procedure, consequently no spiked analyses were performed.

Analytical precision was evaluated on six samples, where the analyses were performed in duplicate. Only one duplicate sample had detectable activity, which exhibited precision of 2.1 RPD. The program did not specify a control limit for this analyte.

No contamination was observed in any of the reagent blanks. One reagent blank was analyzed in each batch of samples.

Americium-241 by GEA

Samples were diluted in acid to solubilize the analyte, and then were analyzed for ^{241}Am using procedure LA-548-121, revision E-0, on October 2, 27, 28 and 29; November 28; December 2, 1996; and January 11, 1997. No procedural anomalies occurred during the analyses, and there were no technical difficulties. All sample results were from less than the detection limit. The program did not specify a PQL for this analyte.

Analytical accuracy was determined on the basis of a surrogate (^{137}Cs) control standard. The percent recoveries of the control standard ranged from 98.0 to 105.3. The program did not specify control limits for this analyte

Analytical precision was evaluated on six samples, where the analyses were performed in duplicate. The RSD values for all of the duplicate samples was incalculable because all analytical values were less than the detection limit.

No contamination was observed in any of the reagent blanks. One reagent blank was analyzed in each batch of samples.

Strontium-89/90 by Separation/Proportional Counting

Samples were diluted in acid to solubilize the analyte, and then were analyzed for $^{89/90}Sr$ using procedure LA-220-101, revision D-1, on December 9, 11, 12, 15 through 17 and 21, 1996, and January 7 and 9, 1997. The only procedural anomalies that was noted was associated with samples D011, D082 and D119, where the technician's narrative stated that the centrifuge would not attain the speed (in RPMs) that was stated in the procedure. There were no technical difficulties.

Sample results ranged from 0.000568 to 35.2 µCi/ml. The required PQL of 0.1 µCi/ml was met for all samples.

Analytical accuracy was determined on the basis of four spiked samples. The spike percent recoveries ranged from 99.0 to 111.3, which were within the program's specified control limits of 100 ±20 percent recovery. Strontium-89/90 control standards performed well, with results ranging from 100.0 to 110.1 percent recovery.

Analytical precision was evaluated on four samples, where the analyses were performed in duplicate. The precision results ranged from 1.1 to 17.1 RPD, which where within the program's specified control limits of ±40 RPD.

Contamination in the reagent blanks with the potential to have affected sample analytical results was observed for samples D055, D139, D140, D148, D174 and D194. One reagent blank was analyzed in each batch of samples.

Plutonium-239/240 by Ion Exchange/AEA

Samples were diluted in acid to solubilize the analyte, and then were analyzed using procedure LA-943-128, revision B-0. The analysis of $^{239/240}Pu$ was performed on November 11, 14, 20, 21, 22 and 27, 1996; December 13, 15, 17, 23 and 30, 1996; and January 3, 1997. No procedural anomalies occurred during the analyses. There were no technical difficulties.

Sample results ranged from less than the detection limit to 0.00266 µCi/ml. All samples met the required PQL of 0.003 µCi/ml.

Analytical accuracy was determined on the basis of spiked samples. The spike percent recoveries ranged from 85.2 to 98.0. All five of the spikes were within the program's specified control limits of 100 ±20 percent recovery. The performance of $^{239/240}Pu$ control standards was within laboratory acceptance limits, with results ranging from 87.9 to 118.1 percent recovery.

Analytical precision was evaluated on five samples, where the analyses were performed in duplicate. The RPD values for four of the spikes was within the program's specified control limits of ±25 RPD, ranging from 0.2 to 16.4 RPD. The duplicate for D046 yielded a result of 90.7 RPD, however the sample activity was near the detection limit, consequently the estimate of precision is not valid for this sample.

No contamination was observed in any of the preparation blanks. One preparation blank was analyzed in each batch of samples.

Plutonium-238 by Ion Exchange/AEA

Samples were diluted in acid to solubilize the analyte, and then were analyzed using procedure LA-943-128, revision B-0. The analysis of ^{238}Pu was performed on November 11, 14, 20, 21, 22 and 27, 1996; December 13, 15, 17, 23 and 30, 1996; and January 3, 1997. No procedural anomalies occurred during the analyses. There were no technical difficulties.

Sample results ranged from less than the detection limit to 0.000626 μCi/ml. All samples met the program specified maximum PQL of 0.003 μCi/ml.

No control standard exists for ^{238}Pu, consequently it was not possible to spike samples to evaluate analytical accuracy. Because ^{238}Pu is a byproduct of $^{239/240}$Pu analysis, it is possible to use the ^{239}Pu control standard as a surrogate for evaluation of ^{238}Pu accuracy. The performance of ^{239}Pu control standards was within laboratory acceptance limits, with results ranging from 87.9 to 118.1 percent recovery.

Analytical precision was evaluated on five samples, where the analyses were performed in duplicate. The RPD values for the three duplicate samples which could be calculated ranged from 10.6 to 19.2 RPD, and were within the program specified control limits of ±25 RPD. Precision for two of the precision pairs was incalculable because the analytical values for the samples were less than the detection limit.

No contamination was observed in any of the preparation blanks. One preparation blank was analyzed in each batch of samples.

SAMPLE DATA SUMMARY

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Alpha in Liquid Samples
Analysis performed on an Acid Dilution

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Preparation Blank µCi/mL	Counting Error %
S96K000027	D011	3.19E-03	5.49E-03	4.34E-03	53.0	3.00E-03	74.0	76.0	<1.70E-03	73.5
S96K000032	D016	2.81E-03	n/a	n/a	n/a	3.00E-03	85.7	n/a	<2.23E-03	91.7
S96K000029	D017	1.53E-03	n/a	n/a	n/a	3.00E-03	74.0	n/a	<1.70E-03	130.0
S96K000034	D022	<5.56E-06	n/a	n/a	n/a	5.46E-06	74.0	n/a	<1.70E-03	500.0
S96K000036	D023	7.95E-05	<8.56E-05	n/a	n/a	1.32E-04	85.7	80.8	<2.23E-03	113.0
S96K000039	D024	<2.35E-04	n/a	n/a	n/a	2.76E-04	74.0	n/a	<1.70E-03	155.0
S96K000055	D028	8.08E-04	n/a	n/a	n/a	4.92E-04	71.9	n/a	<1.59E-03	50.9
S96K000057	D031	3.84E-03	n/a	n/a	n/a	5.00E-03	71.9	n/a	<1.59E-03	91.5
S96K000043	D032	<2.33E-05	n/a	n/a	n/a	2.73E-05	73.6	n/a	<2.28E-05	155.0
S96K000061	D035	4.44E-03	4.56E-03	4.50E-03	2.7	1.00E-03	71.9	83.0	<1.59E-03	25.2
S96K000063	D036	<3.50E-03	n/a	n/a	n/a	4.00E-03	74.5	n/a	<1.86E-03	500.0
S96K000045	D037	3.16E-05	n/a	n/a	n/a	2.73E-05	73.6	n/a	<2.28E-05	73.5
S96K000047	D039	3.34E-03	n/a	n/a	n/a	2.73E-05	73.6	n/a	<2.28E-05	5.5
S96K000049	D041	2.17E-03	n/a	n/a	n/a	3.00E-03	73.6	n/a	<2.28E-05	113.0
S96K000051	D043	<8.70E-03	n/a	n/a	n/a	1.30E-02	88.3	n/a	<9.89E-03	500.0
S96K000067	D044	1.94E-03	n/a	n/a	n/a	3.00E-03	80.1	n/a	<1.66E-03	106.0
S96K000069	D045	4.17E-04	n/a	n/a	n/a	1.00E-03	80.1	n/a	<1.66E-03	121.0
S96K000071	D046	2.79E-03	n/a	n/a	n/a	3.00E-03	80.1	n/a	<1.66E-03	74.3
S96K000053	D047	2.10E-03	2.72E-03	2.41E-03	25.7	2.00E-03	71.9	80.8	<1.59E-03	91.5
S96K000073	D050	6.65E-04	n/a	n/a	n/a	1.00E-03	80.1	n/a	<1.66E-03	143.0
S96K000075	D052	1.66E-03	n/a	n/a	n/a	3.00E-03	80.1	n/a	<1.66E-03	121.0
S96K000077	D055	<1.02E-03	n/a	n/a	n/a	2.00E-03	87.0	n/a	<2.55E-04	500.0
S96K000079	D057	<1.02E-03	n/a	n/a	n/a	2.00E-03	87.0	n/a	<2.55E-04	500.0
S96K000083	D059	1.60E-04	n/a	n/a	n/a	1.46E-04	94.4	n/a	1.24E-04	82.1
S96K000085	D060	<1.02E-03	n/a	n/a	n/a	2.00E-03	87.0	n/a	<2.55E-04	500.0
S96K000087	D061	<2.55E-04	<2.55E-04	n/a	n/a	1.00E-03	87.0	77.4	<2.55E-04	500.0
S96K000091	D063	<2.14E-04	n/a	n/a	n/a	4.99E-04	93.5	n/a	<2.11E-04	500.0
S96K000095	D065	<3.47E-05	n/a	n/a	n/a	4.91E-05	71.4	n/a	<2.37E-05	225.0
S96K000111	D066	<2.72E-05	n/a	n/a	n/a	3.32E-05	94.8	n/a	<4.80E-04	500.0
S96K000097	D067	<5.14E-05	n/a	n/a	n/a	4.94E-05	93.5	n/a	<2.11E-04	500.0
S96K000099	D068	<4.21E-04	n/a	n/a	n/a	1.00E-03	93.5	n/a	<2.11E-04	500.0
S96K000101	D069	<5.04E-03	n/a	n/a	n/a	9.00E-03	87.9	n/a	<8.73E-04	500.0
S96K000103	D075	<1.90E-04	<1.90E-04	n/a	n/a	1.00E-03	83.9	81.6	<2.75E-04	500.0
S96K000109	D078	8.37E-04	1.74E-03	1.29E-03	70.1	2.00E-03	87.9	83.0	<8.73E-04	137.0
S96K000113	D079	2.50E-03	n/a	n/a	n/a	4.00E-03	79.2	n/a	<1.86E-03	122.0
S96K000115	D080	1.43E-03	n/a	n/a	n/a	1.00E-03	85.3	n/a	<4.64E-04	69.3
S96K000119	D084	<4.64E-04	n/a	n/a	n/a	1.00E-03	85.3	n/a	<4.64E-04	500.0
S96K000121	D086	<2.29E-03	n/a	n/a	n/a	3.00E-03	85.3	n/a	<4.64E-04	500.0
S96K000123	D087	<1.86E-03	n/a	n/a	n/a	4.00E-03	79.2	n/a	<1.86E-03	500.0
S96K000125	D091	3.69E-04	n/a	n/a	n/a	8.77E-05	79.7	n/a	<1.21E-03	55.4
S96K000127	D092	6.25E-06	n/a	n/a	n/a	7.97E-06	79.7	n/a	<1.21E-03	101.0
S96K000129	D093	8.48E-06	n/a	n/a	n/a	7.97E-06	79.7	n/a	<1.21E-03	82.4
S96K000133	D095	<1.66E-02	n/a	n/a	n/a	4.20E-02	77.9	n/a	<2.41E-02	500.0
S96K000135	D098	<1.89E-03	<1.27E-03	n/a	n/a	2.00E-03	79.7	78.8	<1.21E-03	500.0
S96K000140	D107	<1.73E-03	n/a	n/a	n/a	3.00E-03	86.6	n/a	<1.73E-03	500.0
S96K000142	D108	7.39E-04	n/a	n/a	n/a	4.55E-04	91.8	n/a	<2.87E-04	60.0
S96K000144	D112	3.91E-03	n/a	n/a	n/a	5.00E-03	91.8	n/a	<2.87E-04	143.0
S96K000146	D113	<7.52E-05	<1.07E-04	n/a	n/a	1.49E-04	86.6	86.6	<1.73E-03	500.0
S96K000148	D114	1.03E-04	n/a	n/a	n/a	9.91E-05	91.8	n/a	<2.87E-04	74.3
S96K000152	D116	1.99E-03	n/a	n/a	n/a	1.00E-03	80.1	n/a	<6.18E-04	73.3
S96K000154	D117	1.28E-02	1.13E-02	1.20E-02	12.4	5.00E-03	80.1	75.8	<6.18E-04	79.0
S96K000156	D118	4.30E-04	n/a	n/a	n/a	4.83E-04	80.1	n/a	<6.18E-04	175.0
S96K000158	D119	<3.20E-03	n/a	n/a	n/a	4.00E-03	84.0	n/a	<3.36E-03	155.0
S96K000160	D120	1.29E-03	n/a	n/a	n/a	2.00E-03	84.0	n/a	<3.36E-03	82.6
S96K000162	D121	6.50E-04	n/a	n/a	n/a	2.41E-04	80.1	n/a	<6.18E-04	54.1
S96K000164	D122	<6.15E-04	n/a	n/a	n/a	1.00E-03	88.8	n/a	<9.29E-04	303.0
S96K000220	D125	<2.01E-03	n/a	n/a	n/a	5.00E-03	73.0	n/a	<2.01E-03	500.0
S96K000222	D126	<5.38E-04	n/a	n/a	n/a	1.00E-03	73.0	n/a	<2.01E-03	500.0
S96K000169	D127	<5.28E-03	n/a	n/a	n/a	7.00E-03	77.8	n/a	<2.93E-03	500.0

