DISTRIBUTION SHEET

To	From	Page 2 of 2
Distribution	Spent Nuclear Fuel Evaluations 8M710	Date 5/10/95
Project Title/Work Order		EDT No. 610169
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DISTRIBUTION SHEET

To	From	Page 1 of 2
Distribution	Spent Nuclear Fuel Evaluations 8M710	Date 5/10/95
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R. G. Cowan	R3-86	X			
G. M. Davis	X3-80	X			
J. R. Frederickson	R3-86	X			
J. C. Fulton	R3-11	X			
R. G. Gant	X3-79	X			
E. W. Gerber	R3-86	X			
M. A. Green	X3-72	X			
R. A. Harris	L5-01	X			
S. A. Hecht	L5-01	X			
M. J. Langevin	X3-74	X			
L. A. Lawrence	L5-01	X			
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T. A. Meling	L5-01	X			
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R. P. Omberg	R3-85	X			
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7. Abstract

Forty-one gas and liquid samples were taken from spent fuel storage canisters in the K West Basin during a March 1995 sampling campaign. A description of the sampling process, gamma energy analysis data, and quantitative gas mass spectroscopy data are documented. This documentation does not include data analysis.

DISCLAIMER

8. RELEASE STAMP

DATA COMPILATION REPORT: GAS AND LIQUID SAMPLES FROM K WEST BASIN FUEL STORAGE CANISTERS

D. J. Trimble
Westinghouse Hanford Company

May 1995

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DATA COMPILATION REPORT: GAS AND LIQUID SAMPLES FROM K WEST BASIN FUEL STORAGE CANISTERS

INTRODUCTION

Samples of gas and liquid were taken from ten fuel storage canisters in the 105-K West fuel storage basin (K West Basin) for the fuel characterization program in accordance with the sampling and analysis plan (SAP, Harris 1995). The Data Quality Objectives (DQO) process was used in the development of the SAP (Makenas 1995a). Analysis has included gamma energy analysis (GEA) of each sample and mass spectrometry of gas samples. More extensive chemical and radiological analyses are planned for the liquid samples.

The sample data were used in the selection of canisters opened for retrieving fuel for hot cell characterization and will be used to aid in characterizing the contents of the canisters. Correlations between these data and hot cell examinations of the fuel will be investigated.

This report is a description of the sampling process and is a compilation of all available data. It does not provide analysis of the data, and the data provided has not been thoroughly reviewed for quality. Liquid sample analysis data will be documented when it becomes available.

BACKGROUND

Spent fuel from the N Reactor is stored in sealed canisters at the bottom of the K West Basin. A canister consists of two independent barrels; each barrel contains up to seven N Reactor fuel assemblies. The fuel was loaded into the canisters in the 105-N Basin. After loading the canister lids were installed, each barrel was nitrogen gas purged, and a potassium nitrite corrosion inhibitor was added. The canisters were then shipped to the K West Basin for storage. The purge flowed nitrogen gas into the side valve with the center valve open, displacing water from the gas trap and the top 6.4 cm (2.5 in.) of the barrel (Figure 1).

The history of the sampled canisters and contained fuel are presented in Table 1. The canisters were selected from a list developed to meet specified criteria (Makenas 1995b).

EQUIPMENT

Samples of gas and liquid were extracted from sealed K West Basin canisters using equipment (Figure 2) developed and tested in accordance with documented requirements (Pitkoff 1994a and Pitkoff 1994b).

Figure 1. MARK II Fuel Storage Canister.

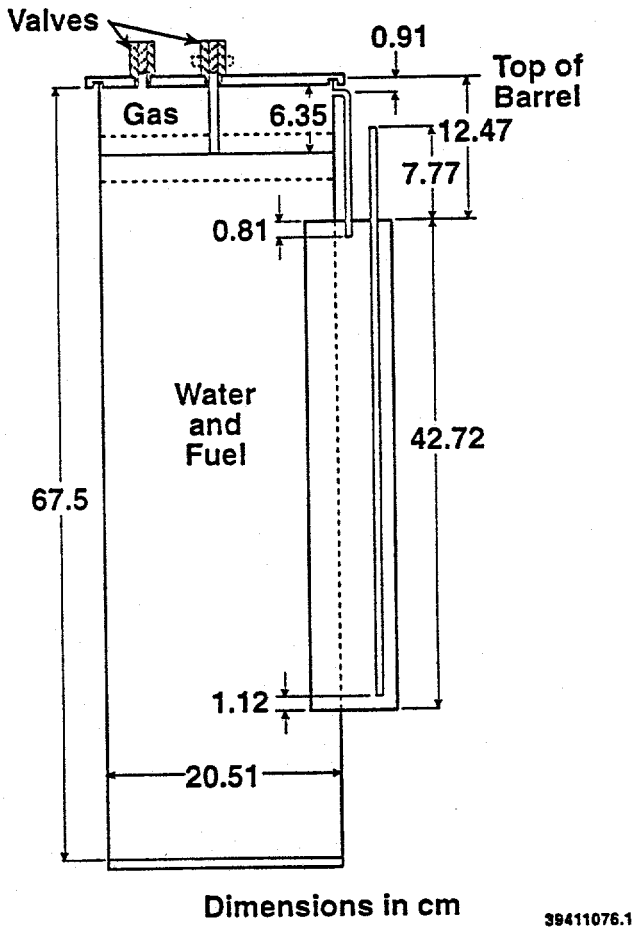
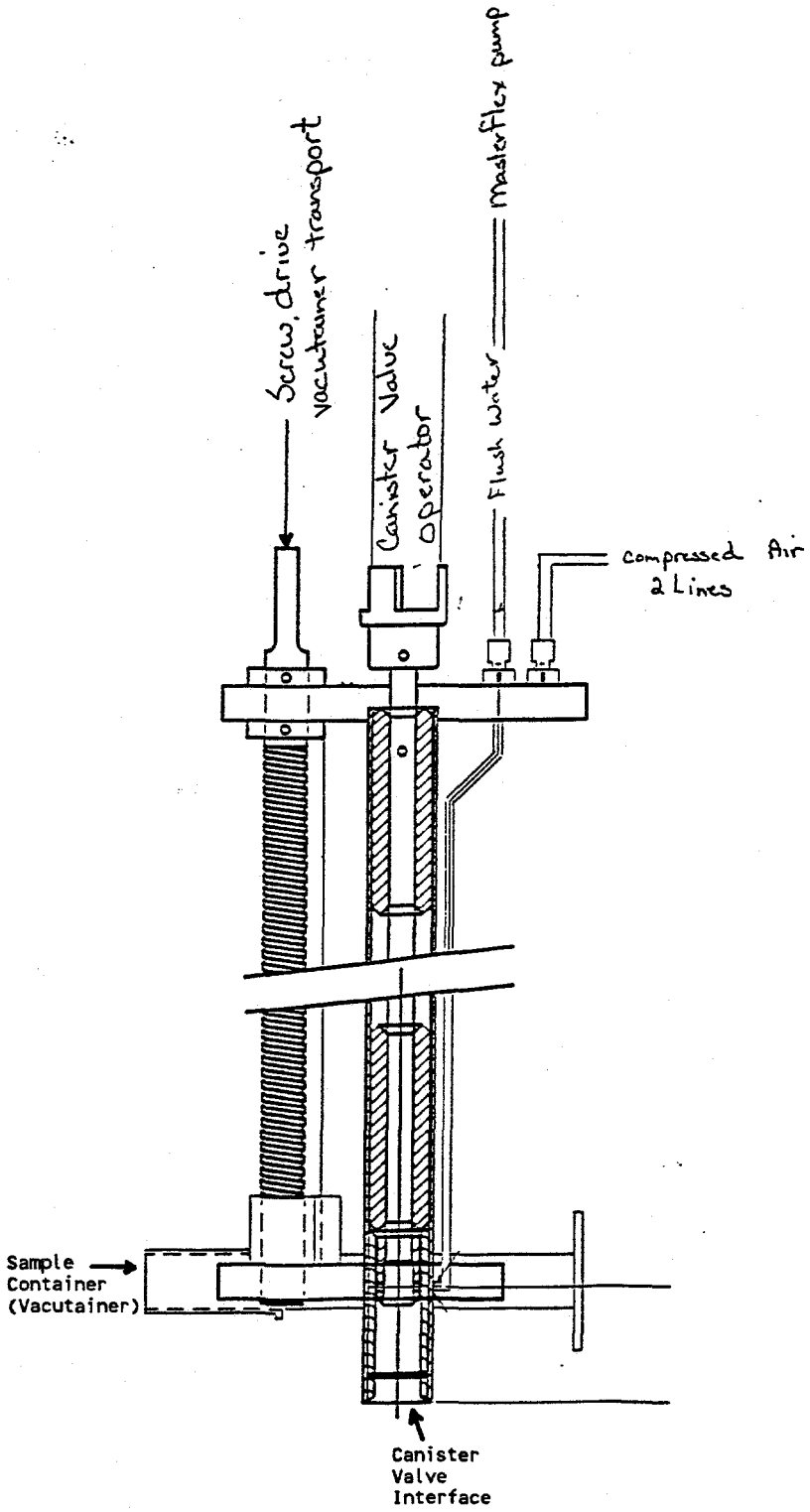