Alpha in Liquid Samples
Analysis performed on an Acid Dilution

Labcore Number.	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Preparation Blank µCi/mL	Counting Error %
S96K000224	D128	<2.35E-03	n/a	n/a	n/a	5.00E-03	73.0	n/a	<2.01E-03	500.0
S96K000228	D131	<4.02E-04	n/a	n/a	n/a	1.00E-03	73.0	n/a	<2.01E-03	500.0
S96K000242	D133	<1.32E-03	n/a	n/a	n/a	2.00E-03	71.7	n/a	<1.11E-03	500.0
S96K000234	D137	<6.25E-04	<9.16E-04	n/a	n/a	1.00E-03	71.7	65.5	<1.11E-03	500.0
S96K000236	D138	<4.90E-04	n/a	n/a	n/a	1.00E-03	71.7	n/a	<1.11E-03	500.0
S96K000238	D139	<3.69E-04	n/a	n/a	n/a	1.00E-03	71.7	n/a	<1.11E-03	500.0
S96K000240	D140	<3.94E-04	n/a	n/a	n/a	1.00E-03	71.7	n/a	<1.11E-03	500.0
S96K000244	D143	<1.05E-03	n/a	n/a	n/a	2.00E-03	71.7	n/a	<1.11E-03	500.0
S96K000246	D146	<2.64E-03	<1.91E-03	n/a	n/a	3.00E-03	93.5	91.1	<2.87E-03	155.0
S96K000171	D147	6.28E-03	n/a	n/a	n/a	4.00E-03	69.6	n/a	<3.33E-03	76.1
S96K000173	D149	8.21E-03	n/a	n/a	n/a	9.00E-03	69.6	n/a	<3.33E-03	90.3
S96K000175	D156	1.38E-02	n/a	n/a	n/a	1.60E-02	69.6	n/a	<3.33E-03	101.0
S96K000254	D158	<9.12E-04	n/a	n/a	n/a	1.00E-03	93.5	n/a	<2.87E-03	500.0
S96K000256	D159	<9.18E-04	n/a	n/a	n/a	1.00E-03	93.5	n/a	<2.87E-03	500.0
S96K000258	D160	<1.16E-03	n/a	n/a	n/a	3.00E-03	93.5	n/a	<2.87E-03	500.0
S96K000260	D161	<2.98E-04	n/a	n/a	n/a	4.73E-04	69.1	n/a	<4.80E-04	299.0
S96K000179	D163	<1.29E-03	n/a	n/a	n/a	3.00E-03	77.8	n/a	<2.93E-03	500.0
S96K000181	D164	<1.29E-03	n/a	n/a	n/a	3.00E-03	77.8	n/a	<2.93E-03	500.0
S96K000209	D167	<2.05E-03	n/a	n/a	n/a	3.00E-03	87.0	n/a	<5.37E-02	500.0
S96K000262	D168	<1.61E-01	n/a	n/a	n/a	1.91E-01	69.1	n/a	<4.80E-04	160.0
S96K000183	D170	<2.05E-03	n/a	n/a	n/a	3.00E-03	77.8	n/a	<2.93E-03	500.0
S96K000185	D171	<2.05E-03	n/a	n/a	n/a	3.00E-03	77.8	n/a	<2.93E-03	500.0
S96K000212	D172	<1.33E-03	n/a	n/a	n/a	3.00E-03	87.0	n/a	<5.37E-02	500.0
S96K000187	D173	<8.27E-02	n/a	n/a	n/a	1.35E-01	87.0	n/a	<5.37E-02	500.0
S96K000189	D174	<5.37E-02	n/a	n/a	n/a	1.35E-01	87.0	n/a	<5.37E-02	500.0
S96K000266	D184	<3.82E-04	n/a	n/a	n/a	1.00E-03	93.5	n/a	<2.87E-03	500.0
S96K000193	D185	<2.72E-05	<2.25E-05	n/a	n/a	3.32E-05	87.0	77.4	<5.37E-02	500.0
S96K000197	D187	<7.61E-03	n/a	n/a	n/a	3.00E-03	87.0	n/a	<5.37E-02	500.0
S96K000270	D192	<3.37E-04	n/a	n/a	n/a	1.00E-03	86.1	n/a	<3.37E-04	500.0
S96K000214	D194	<1.33E-03	n/a	n/a	n/a	3.00E-03	87.0	n/a	<5.37E-02	500.0
S96K000216	D195	<7.07E-03	n/a	n/a	n/a	5.00E-03	74.8	n/a	<4.31E-03	438.0
S96K000272	D196	9.17E-05	n/a	n/a	n/a	4.65E-05	76.5	n/a	<3.59E-05	43.3
S96K000274	D197	1.86E-05	n/a	n/a	n/a	6.01E-06	86.1	n/a	<3.37E-04	47.1
S96K000276	E21	<1.32E-03	n/a	n/a	n/a	2.00E-03	76.5	n/a	<3.59E-05	500.0

Beta in Liquid Samples
Analysis performed on an Acid Dilution

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Preparation Blank µCi/mL	Counting Error %
S96K000032	D016	1.04E+02	n/a	n/a	n/a	1.60E-02	103.7	n/a	<1.04E-02	0.3
S96K000036	D023	2.65E+00	2.69E+00	2.67E+00	1.5	1.00E-03	103.7	104.0	<1.04E-02	0.3
S96K000059	D033	3.96E-03	n/a	n/a	n/a	1.76E-05	99.0	n/a	5.00E-05	1.4
S96K000063	D036	4.56E+01	n/a	n/a	n/a	1.60E-02	97.3	n/a	<6.74E-01	0.4
S96K000065	D040	8.16E+00	8.06E+00	8.11E+00	1.2	2.00E-03	104.4	101.3	<1.55E-03	0.3
S96K000051	D043	2.44E+02	n/a	n/a	n/a	7.80E-02	107.4	n/a	<7.63E-02	0.4
S96K000083	D059	2.37E+00	n/a	n/a	n/a	1.00E-03	107.4	n/a	<5.90E-04	0.4
S96K000095	D065	5.17E-01	n/a	n/a	n/a	1.37E-04	96.6	n/a	<9.08E-05	0.4
S96K000111	D066	3.13E-01	n/a	n/a	n/a	1.59E-04	104.4	n/a	<3.35E-03	0.5
S96K000103	D075	9.08E+00	9.26E+00	9.17E+00	2.0	3.00E-03	103.0	102.6	1.10E-02	0.4
S96K000113	D079	5.17E+01	n/a	n/a	n/a	1.60E-02	102.4	n/a	<1.43E-02	0.4
S96K000123	D087	3.20E+01	n/a	n/a	n/a	1.60E-02	102.4	n/a	<1.43E-02	0.5
S96K000133	D095	1.78E+02	n/a	n/a	n/a	1.44E-01	98.3	n/a	<1.24E-01	0.7
S96K000140	D107	4.53E+01	n/a	n/a	n/a	1.40E-02	99.3	n/a	<1.06E-02	0.4
S96K000146	D113	2.64E+00	2.91E+00	2.78E+00	9.7	1.00E-03	99.3	98.7	<1.06E-02	0.3
S96K000158	D119	2.03E+02	n/a	n/a	n/a	2.60E-02	104.4	n/a	<2.71E-02	0.3
S96K000160	D120	1.71E+01	n/a	n/a	n/a	8.00E-03	104.4	n/a	<2.71E-02	0.4
S96K000171	D147	6.60E+01	n/a	n/a	n/a	3.60E-02	93.6	n/a	3.30E-02	0.5
S96K000248	D148	3.16E+01	n/a	n/a	n/a	1.63E+00	101.0	n/a	<1.21E+00	5.7
S96K000173	D149	1.66E+02	n/a	n/a	n/a	7.30E-02	93.6	n/a	3.30E-02	0.4
S96K000175	D156	4.97E-01	n/a	n/a	n/a	1.32E-01	93.6	n/a	3.30E-02	40.5
S96K000260	D161	5.37E+00	n/a	n/a	n/a	2.00E-03	94.3	n/a	2.00E-03	0.4
S96K000262	D168	2.29E+02	n/a	n/a	n/a	7.18E-01	94.3	n/a	2.00E-03	1.1
S96K000268	D189	9.68E+00	n/a	n/a	n/a	1.63E+00	101.0	n/a	<1.21E+00	13.2
S96K000216	D195	2.47E+01	n/a	n/a	n/a	1.80E-02	99.7	n/a	1.70E-02	0.5
S96K000272	D196	4.02E-01	n/a	n/a	n/a	1.63E-04	96.3	n/a	2.57E-04	0.4
S96K000276	E21	1.91E+01	n/a	n/a	n/a	7.00E-03	96.3	n/a	2.57E-04	0.4