Table 1. Fuel Canisters Sampled.

Canister Lid Number	Key	Fuel Type-Length Code	Number of Assemblies	Date Encapsulated Mo/Yr	Water Level Trap 1/2	Pu-240 percent
1990	13858	MKIV-E MKIV-S	13 1	11/83	1"/1"	12
4246	13858	MKIV-E	14	11/83	1"/1"	12
4366	13858	MKIV-E	14	11/83	8"/1"	12
4368	13858	MKIV-E	14	11/83	1"/1"	12
4378	13858	MKIV-E	14	11/83	1"/0"	12
4432	13858	MKIV-E	14	11/83	1"/0"	12
4556	13858	MKIV-E	14	11/83	1"/1"	12
4573	13858	MKIV-E	14	11/83	1"/0"	12
4576	13858	MKIV-E	14	11/83	1"/1"	12
4685	13858	MKIV-E	14	11/83	1"/1"	12

Figure 2. Gas/Liquid Sampler.



PROCESS

The samples were taken in accordance with the Master Work Plan (MWP 1995) using K Basin Operating Procedure Number 60-43-12, "Obtain Samples from Encapsulated Canisters at 105-K West." The planned sampling process (Trimble 1995) was modified taking samples before and/or after flooding the barrel. Canister flooding consisted of opening the side and center valves allowing basin water to displace the gas in the barrel and its gas trap. Figure 3 shows the logic that was used in selecting analyses for a sample. Liquid samples were shipped to the 222-S Laboratory for analysis, and gas samples were analyzed at the 325 Building laboratory.

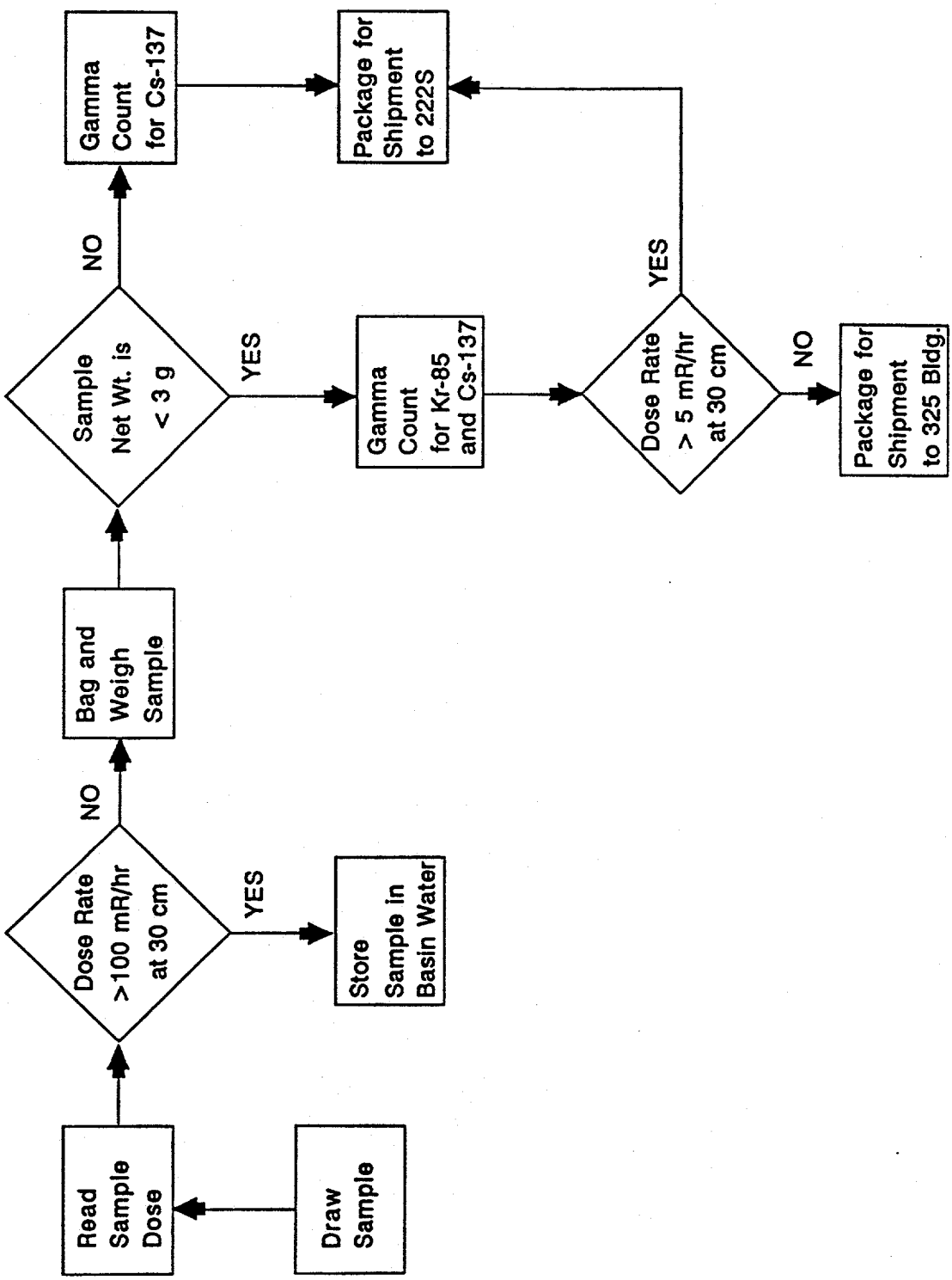
Before flooding and given that the canister had been properly purged and the lid seal has not leaked, the side valve would yield a sample of the canister barrel gas and a center-valve sample may result in liquid, or gas, or a mixture of gas and liquid. The reason for various possible sample types from the center valve was that with the barrel initially purged, the end of the valve stem was at the gas-liquid interface, and depending upon the exact location of the interface, a 15 ml sample could be all or partial liquid. Subsequent to canister purging, corrosion of exposed uranium (if present) consumes water and produces hydrogen gas lowering the level of the gas-liquid interface. This condition could result in gas and no liquid when sampling from the center valve.

The samples were weighted in the mobile laboratory truck using a balance checked with calibration certified weights. Sample liquid volume was estimated from the difference of sample gross weight and tare weight. It was estimated that about 1 gram water that does not represent the contents of the canister is taken with each sample. This liquid is a combination of basin water trapped at the sampler equipment-to-lid valve interface and flush water trapped in the equipment. Therefore, the net sample weight (NSW) in grams is defined as the gross weight (GW) minus tare weight minus one gram (NSW = GW - tare - 1).

Equipment problems were experienced during the sampling process requiring repairs and causing the quality of some of the samples to be suspect. As the result of unexplainably low sample weight for samples B16 through B22, the sampler needle was inspected and replaced when found to be broken. Sample B23 was the first sample taken after the replacement and was the expected net weight. It could not be determined at what point in time the needle breakage occurred.

In another problem the lid-valve opener handle was observed to be slipping on the shaft causing uncertainty about the valve being opened when required. This problem was fixed between the taking of samples B36 and B37. It is apparent that sample B36 was affected and possibly sample B32. Sample B36 should have been liquid from a flooded barrel but had a NSW of 1 gram, and sample B32 should have been gas (side valve, not flooded) but weighed 14 grams indicating a substantially liquid sample.

Figure 3. Gas/Liquid Sample Classification Logic.



ANALYSES

GEA was obtained for each of the forty-four samples from this campaign. This analysis was provided by Special Analytical Services (SAS) using equipment set-up in a truck located at a door to the K West Basin and in accordance with a desk instruction (Appendix A).

Eleven gas samples were shipped to the 325 Building laboratory for quantitative gas mass spectrometry analyses. After gas analyses were completed, the stoppers were removed from the gas sample vials and the sample liquid volume was measured. All stoppers were tightly seated.

Twenty-six liquid samples were sent to the 222-S Laboratory for chemical and radiochemical analyses. The details and results of these analyses will be reported separately.

SAMPLES

Table 2 lists all forty-four samples in the order they were collected. Forty-one samples were from ten fuel storage canisters and three were quality control (QC) samples. The QC samples included one of basin water from the weasel pit and two from canister number 0000 containing clean deionized water and no fuel.

Six of the forty-one fuel-canister samples were resamples of locations/ conditions previously sampled. Four of these were to evaluate sample reproducibility, and two were to replace incomplete samples.

Table 2 includes commentary on sample type (liquid or gas) and sample quality based on net sample weight (NSW), sampling location (side or center valve), and canister barrel status (had it been flooded). Before flooding, side valves should yield gas samples and center valves may yield gas and/or liquid. After flooding, center and side valves were expected to yield liquid samples. If a liquid sample was expected it was listed as "LIQUID" when the sample liquid content (NSW) exceeded 10 grams, "SHORT LIQ" if between 6 and 10 grams, "SUSPECT LIQ" if between 3 and 6 grams, and "BAD SAMPLE" if less that 3 grams. If a gas sample was expected it was listed as "GAS" when the NSW was less than 3 grams and "BAD SAMPLE" when it exceeded 8 grams NSW. If liquid or gas was expected and 3<NSW<10, the sample was listed "GAS/LIQUID."

Sample breakdown was as follows: twenty-one liquid, three short liquid, four suspect liquid, ten gas, one gas/liquid, and five bad samples.

Table 2. Gas and Liquid Samples from.K West Canisters (March 1995).

SAMPLE FC-	CAN-LID	VALVE*	FLOODED	NSW gram	SAMPLE CLASSFCTN	DOSE** mR/hr	Cs-137 uCi	Cs-134 uCi	Kr-85 uCi	Gas % H2
B01	WEASEL PIT WATER		NA	11.58	LIQUID	0	<2.7E-3	<1.2E-4	<.035	
B02	1990-M	C	NO	10.54	LIQUID	80	79	0.506	<1.4	
B03	1990-M	S	NO	-0.27	GAS	0	0.017	0.0001	53	72.0
B04	4366-M	C	NO	-0.03	GAS	0	<5.3E-3	0.00012	27	65.7
B05	4366-U	C	NO	3.57	GAS/LIQUID	6	2.9	0.016	<0.38	7.7
B06	4366-U	S	NO	-0.37	GAS	0	0.15	0.00079	3.8	72.7
B07	0000-U	C	NA	9.71	SHORT LIQ	0	<7.0E-3	<1.0E-4	<.028	
B08	4573-M	C	NO	-0.51	GAS	0	0.062	0.00036	<.045	****
B09	4573-U	C	NO	-0.04	GAS	0	0.13	0.00071	<.073	****
B10	1990-M	C	YES	12.95	LIQUID	170	184.8	1.2	<19	
B10 (R1)***	1990-M	C	YES	12.95	RECOUNT		182.0	1.2	<19	
B10 (R2)***	1990-M	C	YES	12.95	RECOUNT		182.3	1.2	<19	
B12	1990-U	C	NO	0.45	GAS	0	<1.8E-3	<1.0E-4	<.023	****
B13	1990-U	S	NO	0.77	GAS	0	0.061	0.00013	<.052	0.0
B14	4366-M	C	YES	13.96	LIQUID	0	0.016	0.00013	<.035	
B15	4366-U	C	YES	14.01	LIQUID	65	95	0.53	<16	
B16	4573-M	C	YES	8.45	SHORT LIQ	57	47	0.31	<16	
B17	4573-U	C	YES	3.88	SUSPECT LIQ	14	34	0.19	<4.9	
B18	1990-U	C	YES	4.04	SUSPECT LIQ	6	4.3	0.026	<1.0	
B19	1990-M	C	YES	9.22	SHORT LIQ	155	130	0.84	<27	
B20	0000-U	C	NA	4.83	SUSPECT LIQ	0	0.26	0.0015	<.09	
B21	4685-M	C	YES	4.76	SUSPECT LIQ	0	8	0.039	<2.4	
B22	4685-U	C	YES	1.55	BAD SAMPLE	0	0.66	0.0033	<0.25	
B23	4685-U	C	YES	16.13	LIQUID	13	16.35	0.12	<16	
B23 (R1)***	4685-U	C	YES	16.13	RECOUNT		16.53	0.098	<4.9	
B23 (R2)***	4685-U	C	YES	16.13	RECOUNT		16.12	0.081	<4.7	
B24	4685-M	C	YES	14.57	LIQUID	260	520	3	<680	
B25	4432-M	C	YES	14.03	LIQUID	13	20	0.11	<13	
B26	4432-U	C	YES	13.91	LIQUID	25	45	0.27	<15	
B27	4246-M	S	NO	8.78	BAD SAMPLE	0	0.069	0.00054	<.096	
B28	4246-U	S	NO	8.41	BAD SAMPLE	0	0.047	<2.2E-4	<.08	
B29	4378-M	C	YES	15.26	LIQUID	9	7.5	0.039	<2.4	
B30	4378-U	C	YES	14.81	LIQUID	520	600	3	<190	
B31	4556-M	S	NO	0.03	GAS	0	0.042	<3.6E-4	45	94.5
B32	4556-U	S	NO	14.17	BAD SAMPLE	0	0.081	0.00041	<.067	
B33	4368-M	S	NO	1.00	GAS	0	0.17	0.00084	19	86.4
B34	4368-U	S	NO	1.16	GAS	0	0.0072	<1.2E-4	25	98.6
B35	4246-M	C	YES	14.90	LIQUID	260	270	1.5	<86	
B36	4246-U	C	YES	1.01	BAD SAMPLE	0	0.63	0.0039	<0.14	
B37	4576-M	C	YES	15.00	LIQUID	130	140	1	<63	
B38	4576-U	C	YES	14.98	LIQUID	260	270	1.5	<86	
B39	4368-M	C	YES	15.09	LIQUID	300	262.6	1.4	<86	
B39 (R1)***	4368-M	C	YES	15.09	RECOUNT		263.5	1.5	<85	
B40	4368-U	C	YES	10.81	LIQUID	365	301.0	1.5	<93	
B40 (R1)***	4368-U	C	YES	10.81	RECOUNT		302.7	1.3	<130	
B41	4556-M	C	YES	13.74	LIQUID	260	230	1.3	<80	
B42	4556-U	C	YES	15.07	LIQUID	220	190	1.3	<74	
B43	4556-M	C	YES	14.92	LIQUID	260	250	1.4	<83	
B44	4576-U	S	YES	12.27	LIQUID	130	270	1.5	<86	
B45	4576-U	C	YES	14.37	LIQUID	170	330	1.9	<96	

*C=CENTER VALVE; S=SIDE VALVE

**DOSE RATE AT SAMPLE SURFACE MEASURED WITH CP WINDOW CLOSED. GEOMETRIC CORRECTION APPLIED TO INSTRUMENT READING.

***RECOUNT OF GEA FOR QUALITY CONTROL MEASUREMENT

****INSUFFICIENT GAS IN SAMPLE FOR ANALYSIS

DATA

A summary of the GEA and hydrogen gas data are shown in Table 2.