Cesium-134 by GEA
Analyses Performed on Direct Sample

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Blank µCi/mL	Counting Error %
S96K000035	D023	5.32E-03	n/a	n/a	n/a	n/a	n/a	n/a	<1.46E-04	13.4
S96K000038	D024	4.74E-03	n/a	n/a	n/a	n/a	n/a	n/a	<1.46E-04	16.4
S96K000042	D032	2.15E-02	n/a	n/a	n/a	n/a	n/a	n/a	<1.46E-04	17.7
S96K000058	D033	<9.01E-05	<8.37E-05	n/a	n/a	9.01E-05	n/a	n/a	<1.77E-03	n/a
S96K000062	D036	<1.19E-02	n/a	n/a	n/a	1.20E-02	n/a	n/a	<1.77E-03	n/a
S96K000044	D037	<1.27E-02	n/a	n/a	n/a	1.30E-02	n/a	n/a	<1.46E-04	n/a
S96K000046	D039	1.44E-02	n/a	n/a	n/a	n/a	n/a	n/a	<1.46E-04	8.2
S96K000048	D041	2.98E-01	n/a	n/a	n/a	n/a	n/a	n/a	<1.46E-04	9.1
S96K000316	D041	3.66E-01	n/a	n/a	n/a	n/a	n/a	n/a	<1.99E-02	15.0
S96K000050	D043	3.48E-01	3.55E-01	3.51E-01	2.0	n/a	n/a	n/a	<1.46E-04	8.2
S96K000068	D045	1.32E-02	n/a	n/a	n/a	n/a	n/a	n/a	<1.77E-03	7.6
S96K000070	D046	5.90E-02	n/a	n/a	n/a	n/a	n/a	n/a	<1.77E-03	7.5
S96K000052	D047	5.06E-02	n/a	n/a	n/a	n/a	n/a	n/a	<1.77E-03	7.3
S96K000074	D052	1.60E-01	n/a	n/a	n/a	n/a	n/a	n/a	<1.77E-03	4.2
S96K000080	D058	4.81E-03	n/a	n/a	n/a	n/a	n/a	n/a	<2.09E-05	4.6
S96K000084	D060	1.10E-01	n/a	n/a	n/a	n/a	n/a	n/a	<2.09E-05	6.5
S96K000086	D061	6.62E-03	6.35E-03	6.48E-03	4.2	n/a	n/a	n/a	<2.09E-05	8.2
S96K000102	D075	2.02E-02	n/a	n/a	n/a	n/a	n/a	n/a	<2.09E-05	6.6
S96K000104	D076	1.63E-02	n/a	n/a	n/a	n/a	n/a	n/a	<2.09E-05	6.7
S96K000128	D093	<1.89E-04	n/a	n/a	n/a	1.89E-04	n/a	n/a	<1.34E-04	n/a
S96K000130	D094	4.67E-02	n/a	n/a	n/a	n/a	n/a	n/a	<1.34E-04	6.7
S96K000317	D094	<2.40E-02	n/a	n/a	n/a	2.40E-02	n/a	n/a	<1.99E-02	n/a
S96K000132	D095	<6.21E-05	n/a	n/a	n/a	6.21E-05	n/a	n/a	<1.34E-04	n/a
S96K000318	D095	<1.21E-01	n/a	n/a	n/a	1.21E-01	n/a	n/a	<1.99E-02	n/a
S96K000134	D098	1.39E-01	n/a	n/a	n/a	n/a	n/a	n/a	<1.34E-04	5.6
S96K000136	D099	<5.61E-04	n/a	n/a	n/a	1.00E-03	n/a	n/a	<1.34E-04	n/a
S96K000138	D100	1.21E-05	n/a	n/a	n/a	n/a	n/a	n/a	<1.34E-04	5.6
S96K000147	D114	5.18E-03	n/a	n/a	n/a	n/a	n/a	n/a	<1.71E-04	7.4
S96K000149	D115	<7.19E-03	n/a	n/a	n/a	7.00E-03	n/a	n/a	<1.71E-04	n/a
S96K000153	D117	2.74E-01	n/a	n/a	n/a	n/a	n/a	n/a	<1.71E-04	6.0
S96K000165	D123	2.16E-02	n/a	n/a	n/a	n/a	n/a	n/a	<1.71E-04	39.0
S96K000217	D124	1.03E-02	n/a	n/a	n/a	n/a	n/a	n/a	<2.18E-05	27.9
S96K000225	D130	7.30E-03	7.30E-03	7.30E-03	0.0	n/a	n/a	n/a	<2.18E-05	10.0
S96K000231	D136	3.01E-02	n/a	n/a	n/a	n/a	n/a	n/a	<2.18E-05	5.2
S96K000176	D162	7.10E-02	n/a	n/a	n/a	n/a	n/a	n/a	<1.05E-03	6.7
S96K000261	D168	1.86E-01	n/a	n/a	n/a	n/a	n/a	n/a	<4.04E-03	14.9
S96K000210	D169	2.71E-02	n/a	n/a	n/a	n/a	n/a	n/a	<2.18E-05	14.0
S96K000184	D171	2.45E-02	n/a	n/a	n/a	n/a	n/a	n/a	<1.05E-03	19.8
S96K000190	D177	7.53E-03	n/a	n/a	n/a	n/a	n/a	n/a	<1.05E-03	16.4
S96K000194	D186	1.06E-05	n/a	n/a	n/a	n/a	n/a	n/a	<1.05E-03	6.1
S96K000167	E19	<2.09E-02	<2.03E-02	n/a	n/a	2.10E-02	n/a	n/a	<1.71E-04	n/a

Cesium-137 by GEA
Analyses Performed on Direct Sample

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Blank µCi/mL	Counting Error %
S96K000028	D017	9.95E+01	1.01E+02	1.00E+02	1.5	n/a	101.2	n/a	<5.30E-03	0.2
S96K000035	D023	1.87E+00	n/a	n/a	n/a	n/a	102.2	n/a	<3.39E-04	0.6
S96K000038	D024	6.08E+00	n/a	n/a	n/a	n/a	102.2	n/a	<3.39E-04	0.2
S96K000042	D032	5.74E+00	n/a	n/a	n/a	n/a	102.2	n/a	<3.39E-04	0.9
S96K000058	D033	8.08E-04	7.99E-04	8.03E-04	1.1	n/a	105.3	n/a	<2.53E-03	20.5
S96K000062	D036	2.71E+01	n/a	n/a	n/a	n/a	105.3	n/a	<2.53E-03	0.3
S96K000044	D037	2.59E+01	n/a	n/a	n/a	n/a	102.2	n/a	<3.39E-04	0.3
S96K000046	D039	5.95E+00	n/a	n/a	n/a	n/a	102.2	n/a	<3.39E-04	0.3
S96K000048	D041	1.62E+02	n/a	n/a	n/a	n/a	102.2	n/a	<3.39E-04	0.2
S96K000316	D041	1.84E+02	n/a	n/a	n/a	n/a	103.7	n/a	<5.79E-02	0.5
S96K000050	D043	1.72E+02	1.70E+02	1.71E+02	1.2	n/a	102.2	n/a	<3.39E-04	0.2
S96K000068	D045	7.38E+00	n/a	n/a	n/a	n/a	105.3	n/a	<2.53E-03	0.3
S96K000070	D046	3.10E+01	n/a	n/a	n/a	n/a	105.3	n/a	<2.53E-03	0.3
S96K000052	D047	1.56E+01	n/a	n/a	n/a	n/a	105.3	n/a	<2.53E-03	0.4
S96K000074	D052	3.77E+01	n/a	n/a	n/a	n/a	105.3	n/a	<2.53E-03	0.3
S96K000080	D058	1.51E+00	n/a	n/a	n/a	n/a	103.5	n/a	<3.54E-05	0.2
S96K000084	D060	2.40E+01	n/a	n/a	n/a	n/a	103.5	n/a	<3.54E-05	0.4
S96K000086	D061	3.18E+00	3.18E+00	3.18E+00	0.0	n/a	103.5	n/a	<3.54E-05	0.2
S96K000102	D075	9.06E+00	n/a	n/a	n/a	n/a	103.5	n/a	<3.54E-05	0.2
S96K000104	D076	7.78E+00	n/a	n/a	n/a	n/a	103.5	n/a	<3.54E-05	0.2
S96K000128	D093	2.33E-02	n/a	n/a	n/a	n/a	98.8	n/a	<3.66E-04	3.7
S96K000130	D094	2.31E+01	n/a	n/a	n/a	n/a	98.8	n/a	<3.66E-04	0.2
S96K000317	D094	1.52E+00	n/a	n/a	n/a	n/a	103.7	n/a	<5.79E-02	6.2
S96K000132	D095	1.62E-01	n/a	n/a	n/a	n/a	98.8	n/a	<3.66E-04	0.2
S96K000318	D095	1.51E+02	n/a	n/a	n/a	n/a	103.7	n/a	<5.79E-02	0.6
S96K000134	D098	4.13E+01	n/a	n/a	n/a	n/a	98.8	n/a	<3.66E-04	0.2
S96K000136	D099	1.61E-01	n/a	n/a	n/a	n/a	98.8	n/a	<3.66E-04	1.9
S96K000138	D100	3.67E-03	n/a	n/a	n/a	n/a	98.8	n/a	<3.66E-04	0.3
S96K000147	D114	2.31E+00	n/a	n/a	n/a	n/a	104.5	n/a	<3.23E-04	0.3
S96K000149	D115	2.83E+01	n/a	n/a	n/a	n/a	104.5	n/a	<3.23E-04	0.2
S96K000153	D117	1.42E+02	n/a	n/a	n/a	n/a	104.5	n/a	<3.23E-04	0.2
S96K000165	D123	5.85E+01	n/a	n/a	n/a	n/a	104.5	n/a	<3.23E-04	0.4
S96K000217	D124	2.79E+01	n/a	n/a	n/a	n/a	98.0	n/a	<7.35E-05	0.2
S96K000225	D130	5.68E+00	5.64E+00	5.66E+00	0.7	n/a	98.0	n/a	<7.35E-05	0.2
S96K000231	D136	8.34E+00	n/a	n/a	n/a	n/a	98.0	n/a	<7.35E-05	0.3
S96K000176	D162	2.43E+01	n/a	n/a	n/a	n/a	101.4	n/a	<3.08E-03	0.3
S96K000261	D168	2.37E+02	n/a	n/a	n/a	n/a	99.8	n/a	<1.21E-02	0.2
S96K000210	D169	1.51E+01	n/a	n/a	n/a	n/a	98.0	n/a	<7.35E-05	0.3
S96K000184	D171	3.05E+01	n/a	n/a	n/a	n/a	101.4	n/a	<3.08E-03	0.3
S96K000190	D177	4.38E+00	n/a	n/a	n/a	n/a	101.4	n/a	<3.08E-03	0.5
S96K000194	D186	3.56E-03	n/a	n/a	n/a	n/a	101.4	n/a	<3.08E-03	0.3
S96K000167	E19	3.00E+01	2.90E+01	2.95E+01	3.4	n/a	104.5	n/a	<3.23E-04	0.5

Cobalt-60 by GEA
Analyses Performed on Direct Sample

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Blank µCi/mL	Counting Error %
S96K000028	D017	<2.37E-03	<2.78E-03	n/a	n/a	2.00E-03	96.8	n/a	<1.95E-03	n/a
S96K000035	D023	<3.54E-04	n/a	n/a	n/a	3.54E-04	98.4	n/a	<1.25E-04	n/a
S96K000038	D024	<1.99E-04	n/a	n/a	n/a	1.99E-04	98.4	n/a	<1.25E-04	n/a
S96K000042	D032	<2.88E-03	n/a	n/a	n/a	3.00E-03	98.4	n/a	<1.25E-04	n/a
S96K000058	D033	4.71E-04	4.81E-04	4.76E-04	2.1	n/a	101.6	n/a	<1.72E-03	19.0
S96K000062	D036	<2.91E-03	n/a	n/a	n/a	3.00E-03	101.6	n/a	<1.72E-03	n/a
S96K000044	D037	<1.15E-03	n/a	n/a	n/a	1.00E-03	98.4	n/a	<1.25E-04	n/a
S96K000046	D039	<3.69E-04	n/a	n/a	n/a	3.69E-04	98.4	n/a	<1.25E-04	n/a
S96K000048	D041	<5.69E-03	n/a	n/a	n/a	6.00E-03	98.4	n/a	<1.25E-04	n/a
S96K000316	D041	<2.31E-02	n/a	n/a	n/a	2.30E-02	103.4	n/a	<2.47E-02	n/a
S96K000050	D043	<4.81E-03	<5.26E-03	n/a	n/a	5.00E-03	98.4	n/a	<1.25E-04	n/a
S96K000068	D045	<4.81E-04	n/a	n/a	n/a	4.81E-04	101.6	n/a	<1.72E-03	n/a
S96K000070	D046	<1.97E-03	n/a	n/a	n/a	2.00E-03	101.6	n/a	<1.72E-03	n/a
S96K000052	D047	<1.98E-03	n/a	n/a	n/a	2.00E-03	101.6	n/a	<1.72E-03	n/a
S96K000074	D052	<2.36E-03	n/a	n/a	n/a	2.00E-03	101.6	n/a	<1.72E-03	n/a
S96K000080	D058	<4.38E-05	n/a	n/a	n/a	4.38E-05	102.1	n/a	<2.44E-05	n/a
S96K000084	D060	<2.55E-03	n/a	n/a	n/a	3.00E-03	102.1	n/a	<2.44E-05	n/a
S96K000086	D061	<1.05E-04	<1.10E-04	n/a	n/a	1.05E-04	102.1	n/a	<2.44E-05	n/a
S96K000102	D075	<2.83E-04	n/a	n/a	n/a	2.83E-04	102.1	n/a	<2.44E-05	n/a
S96K000104	D076	<2.48E-04	n/a	n/a	n/a	2.48E-04	102.1	n/a	<2.44E-05	n/a
S96K000128	D093	<1.68E-04	n/a	n/a	n/a	1.68E-04	97.1	n/a	<1.24E-04	n/a
S96K000130	D094	<7.72E-04	n/a	n/a	n/a	1.00E-03	97.1	n/a	<1.24E-04	n/a
S96K000317	D094	<2.27E-02	n/a	n/a	n/a	2.30E-02	103.4	n/a	<2.47E-02	n/a
S96K000132	D095	<5.62E-06	n/a	n/a	n/a	5.62E-06	97.1	n/a	<1.24E-04	n/a
S96K000318	D095	<2.01E-02	n/a	n/a	n/a	2.00E-02	103.4	n/a	<2.47E-02	n/a
S96K000134	D098	<1.67E-03	n/a	n/a	n/a	2.00E-03	97.1	n/a	<1.24E-04	n/a
S96K000136	D099	<6.32E-04	n/a	n/a	n/a	1.00E-03	97.1	n/a	<1.24E-04	n/a
S96K000138	D100	<1.50E-07	n/a	n/a	n/a	1.50E-07	97.1	n/a	<1.24E-04	n/a
S96K000147	D114	7.00E-04	n/a	n/a	n/a	n/a	100.8	n/a	<1.51E-04	24.6
S96K000149	D115	<1.06E-03	n/a	n/a	n/a	1.00E-03	100.8	n/a	<1.51E-04	n/a
S96K000153	D117	<7.15E-03	n/a	n/a	n/a	7.00E-03	100.8	n/a	<1.51E-04	n/a
S96K000165	D123	<5.34E-03	n/a	n/a	n/a	5.00E-03	100.8	n/a	<1.51E-04	n/a
S96K000217	D124	<7.61E-04	n/a	n/a	n/a	1.00E-03	98.1	n/a	<3.41E-05	n/a
S96K000225	D130	<1.69E-04	<1.94E-04	n/a	n/a	1.69E-04	98.1	n/a	<3.41E-05	n/a
S96K000231	D136	<3.81E-04	n/a	n/a	n/a	3.81E-04	98.1	n/a	<3.41E-05	n/a
S96K000176	D162	<1.65E-03	n/a	n/a	n/a	2.00E-03	98.8	n/a	<1.07E-03	n/a
S96K000261	D168	<6.58E-03	n/a	n/a	n/a	7.00E-03	102.0	n/a	<3.85E-03	n/a
S96K000210	D169	<4.64E-04	n/a	n/a	n/a	4.64E-04	98.1	n/a	<3.41E-05	n/a
S96K000184	D171	<1.20E-03	n/a	n/a	n/a	1.00E-03	98.8	n/a	<1.07E-03	n/a
S96K000190	D177	<4.92E-04	n/a	n/a	n/a	4.92E-04	98.8	n/a	<1.07E-03	n/a
S96K000194	D186	3.43E-07	n/a	n/a	n/a	n/a	98.8	n/a	<1.07E-03	47.2
S96K000167	E19	<6.41E-03	<6.44E-03	n/a	n/a	6.00E-03	100.8	n/a	<1.51E-04	n/a