The complete gas analysis results with a description of analysis methods is attached (Appendix B). A summary of these data are also provided (Table 3). The corrected values for gas analyses were derived by subtracting background gasses found in a sample of "empty vials" as described in Appendix B.

The samples are listed by canister origin in Table 4. The commentary on data quality in Table 2 was revised for Table 4 considering the analysis findings. For example where attempts to analyze for gas species found insufficient gas for a reliable analysis, a bad or suspect sample was noted. Also provided are calculations of Cs-137 concentration in the sample liquid (μCi per gram of NSW). The data for samples listed as "bad" should not be used and those data listed as "suspect" should be used with caution.

Gas sample liquid volume measurements are shown with NSW in Table 5. The actual net weight (NSW+1) is plotted against the measured liquid volume (Figure 4).

Table 3. Gas Sample Data for K West Basin Canisters (March 1995).

		UNCORRECTED VALUES*									
SAMPLE	CAN-LID	%H2	%O2	%N2	%Xe**	%Kr**	%Ar	%CO2	SUM	%O2/%N2	GAS PRESSURE
B03	1990-M	66.2	1.83	31.6	3.7E-02	6.1E-03	0.243	0.098	100.01	0.058	GOOD
B04	4366-M	60.8	2.11	36.7	2.0E-02	3.3E-03	0.246	0.097	99.97	0.057	GOOD
B05	4366-U	3.56	23.9	70.3	5.3E-03	0.0E+00	1.11	0.93	99.81	0.340	LOW
B06	4366-U	50.7	10.4	37.8	1.3E-02	3.2E-03	0.54	0.436	99.89	0.275	LOW
B08	4573-M	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0	0.0	0.0		ZERO
B09	4573-U	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0	0.0	0.0		ZERO
B12	1990-U	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0	0.0	0.0		ZERO
B13	1990-U	0.52	24.8	71.8	0.0E+00	0.0E+00	1.17	1.51	99.80	0.345	LOW
B31	4556-M	86.8	1.95	11.0	3.5E-02	4.6E-03	0.17	0.073	100.03	0.177	GOOD
B33	4368-M	80.5	11.5	7.6	2.1E-02	2.8E-03	0.125	0.13	99.88	1.513	GOOD
B34	4368-U	90.6	1.97	7.2	2.9E-02	3.5E-03	0.128	0.085	100.01	0.274	GOOD
AIR	HNDBK	0.00005	20.946	78.084	8.7E-06	1.1E-04	0.934	0.033	100.00	0.268	
		VALUES* CORRECTED FOR BACKGROUND GASES									
B03	1990-M	72.0	0.14	27.6	0.0396	0.0065	0.173	0.041	99.99	0.005	GOOD
B04	4366-M	65.7	0.56	33.5	0.0211	0.0036	0.181	0.043	100.01	0.017	GOOD
B05	4366-U	7.7	28.4	61.3	0.0138	0.0000	1.23	1.21	99.85	0.463	LOW
B06	4366-U	72.7	5.7	21.0	0.0184	0.0045	0.31	0.29	100.02	0.271	LOW
B13	1990-U	0.0	37.2	57.1	0.0000	0.0000	1.62	4.09	100.01	0.651	LOW
B31	4556-M	94.5	0.22	5.1	0.0381	0.0051	0.092	0.012	99.96	0.043	GOOD
B33	4368-M	86.4	10.82	2.59	0.0225	0.0030	0.058	0.132	100.03	4.178	GOOD
B34	4368-U	98.6	0.27	1.06	0.0310	0.0038	0.047	0.026	100.00	0.255	GOOD

*MOLE PERCENT

** Xe AND Kr VALUES ARE FOR THE SUM OF ALL ISOTOPES.

Table 4. Gas and Liqud Samples Sorted by Canisters.

SAMPLE FC-	CAN-LID	VALVE **	FLOODED	NSW gram	Cs-137 uCi	Cs-134 uCi	Cs-137 uCi/cc	Kr-85 uCi	Gas % H2	SAMPLE CLASSFCTN*
B02	1990-M	C	NO	10.54	79	0.506	7.50			LIQUID
B03	1990-M	S	NO	-0.27	0.017	0.0001		53	72.0	GAS
B10	1990-M	C	YES	12.95	183	1.2	14.13			LIQUID
B19	1990-M	C	YES	9.22	130	0.84	14.10			SHORT LIQ
B12	1990-U	C	NO	0.45	<1.8E-3	<1.0E-4	0.00	<.023		NO GAS
B13	1990-U	S	NO	0.77	0.061	0.00013	0.08	<.052	0.0	SUSPECT GAS
B18	1990-U	C	YES	4.04	4.3	0.026	1.06			SUSPECT LIQ
B27	4246-M	S	NO	8.78	0.069	0.00054	0.01			BAD SAMPLE
B35	4246-M	C	YES	14.90	270	1.5	18.12			LIQUID
B28	4246-U	S	NO	8.41	0.047	0.00022	0.01			BAD SAMPLE
B36	4246-U	C	YES	1.01	0.63	0.0039	0.62			BAD SAMPLE
B04	4366-M	C	NO	-0.03	<5.3E-3	0.00012	0.00	27	65.7	GAS
B14	4366-M	C	YES	13.96	0.016	0.00013	0.00			SUSPECT LIQ
B05	4366-U	C	NO	3.57	2.9	0.016	0.81	<.38	7.7	SUSPECT GAS
B06	4366-U	S	NO	-0.37	0.15	0.00079		3.8	72.7	SUSPECT GAS
B15	4366-U	C	YES	14.01	95	0.53	6.78			SUSPECT LIQ
B33	4368-M	S	NO	1.00	0.17	0.00084	0.17	19	86.4	GAS
B39	4368-M	C	YES	15.09	263	1.4	17.43			LIQUID
B34	4368-U	S	NO	1.16	0.0072	<1.2E-4	0.01	25	98.6	GAS
B40	4368-U	C	YES	10.81	302	1.4	27.94			LIQUID
B29	4378-M	C	YES	15.26	7.5	0.039	0.49			LIQUID
B30	4378-U	C	YES	14.81	600	3	40.51			LIQUID
B25	4432-M	C	YES	14.03	20	0.11	1.43			LIQUID
B26	4432-U	C	YES	13.91	45	0.27	3.24			LIQUID
B31	4556-M	S	NO	0.03	0.042	<3.6E-4	1.40	45	94.5	GAS
B41	4556-M	C	YES	13.74	230	1.3	16.74			LIQUID
B43	4556-M	C	YES	14.92	250	1.4	16.76			LIQUID
B32	4556-U	S	NO	14.17	0.081	0.00041	0.01			BAD SAMPLE
B42	4556-U	C	YES	15.07	190	1.3	12.61			LIQUID
B08	4573-M	C	NO	-0.51	0.062	0.00036		<.045		NO GAS
B16	4573-M	C	YES	8.45	47	0.31	5.56			SHORT LIQ
B09	4573-U	C	NO	-0.04	0.13	0.00071		<.073		NO GAS
B17	4573-U	C	YES	3.88	34	0.19	8.76			SUSPECT LIQ
B37	4576-M	C	YES	15.00	140	1	9.33			LIQUID
B38	4576-U	C	YES	14.98	270	1.5	18.02			LIQUID
B44	4576-U	S	YES	12.27	270	1.5	22.00			LIQUID
B45	4576-U	C	YES	14.37	330	1.9	22.96			LIQUID
B21	4685-M	C	YES	4.76	8	0.039	1.68			BAD SAMPLE
B24	4685-M	C	YES	14.57	520	3	35.69			LIQUID
B22	4685-U	C	YES	1.55	0.66	0.0033	0.43			BAD SAMPLE
B23	4685-U	C	YES	16.13	16.3	0.12	1.01			LIQUID

*LIQUID: NSW> 10g; SHORT LIQ: 5<NSW<10g; SUSPECT LIQ: NSW<5g; GAS: NSW<3g & gas pressure good; SUSPECT GAS: low gas pressure; NO GAS: very low gas pressure

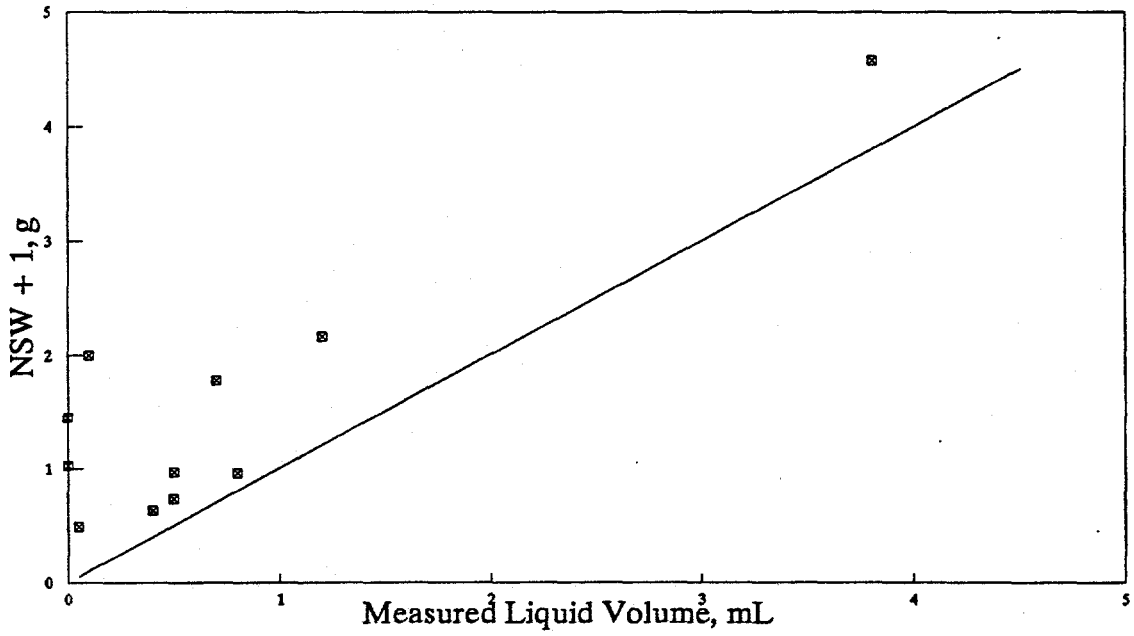
**C = Center valve; S = Side valve

Table 5. Liquid in Gas Samples.

SAMPLE FC–	NSW* gram	NSW+1 gram	Measured Liquid, mL	delta**
B31	0.03	1.03	0	1.03
B12	0.45	1.45	0	1.45
B08	−0.51	0.49	0.05	0.44
B33	1	2	0.1	1.9
B06	−0.37	0.63	0.4	0.23
B03	−0.27	0.73	0.5	0.23
B04	−0.03	0.97	0.5	0.47
B13	0.77	1.77	0.7	1.07
B09	−0.04	0.96	0.8	0.16
B34	1.16	2.16	1.2	0.96
B05	3.57	4.57	3.8	0.77

*NSW = gross wt. − tare −1g
**delta = (NSW+1) − Measured Liquid,mL

Figure 4. Gas Sample Liquid.



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A P P E N D I X A

Memo, G.R. Blewett, OM630-95-008, "Desk Instructions for K West Basin On-Site Sample Analysis," March 2, 1995.

From: Special Analytical Services OM630-95-008
Phone: 373-6922 S3-90
Date: March 2, 1995
Subject: DESK INSTRUCTIONS FOR KW-BASIN ON-SITE SAMPLE ANALYSIS

To: L. L. Lockrem S3-90

cc: G. R. Blewett S3-90
D. J. Moak H6-30
E. F. Riedel S3-90
E. R. Selle S3-90
LLL:DJM File LB

References: WHC-SD-SNF-PLN-004, Rev. 0,"Sampling and Analysis Plan for Canister Liquid and Gas Sampling at 105-KW Fuel Storage Basin."

Draft Letter, D. J. Trimble and R. A. Harris to E. F. Riedel and G. R. Blewett, "Instructions for Gamma Energy Analysis of KW-Basin Canister Samples," dated February 12, 1995.

The following desk instruction pertains to analyses that will be carried out by Special Analytical Studies (SAS) personnel when operating the SAS Mobile Laboratory Truck (MLT) at the 105-KW Fuel Storage Basin.

References made in this desk instruction to a Sampling and Analysis Plan (SAP), refer to WHC-SD-SNF-PLN-004, Rev. 0; Sampling And Analysis Plan For Canister Liquid And Gas Sampling At 105-KW Fuel Storage Basin.

References made in this desk instruction to a Letter of Instruction (LOI), refer to a draft letter dated February 12, 1995, from D. J. Trimble and R. A. Harris to E. R. Riedel and G. R. Blewett, subject "Instructions For Gamma Energy Analysis of KW-Basin Canister Samples."

Approximately 60 different 17 ml. test tubes of solution taken from the fuel canisters in the basin will be analyzed for ^{137}Cs (if mostly liquid), or for ^{85}Kr (if mostly gas). This work is tentatively scheduled for March 1995 and will take approximately 2 weeks to complete.

1) Calibrations have been performed using Amersham certified aqueous and homogenous standards of similar geometry to the samples that will be measured. The standards were all near 5 milliliters in volume. They were contained within small ampules that were themselves contained within vials. The vials had the same dimensions as the test tube samples that will be analyzed. The diameter of the thin-walled ampules were close to the 17/32 inches inside diameter of the sample test tubes. The length of the ampules were approximately 2 inches. All standards were counted at a distance of 8 inches from the end cap of the detector which will be used. At that distance, the standards measured are geometrically equivalent to the samples that will be counted, with respect to the detector.

   Two aqueous and homogenous ^{137}Cs standards were prepared by the 222-S Standards Laboratory. One standard is housed within one of the test tube/stainless steel sleeve assemblies provided to SAS by K-Basin personnel. The other standard is in an identical test tube which is not contained within a stainless sleeve. Both standards contain at least 15 milliliters of solution. These standards will be used to confirm calculations performed using the program Microshield.

   The slot in the stainless sleeve will be positioned so that it is opposite from the detector face. This positioning of the slot will be maintained throughout all sample measurements at KW-Basin. This will negate any attenuation differences that would be caused by the slot if positioned toward the detector. If stainless sleeves are supplied that do not have the slot, no special radial orientation will need to be followed.

   Results from the two standards will yield an attenuation factor for the stainless sleeve which will be incorporated in the data reported by SAS. Microshield has been used to calculate the attenuation value of the 0.050 inch thick stainless sleeve for both ^{137}Cs and ^{85}Kr decay energies. The Microshield results will be used as comparisons to the empirically-obtained attenuation values. The empirical results will be used in the calculation of report results.

   Positioning error will be determined when counting replicate samples at KW-Basin, as described below in Section 9. Positioning error is more pronounced for samples

counted near the detector. Each replicate sample will be counted at a specific distance from the detector based upon its activity. Ten percent of the samples will be re-counted in this manner.