Americium-241 by GEA
Analyses Performed on Direct Sample

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Blank µCi/mL	Counting Error %
S96K000028	D017	<2.50E-01	<2.52E-01	n/a	n/a	2.50E-01	n/a	n/a	<1.22E-02	n/a
S96K000035	D023	<1.28E-02	n/a	n/a	n/a	1.30E-02	n/a	n/a	<8.78E-04	n/a
S96K000038	D024	<1.57E-02	n/a	n/a	n/a	1.60E-02	n/a	n/a	<8.78E-04	n/a
S96K000042	D032	<6.45E-02	n/a	n/a	n/a	6.50E-02	n/a	n/a	<8.78E-04	n/a
S96K000058	D033	<1.22E-04	<1.30E-04	n/a	n/a	1.22E-04	n/a	n/a	<2.63E-03	n/a
S96K000062	D036	<1.58E-02	n/a	n/a	n/a	1.60E-02	n/a	n/a	<2.63E-03	n/a
S96K000044	D037	<9.35E-02	n/a	n/a	n/a	9.30E-02	n/a	n/a	<8.78E-04	n/a
S96K000046	D039	<2.30E-02	n/a	n/a	n/a	2.30E-02	n/a	n/a	<8.78E-04	n/a
S96K000048	D041	<4.63E-01	n/a	n/a	n/a	4.63E-01	n/a	n/a	<8.78E-04	n/a
S96K000316	D041	<1.21E+00	n/a	n/a	n/a	1.21E+00	n/a	n/a	<1.46E-01	n/a
S96K000050	D043	<4.77E-01	<4.71E-01	n/a	n/a	4.77E-01	n/a	n/a	<8.78E-04	n/a
S96K000068	D045	<3.57E-03	n/a	n/a	n/a	4.00E-03	n/a	n/a	<2.63E-03	n/a
S96K000070	D046	<1.46E-02	n/a	n/a	n/a	1.50E-02	n/a	n/a	<2.63E-03	n/a
S96K000052	D047	<1.03E-02	n/a	n/a	n/a	1.00E-02	n/a	n/a	<2.63E-03	n/a
S96K000074	D052	<1.83E-02	n/a	n/a	n/a	1.80E-02	n/a	n/a	<2.63E-03	n/a
S96K000080	D058	<3.43E-03	n/a	n/a	n/a	3.00E-03	n/a	n/a	<1.59E-04	n/a
S96K000084	D060	<1.35E-01	n/a	n/a	n/a	1.35E-01	n/a	n/a	<1.59E-04	n/a
S96K000086	D061	<9.62E-03	<9.58E-03	n/a	n/a	1.00E-02	n/a	n/a	<1.59E-04	n/a
S96K000102	D075	<2.29E-02	n/a	n/a	n/a	2.30E-02	n/a	n/a	<1.59E-04	n/a
S96K000104	D076	<2.13E-02	n/a	n/a	n/a	2.10E-02	n/a	n/a	<1.59E-04	n/a
S96K000128	D093	<1.35E-03	n/a	n/a	n/a	1.00E-03	n/a	n/a	<8.32E-04	n/a
S96K000130	D094	<4.34E-02	n/a	n/a	n/a	4.30E-02	n/a	n/a	<8.32E-04	n/a
S96K000317	D094	<2.10E-01	n/a	n/a	n/a	2.10E-01	n/a	n/a	<1.46E-01	n/a
S96K000132	D095	<4.65E-04	n/a	n/a	n/a	4.65E-04	n/a	n/a	<8.32E-04	n/a
S96K000318	D095	<1.09E+00	n/a	n/a	n/a	1.09E+00	n/a	n/a	<1.46E-01	n/a
S96K000134	D098	<1.18E-01	n/a	n/a	n/a	1.18E-01	n/a	n/a	<8.32E-04	n/a
S96K000136	D099	<4.10E-03	n/a	n/a	n/a	4.00E-03	n/a	n/a	<8.32E-04	n/a
S96K000138	D100	<1.10E-05	n/a	n/a	n/a	1.10E-05	n/a	n/a	<8.32E-04	n/a
S96K000147	D114	<1.22E-03	n/a	n/a	n/a	1.00E-03	n/a	n/a	<2.48E-04	n/a
S96K000149	D115	<9.62E-03	n/a	n/a	n/a	1.00E-02	n/a	n/a	<2.48E-04	n/a
S96K000153	D117	<6.07E-02	n/a	n/a	n/a	6.10E-02	n/a	n/a	<2.48E-04	n/a
S96K000165	D123	<4.48E-02	n/a	n/a	n/a	4.50E-02	n/a	n/a	<2.48E-04	n/a
S96K000217	D124	<6.84E-02	n/a	n/a	n/a	6.80E-02	n/a	n/a	<1.77E-04	n/a
S96K000225	D130	<1.52E-02	<1.50E-02	n/a	n/a	1.50E-02	n/a	n/a	<1.77E-04	n/a
S96K000231	D136	<2.74E-02	n/a	n/a	n/a	2.70E-02	n/a	n/a	<1.77E-04	n/a
S96K000176	D162	<9.09E-02	n/a	n/a	n/a	9.10E-02	n/a	n/a	<6.90E-03	n/a
S96K000261	D168	<6.04E-01	n/a	n/a	n/a	6.04E-01	n/a	n/a	<2.92E-02	n/a
S96K000210	D169	<5.06E-02	n/a	n/a	n/a	5.10E-02	n/a	n/a	<1.77E-04	n/a
S96K000184	D171	<1.01E-01	n/a	n/a	n/a	1.01E-01	n/a	n/a	<6.90E-03	n/a
S96K000190	D177	<2.75E-02	n/a	n/a	n/a	2.80E-02	n/a	n/a	<6.90E-03	n/a
S96K000194	D186	<1.07E-05	n/a	n/a	n/a	1.07E-05	n/a	n/a	<6.90E-03	n/a
S96K000167	E19	<3.30E-02	<3.25E-02	n/a	n/a	3.30E-02	n/a	n/a	<2.48E-04	n/a

Pu-238 by TRU-SPEC Resin Ion Exchange
Analysis performed on an Acid Dilution

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Preparation Blank µCi/mL	Counting Error %
S96K000027	D011	2.50E-05	<1.68E-05	n/a	n/a	1.70E-05	n/a	n/a	<1.59E-05	4.9
S96K000029	D017	2.99E-05	n/a	n/a	n/a	2.08E-05	n/a	n/a	<1.59E-05	5.4
S96K000039	D024	2.06E-05	n/a	n/a	n/a	1.67E-05	n/a	n/a	<1.59E-05	7.5
S96K000057	D031	<5.68E-05	n/a	n/a	n/a	5.68E-05	n/a	n/a	<4.15E-05	7.6
S96K000043	D032	<3.34E-05	n/a	n/a	n/a	3.34E-05	n/a	n/a	<3.43E-05	100.0
S96K000061	D035	6.26E-04	n/a	n/a	n/a	1.80E-04	n/a	n/a	<4.15E-05	2.0
S96K000063	D036	<2.26E-04	n/a	n/a	n/a	2.26E-04	n/a	n/a	<4.15E-05	10.0
S96K000049	D041	<1.85E-04	n/a	n/a	n/a	1.85E-04	n/a	n/a	<3.43E-05	8.7
S96K000071	D046	3.20E-05	3.88E-05	3.54E-05	19.2	1.98E-05	n/a	n/a	<1.58E-05	4.9
S96K000077	D055	3.76E-05	n/a	n/a	n/a	3.00E-05	n/a	n/a	<1.80E-05	5.1
S96K000079	D057	<1.72E-05	n/a	n/a	n/a	1.72E-05	n/a	n/a	<1.80E-05	100.0
S96K000085	D060	<1.94E-05	n/a	n/a	n/a	1.94E-05	n/a	n/a	<1.80E-05	10.8
S96K000091	D063	4.66E-05	n/a	n/a	n/a	2.26E-05	n/a	n/a	<1.89E-05	4.0
S96K000101	D069	<9.64E-05	<9.43E-05	n/a	n/a	9.64E-05	n/a	n/a	<8.38E-05	100.0
S96K000109	D078	1.29E-04	n/a	n/a	n/a	4.29E-05	n/a	n/a	<8.38E-05	2.8
S96K000115	D080	1.29E-04	1.16E-04	1.22E-04	10.6	3.69E-05	n/a	n/a	<1.80E-05	2.6
S96K000119	D084	<2.29E-05	n/a	n/a	n/a	2.29E-05	n/a	n/a	<1.80E-05	100.0
S96K000125	D091	1.70E-04	n/a	n/a	n/a	4.56E-05	n/a	n/a	<1.88E-05	2.6
S96K000144	D112	<1.97E-05	n/a	n/a	n/a	1.97E-05	n/a	n/a	<1.77E-05	100.0
S96K000152	D116	<1.76E-05	n/a	n/a	n/a	1.76E-05	n/a	n/a	<1.60E-05	100.0
S96K000158	D119	<1.81E-04	n/a	n/a	n/a	1.81E-04	n/a	n/a	<1.60E-05	100.0
S96K000160	D120	<1.57E-05	n/a	n/a	n/a	1.57E-05	n/a	n/a	<1.60E-05	10.9
S96K000166	D123	<1.98E-05	n/a	n/a	n/a	1.98E-05	n/a	n/a	<1.87E-05	7.9
S96K000220	D125	<2.03E-04	n/a	n/a	n/a	2.03E-04	n/a	n/a	<1.94E-04	9.5
S96K000222	D126	<6.50E-05	n/a	n/a	n/a	6.50E-05	n/a	n/a	<1.94E-04	10.1
S96K000224	D128	<2.10E-04	n/a	n/a	n/a	2.10E-04	n/a	n/a	<1.94E-04	7.9
S96K000242	D133	7.37E-05	n/a	n/a	n/a	3.33E-05	n/a	n/a	<1.74E-05	3.6
S96K000236	D138	<1.82E-05	n/a	n/a	n/a	1.82E-05	n/a	n/a	<1.74E-05	7.7
S96K000246	D146	9.79E-05	n/a	n/a	n/a	5.96E-05	n/a	n/a	<3.74E-05	4.5
S96K000173	D149	5.99E-05	n/a	n/a	n/a	3.75E-05	n/a	n/a	<3.08E-05	4.7
S96K000252	D151	7.48E-05	8.88E-05	8.18E-05	17.1	3.35E-05	n/a	n/a	<3.74E-05	3.1
S96K000254	D158	<2.09E-05	n/a	n/a	n/a	2.09E-05	n/a	n/a	<3.74E-05	6.0
S96K000258	D160	<1.82E-04	n/a	n/a	n/a	1.82E-04	n/a	n/a	<3.74E-05	100.0
S96K000179	D163	<7.98E-05	n/a	n/a	n/a	7.98E-05	n/a	n/a	<3.08E-05	100.0
S96K000181	D164	<8.16E-05	n/a	n/a	n/a	8.16E-05	n/a	n/a	<3.08E-05	6.3
S96K000183	D170	6.30E-05	n/a	n/a	n/a	5.91E-05	n/a	n/a	<3.08E-05	5.9
S96K000185	D171	<1.57E-05	n/a	n/a	n/a	1.57E-05	n/a	n/a	<3.08E-05	9.4
S96K000212	D172	<1.81E-05	n/a	n/a	n/a	1.81E-05	n/a	n/a	<3.67E-05	6.8
S96K000187	D173	<4.31E-05	n/a	n/a	n/a	4.31E-05	n/a	n/a	<3.67E-05	6.3
S96K000189	D174	<3.95E-04	n/a	n/a	n/a	3.95E-04	n/a	n/a	<3.67E-05	100.0
S96K000270	D192	<9.64E-05	n/a	n/a	n/a	9.64E-05	n/a	n/a	<9.59E-05	100.0
S96K000272	D196	<2.11E-05	n/a	n/a	n/a	2.11E-05	n/a	n/a	<9.59E-05	9.2