It is not known at this time how the data results supplied by SAS will compare with those provided by the 222-S laboratories. This determination will have to be made after data results are submitted by both laboratories.

The double plastic bags that will be used around the basin samples should not cause significant reproducibility problems.

Spectral data for the project is produced via the Ortec HPGe detector, in conjunction with an Ortec Nomad™ processing system. This unit contains the power supply, amplifier, and multi-channel analyzer (MCA). A lap-top 486 computer fits into the Nomad™ case enclosure and is used in conjunction with it. All spectra gathered are stored on the computer, as well as all Excel data spreadsheets that will be generated (one data sheet for each sample measured). The computer and Nomad system can be operated by internal battery power, but SAS will connect an extension cord from the MLT to a nearby outlet to routinely operate the system while working at the basin.

Isotope libraries will be available to provide on-site quantification for ^{134}Cs, ^{137}Cs and ^{85}Kr, at a minimum.

2) The MLT will be parked on the north side of the 105-KW Fuel Storage Basin, as was done for the recent "dry run." The loading ramp of the MLT will be attached to the truck at one end, and be resting on the dock by the doorway at the other end.

3) SAS personnel will work under RWP #L-576, Rev. 0 that was prepared by K-Basin Health Physics Technicians (HPT's) (SAP Section 8.0 and 9.2.1). As of this writing, it is understood that the MLT will be posted as a Radiological Buffer Area (RBA). If any unexpected radiological event occurs, SAS will stop analysis work immediately and contact the HPT organization to help control and rectify the situation. ALARA measures will be maintained by SAS personnel throughout the project. Limiting the amount of samples in the MLT at any one time, keeping maximum distance between lab personnel and samples, and minimizing exposure (counting) times are examples of ALARA principles which will be utilized.
If sample leakage occurs outside of the sample tube (even if still contained in the double bags), HPT's will be notified and work will stop in the MLT until the situation is resolved. In the very unlikely event that a spill occurs, i.e., one that results in basin sample liquid leaking outside the double plastic bags, a SAS-supplied spill kit will be used by SAS personnel to contain the spill before contacting the HPT's (if HPT's are not present in

the MLT at the time of the incident). The spill kit contains absorbent material which will be used to absorb the liquid to prevent its spread. All further spill remediation actions will be performed by the HPT organization.

4) Samples will be delivered by K-Basins Operations (KBO) and a member of NFE to the MLT via the loading ramp. It is understood by SAS that only one sample will be provided for analysis at a time to keep counting area backgrounds to a minimum, and to also prevent possible confusion. Chain-of-Custody (COC) paperwork for each sample will accompany the sample into the MLT. SAS personnel will sign for receipt of the sample and the sample will remain in the custody of SAS personnel until analysis is complete. At that time, the sample will be relinquished back to NFE. NFE will again sign the COC as the custodian for the sample (SAP Section 2.3).

5) Upon receipt, each sample tube and bag set will be weighed inside the MLT using an analytical balance. The balance reads out to 0.0001 grams, and will be checked for accuracy daily using a weight set traceable to NBS standards. As listed in Table 3.1 of the SAP, weighing precision of +/- 0.01 g and accuracy of +/- 0.1 g will be maintained. All test tubes and bags will have previously been tare weighed by SAS before samples are collected in the tubes. SAS will record will record the tare weight, gross weight, and the sample net weight (gross minus tare weight) in their controlled logbook. NFE will also record these values for each sample. SAS will use the net sample weight for all per-gram quantifications of isotopes present. SAS will also report total activities determined for each sample. SAS will not remove any sample tubes from their outer bagging for any reason (LOI and SAP Section 2.3). SAS sample I.D. numbers will match those labeled on the sample tubes unless otherwise instructed by NFE (SAP Section 2.3).

6) Samples with net weights of 3 or more grams will be analyzed for ^{137}Cs. Samples weighing 3 grams or less will be analyzed for ^{85}Kr (LOI and SAP Section 2.0). SAS personnel will consult NFE on a sample-by-sample basis regarding analyses to be performed on samples that are borderline in volume or possess abnormally high or low activities.

Based upon the activity of the sample, counting times may range from 5-10 minutes for more active samples, up to 1-2 hours for low activity samples. SAS will keep NFE and KBO updated on the progress of sample analysis as much as possible. If some basin sampling is performed on swing shift, SAS will be able to work this shift as required (LOI).

The expected ranges of activity that will be encountered (per sample) for analyses are from < 0.1 uCi to 20 mCi for ^{137}Cs and from < 0.1 uCi to 50 uCi for ^{85}Kr gas (LOI).

L. L. Lockrem
March 2, 1995
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7) For ^{137}Cs and ^{85}Kr, activity values will be determined to within +/- 10% at the 2 sigma level. (SAP Section 1.4).

8) A Practical Quantification Limit (PQL) of 0.10 uCi/g for ^{137}Cs and 10 uCi for ^{85}Kr will be maintained (SAP Table 3.1). The PQL values reported in the SAS data sheets are those that are at least 1.5 times the MDA activity of the detection system. Isotopes present in this quantity will be accompanied by the associated counting statistic error value. The MDA activities will be reported for listed isotopes not present at 1.5 times the MDA limit. Associated error values will not be reported for these results (SAP Section 3.0).

9) Replicate, blind, blank, and duplicate QA samples will be analyzed as called for in the SAP. As described in the SAP, replicate samples will consist of removing, remounting, and recounting the same sample 3 consecutive times to measure positioning and counting repeatability and accuracy. The SAP calls for 10% of all samples to be recounted in this manner. SAS will remount and recount at least 10 percent of the samples in this manner. SAS will also measure a SAS-supplied QA check source with the same frequency. Counting geometries will be the same for both the calibration data gathered and for the samples that will be analyzed. QA counting geometry will differ from the above geometry, but the QA source is used only as a continuing reference to its measured value at the time of initial calibration.

10) SAS will provide completed analysis sheets to NFE on a daily basis containing the following for the samples analyzed that day:

    I.D. number of sample
    Sample net weight
    * Activity results in total mCi and in mCi/g for ^{137}Cs, as well as ^{85}Kr and other identified or listed isotopes.

    * Activities will be corrected for attenuation due to the stainless sample sleeve. For ^{137}Cs, there is an approximate 5% attenuation due to the .050 inch stainless sleeve when dealing with aqueous samples. For ^{85}Kr, the activity loss for gaseous samples is approximately 9%. Activities will also be normalized for those samples that were not counted at the original 8 inch calibration distance.

SAS will also maintain records of all QA data obtained by using the SAS-supplied check source. This information will be available to NFE as required, and will also be contained within the final report written by SAS to KW-Basins. In addition to data report sheets generated for each sample, and a final report, SAS can make available raw data as requested by NFE. SAS does not anticipate the submission of this raw data in a routine manner unless expressly requested by the above parties. The raw data is not easily

viewed or analyzed without the appropriate software. (LOI and SAP Sections 4.0 and 5.0).

11) A final report containing all pertinent information regarding sample analysis, results, and QA protocol and results will be produced and provided to the Test Engineer within 90 days after completion of field measurement work at the basin (LOI and SAP Section 3.1).

2) All data that is not saved electronically, or is more descriptive in nature than what will be generated in the electronic result sheets, will be hand-recorded in a WHC controlled logbook. The logbook will be maintained such that all reported data can be regenerated through its use by the cognizant SAS scientists involved in the project.

Very truly yours,

G. R. Blewett, Scientist
Special Analytical Studies
Environmental Projects

CONCURRENCE:

Dennis Trimble
Nuclear Fuels Evaluations
Nuclear Engineering

grb/mai

A P P E N D I X B

Letter, M. W. Goheen, "Gas Analysis," April 13, 1995, Pacific Northwest Laboratories, Richland, Washington.

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Pacific Northwest Laboratories
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Telephone (509)
376-3358

April 13, 1995

D.J.Trimble
Nuclear Fuel Evaluations
Nuclear Engineering
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Dear Mr. Trimble:

Gas analyses of the two sets of K-west basin fuel canister samples are complete. The data package includes the results, empty sample vial subtracted results, mass spectrometer sample runs*, empty sample vial runs*, mass spectrometer calibration runs on "pure" gases*, nitrogen performance checks* and measured residual water in the sample vials.

The analyses were performed using the high sensitivity, quantitative gas mass spectrometer (WC38625) built by Finnigan MAT, following procedure PNL-ALO-284 Rev.1. A performance check of the instrument, using high purity nitrogen, is run daily prior to sample analyses. Samples arriving at the 325 Building are assigned an ALO log-in number. The log-in numbers are 95-04777 through 95-04782 and 95-04976 through 95-04981. The work was done under work package ED5360.

One milliliter aliquots of the samples were removed from the sample vials using gas sampling syringes. Aliquot from samples FC B03 and FC B04 contained adequate gas for analysis. There wasn't enough gas in vial samples FC B08, FC B09 or FC B12 for analyses. Samples FC B05, FC B06 and FC B13 were analyzed, but the vials contained very small amounts of gas.

The data package includes mass spectrometer scans on background gases in three pre-evacuated empty vials. Background runs were made on other empty vials in December and January but not included. The first runs on empty vials were made while developing the technique. The three vials were injected with helium using a ten milliliter gas syringe. A one milliliter aliquot was taken from each vial for analysis. About thirty peaks from residual ideal gases and several hydrocarbon gases were detected in the mass spectra runs. All vial background and samples had a fairly high mass peak at 60 which is probably from carbonyl sulfide. Carbon disulfide is probably also present. The ratios of the 60 mass peak to the principal peaks for hydrogen, nitrogen, oxygen, argon and carbon dioxide are pretty consistent for the three runs. Attempts to use argon to correct for air were not successful. The nitrogen used to fill the canisters must have contained argon. Oxygen could be used but there may be oxygen present along with hydrogen as a product of radiolysis. The second peak for carbonyl sulfide is 32 [oxygen principal mass peak].

* Not included in this package (Appendix B).

Correcting the 60 peak out of the sample spectra runs also corrects the thirty-two peak for carbonyl sulfide. The 60 peak was also present in all vials checked during the work in December and January.

To correct for the residual gases in the sample vials, the 60 mass peak was used. Helium is ignored in the work. The mass spectra from the run on the first empty vial was subtracted from the mass spectra in the samples. The correction is an estimate. The background may be quite different from vial lot to vial lot. In most cases the hydrocarbon peaks were smaller after the subtractions. The air content was reduced in most analyses. Hydrogen percentages were higher after the subtractions for most samples. Sample FC B13, after the subtraction, has less than ten parts per million hydrogen. The sample probably contained only the residual gases found in the empty vials along with some extra air from leakage during the handling.

A peak at mass 78 was found both in runs from gas taken from the three empty vials and all the sample vials. The peak is not ^{78}Kr. Mass peak 78 is usually from trace benzene. Benzene and methane are found in the mass spectra from heated hydrocarbons and often as the last hydrocarbon vapor species to pump out of vacuum systems. The benzene, methane and other hydrocarbons present in the vials are probably from the system used to evacuate the vials and from outgassing of the stoppers used in the glass vials. Subtraction of the vial background mass spectra from the sample mass spectras didn't remove all hydrocarbon or other trace gas mass peaks present in the sample vials. In the sample vials that had appreciable gas present, the subtraction did reduce the intensity of most mass peaks except nitrogen and hydrogen. Most if not all of the hydrocarbon and other gases, carbonyl sulfide etc., are from the residual gases present in the sample vials and probably not from the fuel canisters. Our experience with a gas isotope ratio gas mass spectrometer used for FFTF work showed the mass peaks at 15, 16 and 78 [methane and benzene] were the last peaks to disappear after a long weekend bake-out at 200° to 400° Celsius. All other mass peaks from hydrocarbons were reduced during the bake-out. The mass peaks 15, 16 and 78 where present for several weeks after a bake-out.

Vial sample FC B33, ALO No. 95-04979 was run three times. Two additional samples were taken from the vial about an hour after the first sample run was completed. The triplicate samples were taken after insuring that there was gas from the canister in the vial. The results are listed in Tables 1 and 2. Table 2 is for the vial subtract results. As expected the precision of gas species present above the 0.5 atom percent level is quite good. There is more variation in the results on the empty vial subtracted results. Each vial probably has different amounts of air in-leakage over time and during sampling.

After the vials were sampled and results were checked, the vials were opened and the water that was found was measured using a ten milliliter graduated cylinder. Most sample vials contained only residual liquid. The results are listed in Table 3.

The variation in the nitrogen results may be due to the difficulty in obtaining syringe aliquots from the sample vials. The syringe aliquots were taken in a fume hood using two sets of gloves. Nitrogen is the principal gas species in air and there could have been some slight leakage of air during sampling. The precision on H_2, N_2, O_2, and Ar are well within the 10% criteria. Only the Kr isotope results fall out of the 10% criteria. The Kr results are well below the 0.5 atom percent level criteria.

The nitrogen sensitivity calibration results show excellent agreement. The sensitivity checks are run in triplicate prior to sample analyses. The calibration sensitivities change from time to time as the lab temperature changes, samples are run, etc. The expectation is that the sensitivities change in the same direction and change about the same amount for each gas species. Since the results are normalized, small changes have very little effect on the atom percentages. The estimate of precision on results for single analyses on the mass spectrometer is 2% or better. For air samples, that are occasionally run, the major gas species are always within 2% of the accepted values for air.

The calibration gas runs are used to build data reduction libraries. The data reduction libraries are used to do a matrix evaluation on the mass spectra runs to determine the gas species present and the amounts of the gas species present. There are several data reduction libraries in use for data reduction. The data library used for this work includes each isotope of Kr and Xe in order to determine the fission gases found in the sample runs.

Detection for most gas species is from about one to five parts per million for the 200 resolution Faraday cup used for the analyses. The detection limit for each gas species depends on a variety of factors including ionization potential, filament current & electron voltage, mass interference, etc. The secondary electron multiplier [SEM] is more sensitive but less linear. The SEM was used to scan the 44 and 28 mass peaks at 3000 resolution to check for nitrous oxide and carbon monoxide in the carbon dioxide and nitrogen mass peaks.

Sincerely Yours,

M.W. Goheen, Staff Scientist
Atomic and Molecular Spectroscopy

Concurrence 4/13/95

Table 1.

FC B33 uncorrected results

Run	H_2	Ar	N_2	O_2	^{84}Kr	^{86}Kr
1.	80.55	0.125	7.61	11.54	0.00101	0.00151
2.	80.56	0.124	7.63	11.50	0.00116	0.00170
3.	80.62	0.123	7.55	11.52	0.00127	0.00161
Ave	80.58	0.124	7.60	11.52	0.00115	0.00161
s	0.04	0.001	0.04	0.02	0.00013	0.00010

Run	^{131}Xe	^{132}Xe	^{134}Xe	^{136}Xe
1.	0.00233	0.00380	0.00601	0.00870
2.	0.00243	0.00376	0.00611	0.00868
3.	0.00248	0.00379	0.00604	0.00874
Ave	0.00241	0.00378	0.00605	0.00871
s	0.00008	0.00002	0.00005	0.00003

Table 2.

FC B33 empty vial subtracted results

Run	H_2	Ar	N_2	O_2	^{84}Kr	^{86}Kr
1.	86.29	0.0592	2.69	10.85	0.00109	0.00162
2.	86.41	0.0573	2.61	10.79	0.00124	0.00183
3.	86.53	0.0559	2.48	10.81	0.00137	0.00173
Ave	86.41	0.0575	2.59	10.82	0.00123	0.00173
s	0.12	0.0017	0.11	0.03	0.00014	0.00011

Run	^{131}Xe	^{132}Xe	^{134}Xe	^{136}Xe
1.	0.00250	0.00408	0.00644	0.00933
2.	0.00261	0.00404	0.00656	0.00931
3.	0.00266	0.00407	0.00649	0.00939
Ave	0.00259	0.00406	0.00650	0.00934
s	0.00008	0.00002	0.00006	0.00004

Table 3.