Pu-239/240 by TRU-SPEC Resin Ion Exchange
Analysis performed on an Acid Dilution

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Preparation Blank µCi/mL	Counting Error %
S96K000027	D011	2.84E-05	3.14E-05	2.99E-05	10.0	1.70E-05	90.6	85.2	<1.59E-05	4.6
S96K000029	D017	1.49E-04	n/a	n/a	n/a	2.08E-05	90.6	n/a	<1.59E-05	2.7
S96K000039	D024	4.18E-05	n/a	n/a	n/a	1.67E-05	90.6	n/a	<1.59E-05	5.4
S96K000057	D031	<5.68E-05	n/a	n/a	n/a	5.68E-05	118.1	n/a	<4.15E-05	7.2
S96K000043	D032	<3.34E-05	n/a	n/a	n/a	3.34E-05	106.7	n/a	<3.43E-05	100.0
S96K000061	D035	2.66E-03	n/a	n/a	n/a	1.80E-04	118.1	n/a	<4.15E-05	1.4
S96K000063	D036	<2.26E-04	n/a	n/a	n/a	2.26E-04	118.1	n/a	<4.15E-05	100.0
S96K000049	D041	2.74E-04	n/a	n/a	n/a	1.85E-04	106.7	n/a	<3.43E-05	6.0
S96K000071	D046	5.15E-05	1.37E-04	9.43E-05	90.7	1.98E-05	87.9	87.3	<1.58E-05	3.9
S96K000077	D055	3.04E-04	n/a	n/a	n/a	3.00E-05	96.0	n/a	<1.80E-05	2.2
S96K000079	D057	<1.72E-05	n/a	n/a	n/a	1.72E-05	96.0	n/a	<1.80E-05	8.0
S96K000085	D060	5.06E-05	n/a	n/a	n/a	1.94E-05	96.0	n/a	<1.80E-05	4.3
S96K000091	D063	7.27E-05	n/a	n/a	n/a	2.26E-05	98.7	n/a	<1.89E-05	3.3
S96K000101	D069	2.57E-04	2.18E-04	2.38E-04	16.4	9.64E-05	94.6	97.3	<8.38E-05	4.1
S96K000109	D078	6.65E-04	n/a	n/a	n/a	4.29E-05	94.6	n/a	<8.38E-05	1.7
S96K000115	D080	3.81E-04	3.75E-04	3.78E-04	1.6	3.69E-05	98.7	96.6	<1.80E-05	1.8
S96K000119	D084	6.77E-05	n/a	n/a	n/a	2.29E-05	98.7	n/a	<1.80E-05	3.4
S96K000125	D091	6.21E-04	n/a	n/a	n/a	4.56E-05	96.6	n/a	<1.88E-05	1.7
S96K000144	D112	2.33E-05	n/a	n/a	n/a	1.97E-05	91.3	n/a	<1.77E-05	5.7
S96K000152	D116	3.05E-05	n/a	n/a	n/a	1.76E-05	90.6	n/a	<1.60E-05	4.9
S96K000158	D119	4.29E-04	n/a	n/a	n/a	1.81E-04	90.6	n/a	<1.60E-05	3.9
S96K000160	D120	<1.57E-05	n/a	n/a	n/a	1.57E-05	90.6	n/a	<1.60E-05	10.4
S96K000166	D123	3.20E-05	n/a	n/a	n/a	1.98E-05	94.0	n/a	<1.87E-05	5.2
S96K000220	D125	2.85E-04	n/a	n/a	n/a	2.03E-04	97.3	n/a	<1.94E-04	5.3
S96K000222	D126	6.55E-05	n/a	n/a	n/a	6.50E-05	97.3	n/a	<1.94E-04	6.0
S96K000224	D128	<2.10E-04	n/a	n/a	n/a	2.10E-04	97.3	n/a	<1.94E-04	8.1
S96K000242	D133	3.41E-04	n/a	n/a	n/a	3.33E-05	95.3	n/a	<1.74E-05	2.0
S96K000236	D138	<1.82E-05	n/a	n/a	n/a	1.82E-05	95.3	n/a	<1.74E-05	9.2
S96K000246	D146	4.10E-04	n/a	n/a	n/a	5.96E-05	104.0	n/a	<3.74E-05	2.4
S96K000173	D149	1.90E-04	n/a	n/a	n/a	3.75E-05	89.9	n/a	<3.08E-05	2.8
S96K000252	D151	4.60E-04	4.59E-04	4.60E-04	0.2	3.35E-05	104.0	98.0	<3.74E-05	1.6
S96K000254	D158	9.74E-05	n/a	n/a	n/a	2.09E-05	104.0	n/a	<3.74E-05	2.8
S96K000258	D160	2.19E-04	n/a	n/a	n/a	1.82E-04	104.0	n/a	<3.74E-05	5.3
S96K000179	D163	<7.98E-05	n/a	n/a	n/a	7.98E-05	89.9	n/a	<3.08E-05	8.5
S96K000181	D164	<8.16E-05	n/a	n/a	n/a	8.16E-05	89.9	n/a	<3.08E-05	7.4
S96K000183	D170	1.38E-04	n/a	n/a	n/a	5.91E-05	89.9	n/a	<3.08E-05	4.1
S96K000185	D171	<1.57E-05	n/a	n/a	n/a	1.57E-05	89.9	n/a	<3.08E-05	100.0
S96K000212	D172	1.81E-05	n/a	n/a	n/a	1.81E-05	98.7	n/a	<3.67E-05	5.8
S96K000187	D173	2.14E-04	n/a	n/a	n/a	4.31E-05	98.7	n/a	<3.67E-05	2.7
S96K000189	D174	<3.95E-04	n/a	n/a	n/a	3.95E-04	98.7	n/a	<3.67E-05	100.0
S96K000270	D192	<9.64E-05	n/a	n/a	n/a	9.64E-05	94.0	n/a	<9.59E-05	7.0
S96K000272	D196	9.13E-05	n/a	n/a	n/a	2.11E-05	94.0	n/a	<9.59E-05	3.3

Strontium-89/90 High Level
Analysis performed on an Acid Dilution

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Preparation Blank µCi/mL	Counting Error %
S96K000027	D011	2.69E-03	2.66E-03	2.68E-03	1.1	2.29E-04	108.6	111.3	<2.19E-04	10.8
S96K000041	D025	5.68E-04	6.74E-04	6.21E-04	17.1	1.47E-04	102.9	100.7	<7.24E-05	26.6
S96K000057	D031	1.42E+00	n/a	n/a	n/a	1.00E-02	102.2	n/a	1.60E-02	2.6
S96K000065	D040	2.42E-01	n/a	n/a	n/a	2.72E-04	102.2	n/a	3.00E-03	1.3
S96K000051	D043	4.27E+00	n/a	n/a	n/a	1.46E-04	102.9	n/a	<7.24E-05	0.2
S96K000067	D044	8.80E+00	n/a	n/a	n/a	2.48E-04	102.2	n/a	3.00E-03	0.2
S96K000073	D050	1.68E+00	n/a	n/a	n/a	2.67E-04	102.2	n/a	3.00E-03	0.5
S96K000075	D052	4.35E+00	n/a	n/a	n/a	2.59E-04	102.2	n/a	3.00E-03	0.3
S96K000077	D055	1.25E-02	n/a	n/a	n/a	1.39E-04	101.4	n/a	1.00E-03	4.2
S96K000083	D059	4.01E-01	n/a	n/a	n/a	1.38E-04	101.4	n/a	1.00E-03	0.7
S96K000085	D060	2.93E-01	n/a	n/a	n/a	1.41E-04	101.4	n/a	1.00E-03	0.9
S96K000089	D062	1.32E-03	n/a	n/a	n/a	1.60E-05	105.0	n/a	<1.52E-05	4.3
S96K000093	D064	7.35E-02	n/a	n/a	n/a	7.20E-05	105.0	n/a	<1.52E-05	1.2
S96K000095	D065	9.68E-03	n/a	n/a	n/a	1.47E-05	105.0	n/a	<1.52E-05	1.5
S96K000099	D068	1.17E-03	9.94E-04	1.08E-03	16.3	1.43E-05	105.0	99.0	<1.52E-05	4.3
S96K000117	D082	2.47E-02	n/a	n/a	n/a	2.33E-04	108.6	n/a	<2.19E-04	3.1
S96K000125	D091	1.15E-02	n/a	n/a	n/a	1.28E-05	107.1	n/a	2.05E-05	1.4
S96K000133	D095	8.27E-03	7.92E-03	8.09E-03	4.3	1.27E-04	107.1	102.4	2.05E-05	5.1
S96K000146	D113	1.42E-01	n/a	n/a	n/a	2.28E-04	102.9	n/a	1.00E-03	1.2
S96K000152	D116	2.88E-03	n/a	n/a	n/a	1.24E-04	100.0	n/a	1.51E-04	9.2
S96K000158	D119	3.52E+01	n/a	n/a	n/a	1.20E-02	100.0	n/a	1.51E-04	0.8
S96K000164	D122	5.16E-02	n/a	n/a	n/a	2.00E-03	101.4	n/a	8.00E-03	9.4
S96K000169	D127	5.22E+00	n/a	n/a	n/a	1.50E-02	110.1	n/a	1.10E-02	2.0
S96K000238	D139	6.16E-02	n/a	n/a	n/a	5.44E-05	100.0	n/a	1.50E-02	1.2
S96K000240	D140	7.76E-02	n/a	n/a	n/a	5.33E-05	100.0	n/a	1.50E-02	1.1
S96K000171	D147	1.83E+00	n/a	n/a	n/a	1.40E-02	110.1	n/a	1.10E-02	3.4
S96K000248	D148	3.15E-01	n/a	n/a	n/a	1.35E-04	100.0	n/a	1.50E-02	0.8
S96K000179	D163	4.82E+00	n/a	n/a	n/a	1.40E-02	110.1	n/a	1.10E-02	2.1
S96K000185	D171	6.63E-02	n/a	n/a	n/a	1.40E-02	110.1	n/a	1.10E-02	23.3
S96K000187	D173	3.04E-02	n/a	n/a	n/a	1.30E-02	100.0	n/a	1.50E-02	41.0
S96K000189	D174	1.41E-01	n/a	n/a	n/a	1.33E-04	100.0	n/a	1.50E-02	1.2
S96K000270	D192	4.63E+00	n/a	n/a	n/a	1.00E-03	107.1	n/a	2.05E-05	0.7
S96K000214	D194	2.58E-01	n/a	n/a	n/a	2.73E-04	100.0	n/a	1.50E-02	1.3

Tritium By Lachat
Analyses Performed on Direct Sample

Labcore Number	Customer Identification	Sample Result µCi/mL	Duplicate Result µCi/mL	Average Result µCi/mL	Sample Precision RPD	Detection Limit µCi/mL	Standard Recovery %	Spike Recovery %	Blank µCi/mL	Counting Error %
S96K000046	D039	2.38E-02	2.35E-02	2.37E-02	1.3	3.94E-05	98.8	84.7	<3.95E-05	0.6
S96K000048	D041	1.84E-01	n/a	n/a	n/a	3.95E-05	98.8	n/a	<3.95E-05	0.2
S96K000050	D043	1.43E-01	n/a	n/a	n/a	3.95E-05	98.8	n/a	<3.95E-05	0.3
S96K000068	D045	6.54E-03	n/a	n/a	n/a	4.25E-05	92.0	n/a	<4.23E-05	1.1
S96K000076	D055	1.31E-02	n/a	n/a	n/a	3.94E-05	98.8	n/a	<3.95E-05	0.8
S96K000082	D059	1.33E-03	n/a	n/a	n/a	3.44E-05	97.1	n/a	5.78E-05	2.3
S96K000090	D063	1.29E-02	n/a	n/a	n/a	3.40E-05	97.1	n/a	5.78E-05	0.8
S96K000092	D064	1.16E-03	n/a	n/a	n/a	3.44E-05	97.1	n/a	5.78E-05	2.4
S96K000100	D069	1.35E-01	n/a	n/a	n/a	3.45E-05	97.1	n/a	5.78E-05	1.0
S96K000104	D076	9.27E-03	9.31E-03	9.29E-03	0.4	3.45E-05	97.1	105.4	5.78E-05	0.9
S96K000112	D079	8.40E-02	n/a	n/a	n/a	3.59E-05	98.2	n/a	<3.57E-05	0.3
S96K000114	D080	6.33E-02	n/a	n/a	n/a	3.59E-05	98.2	n/a	<3.57E-05	0.4
S96K000116	D082	2.49E-02	n/a	n/a	n/a	3.61E-05	98.2	n/a	<3.57E-05	0.6
S96K000124	D091	6.50E-02	n/a	n/a	n/a	3.62E-05	98.2	n/a	<3.57E-05	0.4
S96K000126	D092	3.04E-04	2.85E-04	2.95E-04	6.5	3.62E-05	98.2	94.5	<3.57E-05	4.0
S96K000151	D116	2.33E-02	n/a	n/a	n/a	3.82E-05	91.2	n/a	<3.85E-05	0.6
S96K000153	D117	8.87E-02	n/a	n/a	n/a	3.91E-05	91.2	n/a	<3.85E-05	0.3
S96K000159	D120	1.71E-02	n/a	n/a	n/a	3.84E-05	91.2	n/a	<3.85E-05	0.7
S96K000165	D123	9.81E-02	n/a	n/a	n/a	3.87E-05	91.2	n/a	<3.85E-05	0.3
S96K000217	D124	4.41E-03	n/a	n/a	n/a	3.30E-05	106.8	n/a	<3.01E-05	1.3
S96K000221	D126	8.55E-04	n/a	n/a	n/a	3.20E-05	106.8	n/a	<3.01E-05	2.8
S96K000223	D128	5.46E-03	n/a	n/a	n/a	3.20E-05	106.8	n/a	<3.01E-05	1.2
S96K000241	D133	2.99E-03	n/a	n/a	n/a	3.24E-05	106.8	n/a	<3.01E-05	1.6
S96K000229	D135	5.44E-03	n/a	n/a	n/a	3.31E-05	106.8	n/a	<3.01E-05	1.2
S96K000245	D146	7.85E-03	n/a	n/a	n/a	3.23E-05	106.8	n/a	<3.01E-05	1.0
S96K000172	D149	1.38E-02	n/a	n/a	n/a	3.46E-05	101.3	n/a	<3.42E-05	0.8
S96K000257	D160	3.11E-03	n/a	n/a	n/a	3.25E-05	106.8	n/a	<3.01E-05	1.6
S96K000259	D161	6.59E-04	n/a	n/a	n/a	3.20E-05	106.8	n/a	<3.01E-05	3.1
S96K000176	D162	2.96E-03	n/a	n/a	n/a	3.43E-05	101.3	n/a	<3.42E-05	1.7
S96K000261	D168	1.71E-02	n/a	n/a	n/a	3.21E-05	106.8	n/a	<3.01E-05	0.7
S96K000265	D184	2.07E-02	2.11E-02	2.09E-02	1.9	6.98E-06	96.3	174.0	<7.38E-06	0.3
S96K000194	D186	1.05E-03	n/a	n/a	n/a	3.49E-05	101.3	n/a	<3.42E-05	2.7

Uranium by Phosphorescence
Analysis performed on an Acid Dilution

Labcore Number	Customer Identification	Sample Result µg/mL	Duplicate Result µg/mL	Average Result µg/mL	Sample Precision RPD	Detection Limit µg/mL	Standard Recovery %	Spike Recovery %	Preparation Blank µg/mL	Counting Error %
S96K000055	D028	<1.85E-02	n/a	n/a	n/a	1.85E-02	104.2	n/a	<2.04E-01	n/a
S96K000057	D031	<2.04E-01	n/a	n/a	n/a	2.04E-01	104.2	n/a	<2.04E-01	n/a
S96K000043	D032	1.51E-01	n/a	n/a	n/a	1.80E-02	102.3	n/a	<2.04E-01	1.8
S96K000063	D036	2.34E-01	n/a	n/a	n/a	1.80E-02	104.2	n/a	<2.04E-01	1.7
S96K000045	D037	2.15E-01	n/a	n/a	n/a	1.80E-02	102.3	n/a	<2.04E-01	1.5
S96K000065	D040	3.21E+01	n/a	n/a	n/a	1.80E-02	98.3	n/a	2.90E-01	3.3
S96K000049	D041	3.20E+00	n/a	n/a	n/a	1.80E-02	102.3	n/a	<2.04E-01	1.2
S96K000051	D043	3.89E+00	n/a	n/a	n/a	1.80E-02	102.3	n/a	<2.04E-01	1.2
S96K000067	D044	1.40E+00	1.41E+00	1.41E+00	0.7	1.80E-02	98.3	108.6	2.90E-01	1.2
S96K000077	D055	4.69E-02	n/a	n/a	n/a	1.80E-02	112.5	n/a	<1.85E-02	1.5
S96K000081	D058	1.80E+02	n/a	n/a	n/a	9.20E-02	112.5	n/a	<1.85E-02	3.3
S96K000103	D075	3.72E-01	n/a	n/a	n/a	1.80E-02	98.1	n/a	2.79E-01	1.3
S96K000109	D078	3.97E+00	n/a	n/a	n/a	1.80E-02	98.1	n/a	2.79E-01	1.3
S96K000113	D079	2.58E-01	2.69E-01	2.64E-01	4.2	1.80E-02	114.9	119.3	<1.85E-02	1.5
S96K000117	D082	7.45E-01	n/a	n/a	n/a	1.80E-02	114.9	n/a	<1.85E-02	1.5
S96K000144	D112	<1.85E-02	n/a	n/a	n/a	1.85E-02	110.0	n/a	<1.85E-02	3.0
S96K000146	D113	<1.85E-02	n/a	n/a	n/a	1.85E-02	110.0	n/a	<1.85E-02	3.3
S96K000150	D115	<1.85E-02	1.23E-02	n/a	n/a	1.85E-02	113.6	132.6	<1.85E-02	4.4
S96K000152	D116	<1.85E-02	n/a	n/a	n/a	1.85E-02	112.4	n/a	3.00E-03	1.6
S96K000158	D119	<1.85E-02	n/a	n/a	n/a	1.85E-02	112.4	n/a	3.00E-03	1.6
S96K000164	D122	5.30E-04	n/a	n/a	n/a	1.85E-04	116.1	120.9	0.00E+00	5.6
S96K000236	D138	<2.04E-01	n/a	n/a	n/a	2.04E-01	104.5	n/a	7.32E+01	1.8
S96K000246	D146	1.94E-01	n/a	n/a	n/a	1.80E-02	102.5	n/a	4.00E-03	1.5
S96K000248	D148	4.81E-01	n/a	n/a	n/a	2.04E-01	104.5	n/a	7.32E+01	1.7
S96K000262	D168	1.15E-01	n/a	n/a	n/a	1.80E-02	102.5	n/a	4.00E-03	1.5
S96K000268	D189	<1.85E-02	n/a	n/a	n/a	1.85E-02	104.5	n/a	7.32E+01	3.8
S96K000270	D192	4.89E-01	n/a	n/a	n/a	1.80E-02	98.7	n/a	1.14E-01	1.6
S96K000272	D196	5.35E-02	n/a	n/a	n/a	1.80E-02	98.7	n/a	1.14E-01	2.8

Specific Gravity
Analyses Performed on Direct Sample

Labcore Number	Customer Identification	Sample Result Sp.G. Unit	Duplicate Result Sp.G. Unit	Average Result Sp.G. Unit	Sample Precision RPD	Detection Limit Sp.G. Unit	Standard Recovery %	Spike Recovery %	Blank Sp.G. Unit	Counting Error %
S96K000251	D151	0.964	n/a	n/a	n/a	0.001	97.3	n/a	n/a	n/a
S96K000279	D183	0.970	n/a	n/a	n/a	0.001	97.3	n/a	n/a	n/a

pH
Analyses Performed on Direct Sample

Labcore Number	Customer Identification	Sample Result pH Unit	Duplicate Result pH Unit	Average Result pH Unit	Sample Precision RPD	Detection Limit pH Unit	Standard Recovery %	Observed Deviation from LCS pH	Spike Recovery %	Blank pH Unit	Counting Error %
S96K000033	D022	6.59	n/a	n/a	n/a	0.01	99.8	0.02	n/a	n/a	n/a
S96K000035	D023	6.67	n/a	n/a	n/a	0.01	99.8	0.02	n/a	n/a	n/a
S96K000040	D025	8.48	8.56	8.52	0.9	0.01	99.8	0.02	n/a	n/a	n/a
S96K000054	D028	6.65	n/a	n/a	n/a	0.01	99.8	0.02	n/a	n/a	n/a
S96K000058	D033	7.05	n/a	n/a	n/a	0.01	99.8	0.02	n/a	n/a	n/a
S96K000048	D041	6.34	n/a	n/a	n/a	0.01	99.8	0.02	n/a	n/a	n/a
S96K000072	D050	7.11	n/a	n/a	n/a	0.01	99.8	0.02	n/a	n/a	n/a
S96K000082	D059	8.68	n/a	n/a	n/a	0.01	99.6	0.03	n/a	n/a	n/a
S96K000088	D062	11.47	11.45	11.46	0.2	0.01	99.6	0.03	n/a	n/a	n/a
S96K000094	D065	7.53	n/a	n/a	n/a	0.01	99.6	0.03	n/a	n/a	n/a
S96K000110	D066	8.44	8.44	8.44	0.0	0.01	100.3	0.02	n/a	n/a	n/a
S96K000098	D068	11.50	n/a	n/a	n/a	0.01	99.6	0.03	n/a	n/a	n/a
S96K000106	D077	8.22	n/a	n/a	n/a	0.01	99.6	0.03	n/a	n/a	n/a
S96K000122	D087	10.35	n/a	n/a	n/a	0.01	100.3	0.02	n/a	n/a	n/a
S96K000139	D107	7.72	n/a	n/a	n/a	0.01	100.3	0.02	n/a	n/a	n/a
S96K000155	D118	6.44	n/a	n/a	n/a	0.01	100.3	0.02	n/a	n/a	n/a
S96K000161	D121	10.88	n/a	n/a	n/a	0.01	100.3	0.02	n/a	n/a	n/a
S96K000163	D122	10.44	n/a	n/a	n/a	0.01	100.3	0.02	n/a	n/a	n/a
S96K000229	D135	9.22	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000237	D139	8.65	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000239	D140	8.21	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000247	D148	7.65	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000249	D150	7.66	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000251	D151	8.61	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000261	D168	8.42	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000184	D171	10.78	n/a	n/a	n/a	0.01	100.3	0.02	n/a	n/a	n/a
S96K000263	D180	8.72	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000196	D187	8.05	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000267	D189	11.85	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000273	D197	7.91	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a
S96K000167	E19	9.03	n/a	n/a	n/a	0.01	100.3	0.02	n/a	n/a	n/a
S96K000275	E21	7.74	n/a	n/a	n/a	0.01	99.9	0.01	n/a	n/a	n/a

Nitrate by IC (Dionex)
Analyses Performed on Direct Sample

Labcore Number	Customer Identification	Sample Result µg/mL	Duplicate Result µg/mL	Average Result µg/mL	Sample Precision RPD	Detection Limit µg/mL	Standard Recovery %	Spike Recovery %	Blank µg/mL	Counting Error %
S96K000096	D067	3.96E+00	3.58E+00	3.77E+00	10.1	3.46E+00	94.5	83.6	7.35E-01	n/a
S96K000106	D077	2.32E+02	2.34E+02	2.33E+02	0.9	4.15E+00	97.6	99.4	<6.92E-01	n/a
S96K000221	D126	8.26E+00	n/a	n/a	n/a	7.18E+00	98.1	n/a	<6.53E-01	n/a
S96K000229	D135	7.83E+00	n/a	n/a	n/a	7.18E+00	98.1	n/a	<6.53E-01	n/a
S96K000172	D149	9.50E+00	n/a	n/a	n/a	7.18E+00	94.4	n/a	<6.53E-01	n/a
S96K000178	D163	7.97E+00	n/a	n/a	n/a	7.18E+00	94.4	n/a	<6.53E-01	n/a
S96K000180	D164	7.40E+00	7.69E+00	7.55E+00	3.8	7.18E+00	94.4	79.8	<6.53E-01	n/a
S96K000182	D170	7.70E+00	n/a	n/a	n/a	7.18E+00	94.4	n/a	<6.53E-01	n/a
S96K000186	D173	8.17E+00	n/a	n/a	n/a	7.18E+00	93.3	n/a	<6.53E-01	n/a
S96K000188	D174	1.15E+01	n/a	n/a	n/a	7.18E+00	93.3	n/a	<6.53E-01	n/a
S96K000263	D180	7.97E+00	8.00E+00	7.99E+00	0.4	7.18E+00	98.1	82.7	<6.53E-01	n/a
S96K000192	D185	8.02E+00	n/a	n/a	n/a	7.18E+00	93.3	n/a	<6.53E-01	n/a
S96K000026	D011	2.55E-01	2.44E-01	2.49E-01	4.4	1.39E-01	104.4	99.7	1.44E-01	n/a
S96K000028	D017	2.21E-01	n/a	n/a	n/a	1.39E-01	104.4	n/a	1.44E-01	n/a
S96K000040	D025	1.64E-01	1.64E-01	1.64E-01	0.0	1.39E-01	102.4	96.8	<1.39E-01	n/a
S96K000048	D041	3.82E-01	n/a	n/a	n/a	1.39E-01	102.4	n/a	<1.39E-01	n/a
S96K000076	D055	1.86E-01	n/a	n/a	n/a	1.39E-01	101.2	n/a	<1.39E-01	n/a
S96K000078	D057	2.50E-01	2.53E-01	2.52E-01	1.2	1.39E-01	101.2	98.3	<1.39E-01	n/a
S96K000080	D058	2.10E+00	1.84E+00	1.97E+00	13.2	1.53E+00	94.8	93.4	1.56E-01	n/a
S96K000092	D064	3.30E+02	3.28E+02	3.29E+02	0.6	1.53E+00	94.8	n/a	1.56E-01	n/a
S96K000100	D069	1.48E+00	n/a	n/a	n/a	8.34E-01	100.5	n/a	<1.39E-01	n/a
S96K000104	D076	3.35E+00	n/a	n/a	n/a	8.34E-01	100.5	n/a	<1.39E-01	n/a
S96K000116	D082	3.18E+01	n/a	n/a	n/a	1.40E+01	98.0	n/a	1.43E-01	n/a
S96K000118	D084	9.31E+01	n/a	n/a	n/a	1.40E+01	98.0	n/a	1.43E-01	n/a
S96K000120	D086	1.63E+00	n/a	n/a	n/a	1.53E+00	98.0	n/a	1.43E-01	n/a
S96K000136	D099	<1.53E+00	n/a	n/a	n/a	1.53E+00	98.0	n/a	1.43E-01	n/a
S96K000139	D107	2.95E+00	n/a	n/a	n/a	2.92E+00	93.9	n/a	<1.39E-01	n/a
S96K000141	D108	8.55E-01	n/a	n/a	n/a	8.34E-01	93.9	n/a	<1.39E-01	n/a
S96K000143	D112	1.03E+00	n/a	n/a	n/a	6.02E-01	93.9	n/a	<1.39E-01	n/a
S96K000153	D117	6.64E-01	n/a	n/a	n/a	4.86E-01	94.6	n/a	1.90E-01	n/a
S96K000165	D123	1.00E+00	n/a	n/a	n/a	4.86E-01	94.6	n/a	1.90E-01	n/a
S96K000217	D124	<1.39E-01	n/a	n/a	n/a	1.39E-01	107.6	n/a	<1.39E-01	n/a
S96K000219	D125	<1.39E-01	n/a	n/a	n/a	1.39E-01	107.6	n/a	<1.39E-01	n/a
S96K000225	D130	<1.39E-01	n/a	n/a	n/a	1.39E-01	107.6	n/a	<1.39E-01	n/a
S96K000227	D131	<1.39E-01	n/a	n/a	n/a	1.39E-01	107.6	n/a	<1.39E-01	n/a
S96K000231	D136	1.35E+01	n/a	n/a	n/a	1.39E-01	107.6	n/a	<1.39E-01	n/a
S96K000249	D150	4.38E+00	n/a	n/a	n/a	1.39E-01	107.6	n/a	<1.39E-01	n/a
S96K000174	D156	5.66E+00	n/a	n/a	n/a	1.53E+00	93.8	n/a	<1.39E-01	n/a
S96K000253	D158	4.23E-01	n/a	n/a	n/a	1.39E-01	107.6	n/a	<1.39E-01	n/a
S96K000255	D159	<1.39E-01	n/a	n/a	n/a	1.39E-01	107.6	n/a	<1.39E-01	n/a
S96K000208	D167	7.16E+00	n/a	n/a	n/a	1.39E-01	107.6	n/a	<1.39E-01	n/a
S96K000190	D177	1.71E+00	n/a	n/a	n/a	1.53E+00	93.8	n/a	<1.39E-01	n/a
S96K000273	D197	3.05E+02	n/a	n/a	n/a	1.53E+00	107.6	n/a	<1.39E-01	n/a

Nitrite by IC (Dionex)
Analyses Performed on Direct Sample

Labcore Number	Customer Identification	Sample Result µg/mL	Duplicate Result µg/mL	Average Result µg/mL	Sample Precision RPD	Detection Limit µg/mL	Standard Recovery %	Spike Recovery %	Blank µg/mL	Counting Error %
S96K000096	D067	1.10E+00	1.22E+00	1.16E+00	10.3	4.99E-01	99.6	99.3	<9.99E-02	n/a
S96K000106	D077	2.39E+01	2.45E+01	2.42E+01	2.5	5.99E-01	101.9	100.7	<9.99E-02	n/a
S96K000221	D126	<5.94E+00	n/a	n/a	n/a	5.94E+00	101.1	n/a	<5.40E-01	n/a
S96K000229	D135	<5.94E+00	n/a	n/a	n/a	5.94E+00	101.1	n/a	<5.40E-01	n/a
S96K000172	D149	<5.94E+00	n/a	n/a	n/a	5.94E+00	101.1	n/a	<5.40E-01	n/a
S96K000178	D163	<5.94E+00	n/a	n/a	n/a	5.94E+00	101.1	n/a	<5.40E-01	n/a
S96K000180	D164	<5.94E+00	<5.94E+00	n/a	n/a	5.94E+00	101.1	99.6	<5.40E-01	n/a
S96K000182	D170	<5.94E+00	n/a	n/a	n/a	5.94E+00	101.1	n/a	<5.40E-01	n/a
S96K000186	D173	<5.94E+00	n/a	n/a	n/a	5.94E+00	101.5	n/a	<5.40E-01	n/a
S96K000188	D174	<5.94E+00	n/a	n/a	n/a	5.94E+00	101.5	n/a	<5.40E-01	n/a
S96K000263	D180	<5.94E+00	<5.94E+00	n/a	n/a	5.94E+00	101.1	101.9	<5.40E-01	n/a
S96K000192	D185	<5.94E+00	n/a	n/a	n/a	5.94E+00	101.5	n/a	<5.40E-01	n/a
S96K000026	D011	<1.08E-01	<1.08E-01	n/a	n/a	1.08E-01	98.5	92.8	<1.08E-01	n/a
S96K000028	D017	<1.08E-01	n/a	n/a	n/a	1.08E-01	98.5	n/a	<1.08E-01	n/a
S96K000040	D025	<1.08E-01	<1.08E-01	n/a	n/a	1.08E-01	97.0	95.9	<1.08E-01	n/a
S96K000048	D041	<1.08E-01	n/a	n/a	n/a	1.08E-01	97.0	n/a	<1.08E-01	n/a
S96K000076	D055	1.26E-01	n/a	n/a	n/a	1.08E-01	97.0	n/a	<1.08E-01	n/a
S96K000078	D057	1.36E-01	1.33E-01	1.35E-01	2.2	1.08E-01	97.0	96.3	<1.08E-01	n/a
S96K000080	D058	<1.19E+00	<1.19E+00	n/a	n/a	1.19E+00	93.2	96.0	<1.08E-01	n/a
S96K000092	D064	4.72E+01	4.78E+01	4.75E+01	1.3	1.19E+00	93.2	n/a	<1.08E-01	n/a
S96K000100	D069	9.57E-01	n/a	n/a	n/a	6.48E-01	91.9	n/a	<1.08E-01	n/a
S96K000104	D076	7.48E+00	n/a	n/a	n/a	6.48E-01	91.9	n/a	<1.08E-01	n/a
S96K000116	D082	3.47E+01	n/a	n/a	n/a	1.09E+01	90.9	n/a	<1.08E-01	n/a
S96K000118	D084	5.47E+02	n/a	n/a	n/a	1.09E+01	90.9	n/a	<1.08E-01	n/a
S96K000120	D086	<1.19E+00	n/a	n/a	n/a	1.19E+00	90.9	n/a	<1.08E-01	n/a
S96K000136	D099	<1.19E+00	n/a	n/a	n/a	1.19E+00	90.9	n/a	<1.08E-01	n/a
S96K000139	D107	<2.27E+00	n/a	n/a	n/a	2.27E+00	96.7	n/a	<1.08E-01	n/a
S96K000141	D108	<6.48E-01	n/a	n/a	n/a	6.48E-01	96.7	n/a	<1.08E-01	n/a
S96K000143	D112	6.78E-01	n/a	n/a	n/a	4.68E-01	96.7	n/a	<1.08E-01	n/a
S96K000153	D117	<3.78E-01	n/a	n/a	n/a	3.78E-01	96.7	n/a	<1.08E-01	n/a
S96K000165	D123	7.59E-01	n/a	n/a	n/a	3.78E-01	96.7	n/a	<1.08E-01	n/a
S96K000217	D124	2.21E-01	n/a	n/a	n/a	1.08E-01	98.1	n/a	<1.08E-01	n/a
S96K000219	D125	<1.08E-01	n/a	n/a	n/a	1.08E-01	98.1	n/a	<1.08E-01	n/a
S96K000225	D130	<1.08E-01	n/a	n/a	n/a	1.08E-01	98.1	n/a	<1.08E-01	n/a
S96K000227	D131	<1.08E-01	n/a	n/a	n/a	1.08E-01	98.1	n/a	<1.08E-01	n/a
S96K000231	D136	1.15E+00	n/a	n/a	n/a	1.08E-01	98.1	n/a	<1.08E-01	n/a
S96K000249	D150	6.81E-01	n/a	n/a	n/a	1.08E-01	98.1	n/a	<1.08E-01	n/a
S96K000174	D156	1.62E+00	n/a	n/a	n/a	1.19E+00	92.5	n/a	<1.08E-01	n/a
S96K000253	D158	2.21E-01	n/a	n/a	n/a	1.08E-01	98.1	n/a	<1.08E-01	n/a
S96K000255	D159	<1.08E-01	n/a	n/a	n/a	1.08E-01	98.1	n/a	<1.08E-01	n/a
S96K000208	D167	1.89E+01	n/a	n/a	n/a	1.08E-01	98.1	n/a	<1.08E-01	n/a
S96K000190	D177	<1.19E+00	n/a	n/a	n/a	1.19E+00	92.5	n/a	<1.08E-01	n/a
S96K000273	D197	9.51E+01	n/a	n/a	n/a	1.19E+00	98.1	n/a	<1.08E-01	n/a

Potassium by ICP
Analysis performed on an Acid Dilution

Labcore Number	Customer Identification	Sample Result µg/mL	Duplicate Result µg/mL	Average Result µg/mL	Sample Precision RPD	Detection Limit µg/mL	Standard Recovery %	Spike Recovery %	Preparation Blank µg/mL	Counting Error %
S96K000027	D011	1.81E+01	<1.75E+01	n/a	n/a	1.75E+01	99.6	98.8	<5.00E-01	n/a
S96K000032	D016	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	94.4	n/a	<5.00E-01	n/a
S96K000029	D017	<1.75E+01	1.86E+01	n/a	n/a	1.75E+01	99.6	n/a	<5.00E-01	n/a
S96K000036	D023	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	94.4	n/a	<5.00E-01	n/a
S96K000039	D024	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	92.0	n/a	<5.00E-01	n/a
S96K000041	D025	6.14E+01	6.35E+01	6.25E+01	3.4	1.75E+01	92.0	n/a	<5.00E-01	n/a
S96K000055	D028	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	102.0	n/a	<5.00E-01	n/a
S96K000057	D031	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	102.0	n/a	<5.00E-01	n/a
S96K000059	D033	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	102.0	n/a	<5.00E-01	n/a
S96K000063	D036	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	102.0	n/a	<5.00E-01	n/a
S96K000045	D037	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	94.4	n/a	<5.00E-01	n/a
S96K000047	D039	5.04E+01	6.03E+01	6.16E+01	17.9	1.75E+01	92.0	n/a	<5.00E-01	n/a
S96K000049	D041	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	97.2	n/a	<5.00E-01	n/a
S96K000051	D043	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	97.2	n/a	<5.00E-01	n/a
S96K000071	D046	2.14E+02	n/a	n/a	n/a	1.75E+01	98.6	n/a	<5.00E-01	n/a
S96K000053	D047	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	97.2	96.4	<5.00E-01	n/a
S96K000075	D052	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	98.6	109.0	<5.00E-01	n/a
S96K000077	D055	3.55E+01	n/a	n/a	n/a	1.75E+01	98.6	n/a	<5.00E-01	n/a
S96K000079	D057	2.18E+01	n/a	n/a	n/a	1.75E+01	98.6	n/a	<5.00E-01	n/a
S96K000081	D058	<8.75E+01	n/a	n/a	n/a	8.75E+01	99.6	n/a	<5.00E-01	n/a
S96K000085	D060	1.76E+01	n/a	n/a	n/a	1.75E+01	99.6	n/a	<5.00E-01	n/a
S96K000087	D061	1.82E+02	n/a	n/a	n/a	1.75E+01	99.6	n/a	<5.00E-01	n/a
S96K000089	D062	2.29E+02	n/a	n/a	n/a	1.75E+01	99.6	n/a	<5.00E-01	n/a
S96K000091	D063	1.07E+02	n/a	n/a	n/a	1.75E+01	94.6	n/a	<5.00E-01	n/a
S96K000093	D064	2.52E+02	n/a	n/a	n/a	8.75E+01	94.6	n/a	<5.00E-01	n/a
S96K000095	D065	<1.75E+01	n/a	n/a	n/a	1.75E+01	94.6	n/a	<5.00E-01	n/a
S96K000097	D067	<1.75E+02	<1.75E+02	n/a	n/a	1.75E+02	94.6	109.0	<5.00E-01	n/a
S96K000099	D068	1.88E+02	n/a	n/a	n/a	1.75E+01	92.6	n/a	<5.00E-01	n/a
S96K000101	D069	2.82E+02	n/a	n/a	n/a	8.75E+01	92.6	n/a	<5.00E-01	n/a
S96K000105	D076	2.37E+02	n/a	n/a	n/a	3.50E+01	92.6	n/a	<5.00E-01	n/a
S96K000107	D077	1.85E+02	n/a	n/a	n/a	3.50E+01	92.6	n/a	<5.00E-01	n/a
S96K000109	D078	1.45E+02	n/a	n/a	n/a	1.75E+01	96.2	n/a	<5.00E-01	n/a
S96K000117	D082	7.36E+01	n/a	n/a	n/a	1.75E+01	96.2	n/a	<5.00E-01	n/a
S96K000119	D084	1.80E+02	n/a	n/a	n/a	1.75E+01	96.2	n/a	<5.00E-01	n/a
S96K000121	D086	1.52E+02	n/a	n/a	n/a	1.75E+01	96.2	n/a	<5.00E-01	n/a
S96K000125	D091	1.39E+02	n/a	n/a	n/a	1.75E+01	91.8	n/a	<5.00E-01	n/a
S96K000127	D092	<1.75E+01	n/a	n/a	n/a	1.75E+01	91.8	n/a	<5.00E-01	n/a
S96K000129	D093	<1.75E+01	n/a	n/a	n/a	1.75E+01	91.8	n/a	<5.00E-01	n/a
S96K000131	D094	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	91.8	110.0	<5.00E-01	n/a
S96K000137	D099	<1.75E+01	n/a	n/a	n/a	1.75E+01	91.8	n/a	<5.00E-01	n/a
S96K000140	D107	4.68E+01	n/a	n/a	n/a	1.75E+01	102.4	n/a	<5.00E-01	n/a
S96K000142	D108	2.83E+01	n/a	n/a	n/a	1.75E+01	102.4	n/a	<5.00E-01	n/a
S96K000144	D112	1.85E+02	n/a	n/a	n/a	1.75E+01	102.4	n/a	<5.00E-01	n/a
S96K000148	D114	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	102.4	78.2	<5.00E-01	n/a
S96K000154	D117	<1.75E+01	n/a	n/a	n/a	1.75E+01	97.2	n/a	<5.00E-01	n/a
S96K000156	D118	<1.75E+01	n/a	n/a	n/a	1.75E+01	97.2	n/a	<5.00E-01	n/a
S96K000160	D120	2.53E+02	n/a	n/a	n/a	1.75E+01	97.2	n/a	<5.00E-01	n/a
S96K000162	D121	2.49E+02	n/a	n/a	n/a	1.75E+01	97.2	n/a	<5.00E-01	n/a
S96K000166	D123	2.16E+02	n/a	n/a	n/a	1.75E+01	97.2	n/a	<5.00E-01	n/a
S96K000218	D124	2.05E+02	n/a	n/a	n/a	1.75E+01	102.2	n/a	<5.00E-01	n/a
S96K000220	D125	<1.75E+01	n/a	n/a	n/a	1.75E+01	102.2	n/a	<5.00E-01	n/a
S96K000222	D126	<1.75E+01	n/a	n/a	n/a	1.75E+01	98.8	n/a	<5.00E-01	n/a
S96K000169	D127	<1.75E+01	n/a	n/a	n/a	1.75E+01	106.0	n/a	<5.00E-01	n/a
S96K000226	D130	<1.75E+01	n/a	n/a	n/a	1.75E+01	98.8	n/a	<5.00E-01	n/a
S96K000228	D131	<1.75E+01	n/a	n/a	n/a	1.75E+01	98.8	n/a	<5.00E-01	n/a
S96K000230	D135	5.57E+01	5.04E+01	5.31E+01	10.0	1.75E+01	98.8	87.9	<5.00E-01	n/a
S96K000232	D136	1.85E+01	n/a	n/a	n/a	1.75E+01	98.8	n/a	<5.00E-01	n/a
S96K000234	D137	2.49E+01	n/a	n/a	n/a	1.75E+01	98.8	n/a	<5.00E-01	n/a
S96K000236	D138	1.36E+02	n/a	n/a	n/a	1.75E+01	98.8	n/a	<5.00E-01	n/a

Potassium by ICP
Analysis performed on an Acid Dilution

Labcore Number	Customer Identification	Sample Result µg/mL	Duplicate Result µg/mL	Average Result µg/mL	Sample Precision RPD	Detection Limit µg/mL	Standard Recovery %	Spike Recovery %	Preparation Blank µg/mL	Counting Error %
S96K000244	D143	<3.50E+01	n/a	n/a	n/a	3.50E+01	98.8	n/a	<5.00E-01	n/a
S96K000171	D147	<1.75E+01	n/a	n/a	n/a	1.75E+01	106.0	n/a	<5.00E-01	n/a
S96K000173	D149	1.94E+01	n/a	n/a	n/a	1.75E+01	106.0	n/a	<5.00E-01	n/a
S96K000250	D150	<1.75E+01	n/a	n/a	n/a	1.75E+01	98.8	n/a	<5.00E-01	n/a
S96K000175	D156	<3.50E+02	n/a	n/a	n/a	3.50E+02	106.0	n/a	<5.00E-01	n/a
S96K000254	D158	2.73E+01	n/a	n/a	n/a	1.75E+01	98.8	n/a	<5.00E-01	n/a
S96K000256	D159	6.74E+01	n/a	n/a	n/a	1.75E+01	96.8	n/a	<5.00E-01	n/a
S96K000258	D160	<1.75E+01	n/a	n/a	n/a	1.75E+01	96.8	n/a	<5.00E-01	n/a
S96K000260	D161	1.88E+01	n/a	n/a	n/a	1.75E+01	96.8	n/a	<5.00E-01	n/a
S96K000177	D162	<1.75E+01	n/a	n/a	n/a	1.75E+01	106.0	n/a	<5.00E-01	n/a
S96K000179	D163	<1.75E+01	n/a	n/a	n/a	1.75E+01	106.0	n/a	<5.00E-01	n/a
S96K000181	D164	<1.75E+01	n/a	n/a	n/a	1.75E+01	106.0	n/a	<5.00E-01	n/a
S96K000209	D167	1.03E+02	9.96E+01	1.01E+02	3.4	1.75E+01	102.2	91.3	<5.00E-01	n/a
S96K000183	D170	<1.75E+01	n/a	n/a	n/a	1.75E+01	106.0	n/a	<5.00E-01	n/a
S96K000185	D171	1.60E+02	n/a	n/a	n/a	1.75E+01	106.0	n/a	<5.00E-01	n/a
S96K000187	D173	6.76E+01	n/a	n/a	n/a	1.75E+01	106.0	n/a	<5.00E-01	n/a
S96K000189	D174	<1.75E+01	n/a	n/a	n/a	1.75E+01	102.2	n/a	<5.00E-01	n/a
S96K000191	D177	<1.75E+01	n/a	n/a	n/a	1.75E+01	102.2	n/a	<5.00E-01	n/a
S96K000264	D180	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	96.8	101.0	<5.00E-01	n/a
S96K000266	D184	<1.75E+01	n/a	n/a	n/a	1.75E+01	96.8	n/a	<5.00E-01	n/a
S96K000193	D185	<1.75E+01	n/a	n/a	n/a	1.75E+01	102.2	n/a	<5.00E-01	n/a
S96K000195	D186	<1.75E+01	<1.75E+01	n/a	n/a	1.75E+01	102.2	111.0	<5.00E-01	n/a
S96K000197	D187	<1.75E+01	n/a	n/a	n/a	1.75E+01	102.2	n/a	<5.00E-01	n/a
S96K000214	D194	<1.75E+01	n/a	n/a	n/a	1.75E+01	102.2	n/a	<5.00E-01	n/a
S96K000216	D195	<1.75E+01	n/a	n/a	n/a	1.75E+01	102.2	n/a	<5.00E-01	n/a
S96K000272	D196	4.21E+02	n/a	n/a	n/a	1.75E+01	96.8	n/a	<5.00E-01	n/a
S96K000274	D197	2.62E+02	n/a	n/a	n/a	1.75E+01	96.8	n/a	<5.00E-01	n/a

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		ECN No.

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