LIQUID FOUND IN SAMPLE VIALS

I.D.	ALO I.D.	ml of liquid found	
FC B03	95-04777	0.5	
FC B04	95-04778	0.5	
FC B08	95-04779	<0.1	
FC B09	95-04780	0.8	
FC B05	95-04781	3.8	
FC B06	95-04782	0.4	
FC B12	95-04977	EMPTY	
FC B34	95-04978	1.2	
FC B33	95-04979	0.1	RUSTY COLORED LIQUID
FC B31	95-04980	EMPTY	
FC B13	95-04981	0.7	

Milton W. Goheen

Concur: 4/18/95

Analytical Chemistry Laboratory (ACL) Analytical Services Request (ASR)

(Cover Page ... information applicable to all samples in series)

Requested By: D.J. Trimble (Print Name) D.J. Trimble 3/22/95 (Signature/Date) 376-8373 (Phone) L5-01 (MSIN)

Requester - Please Complete All Fields In This Section, Unless Specified "Optional" or ASR is a Revision

Request ID (optional): _____

PNL Project Number (if known): _____

Work Order/Pkg.: ED5360

Protocol Requirement: ✓None __RCRA __CERCLA, or

Other (specify): _____

Hold Time Requirement: __None __RCRA __CERCLA, or

Other (specify): 15days WHC-SD-SNF-PLN-004

TPA Support: ✓No, or

Milestone No.: _____

QA Plan: ✓WCS-033, or

Other ACL QA Plan (specify): _____

Additional QA Requirements: __No, or WHC9551015(LOI)

Reference Doc.: WHC-SD-SNF-PLN-004

ACL COC Req'd (PNL-ALO-010): __No ✓Yes

Sample Storage Requirements: __No __Refrigerate, or

Other (specify): < 110°F

Date Sampled (optional): (See Sample Description on back)

Time Sampled (optional): _____

Matrix: __Samples vary (specify on Request Page).

Liquid: ✓Aqueous __Organic __Multi-phasic

Solid: __Soil ✓Sludge __Sediment __Glass

__Filter __Smear __Metal __Organic __Other Sc

Solid/Liquid Mixture: __ Gas: ✓

Biological: __Tissue __Urine __Feces

Process Knowledge: __Sample Information Check Lis

Reference Doc.: WHC 9551015 (LOI)

Sample Disposition ...

Untreated Sample(s): __Return __Dispose ✓Store

Reference Doc.: _____

Prep'd Sample(s): ✓Dispose __Return __Store

Reference Doc.: _____

Additional Instructions: __No, or

Reference Doc.: WHC-SD-SNF-PLN-004 WHC 955105 (LOI)

Date Report Req'd: 15days-prelim; 90days

Send Report to: D.J. Trimble WHC

MSIN: L5-01 Phone: 376-8373

Fax (optional): 376-8027

For ACL Use Only ... Do Not Complete This Section

Date Delivered: 3-22-95

Time Delivered (optional): _____

Deliv. By (if known): _____

Received By: M. W. Goheen

Resp. ACL Mgr.: _____

Signature/Date: _____ 3-22-95

Job Group (optional): _____

Sample Group (optional): _____

PNL Impact Level: __1 X2 __3

DQ Review Req'd: X No __Yes ACL Waste: X No __

PP&C Due Date (optional): _____

Prep. Due Date (optional): _____

Anal. Due Date (optional): _____

ASR Number: 1907 Revision: __

ACL Numbers: 95-04777 → 95-04782

Analytical Chemistry Laboratory (ACL) Analytical Services Request (ASR)
(Request Page ... information specific to individual samples)

	ACL Number (for ACL use only)	Client Sample Number (list each sample separately)	Sample Description (Date/Time Sampled)	Analyses Requested	Test Name (for ACL use only)	Library (for ACL use only)
1	95-04777	FC B03	3-16-95 / 1455	GAS SPECIES	GAS ANAL	325 ADV INORG
2	95-04778	FC B04	3-17-95 / 1358	↓	↓	↓
3	95-04779	FC B08	3-17-95 / 2053	↓	↓	↓
4	95-04780	FC B09	3-17-95 / 2118	↓	↓	↓
5	95-04781	FC B05	3-17-95 / 1420	↓	↓	↓
6	95-04782	FC B06	3-17-95 / 1505	GAS SPECIES	GAS ANAL	325 ADV INORG

ASR Number (for ACL use only): ____________

Page ___ of ___

Analytical Chemistry Laboratory (ACL) Analytical Services Request (ASR)

(Cover Page ... information applicable to all samples in series)

Requested By: D.J. Trimble (Print Name) — M.A. Dreon for D.J. Trimble 3-29-95 (Signature/Date) — 376-8373 (Phone) — L5-01 (MSIN)

Requester - Please Complete All Fields In This Section, Unless Specified "Optional" or ASR is a Revision

Request ID (optional): _____

PNL Project Number (if known): _____

Work Order/Pkg.: ED5360

Protocol Requirement: ✓None __RCRA __CERCLA, or

Other (specify): _____

Hold Time Requirement: __None __RCRA __CERCLA, or

Other (specify): 15days WHC-SD-SNF-PLN-004

TPA Support: ✓No, or

Milestone No.: _____

QA Plan: ✓HCS-033, or

Other ACL QA Plan (specify): _____

Additional QA Requirements: __No, or WHC 9551015 (LOI)

Reference Doc.: WHC-SD-SNF-PLN-004

ACL COC Req'd (PNL-ALO-010): __No ✓Yes

Sample Storage Requirements: __No __Refrigerate, or

Other (specify): < 110°F

Date Sampled (optional): (See Sample Description on back)

Time Sampled (optional): _____

Matrix: __Samples vary (specify on Request Page), or

Liquid: ✓Aqueous __Organic __Multi-phasic

Solid: __Soil ✓Sludge __Sediment __Glass

__Filter __Smear __Metal __Organic __Other Solids

Solid/Liquid Mixture: __ Gas: ✓

Biological: __Tissue __Urine __Feces

Process Knowledge: __Sample Information Check List, or

Reference Doc.: WHC 9551015 (LOI)

Sample Disposition ...

Untreated Sample(s): __Return __Dispose ✓Store, or

Reference Doc.: _____

Prep'd Sample(s): ✓Dispose __Return __Store, or

Reference Doc.: _____

Additional Instructions: __No, or

Reference Doc.: WHC-SD-SNF-PLN-004 WHC 955105 (LOI)

Date Report Req'd: 15days-prelim; 90days final 4-14-95

Send Report to: D.J. Trimble

WHC

MSIN: L5-01 Phone: 376-8373

Fax (optional): 376-8027

For ACL Use Only ... Do Not Complete This Section

Date Delivered: 3/30/95

Time Delivered (optional): 15:00

Deliv. By (if known): _____

Received By: S. J. Bos

Resp. ACL Mgr.: M. W. Gebers

Signature/Date: S J Bos 3-30-95

Job Group (optional): _____

Sample Group (optional): _____

PNL Impact Level: __1 X2 __3

DQ Review Req'd: XNo __Yes ACL Waste: XNo __Yes

PP&C Due Date (optional): _____

Prep. Due Date (optional): _____

Anal. Due Date (optional): _____

ASR Number: 1925 Revision: __Yes

ACL Numbers: 95-04976 — 95-04981

Analytical Chemistry Laboratory (ACL) Analytical Services Request (ASR)
(Request Page ... information specific to individual samples)

ACL Number (for ACL use only)	Client Sample Number (list each sample separately)	Sample Description (Date/Time Sampled)	Analyses Requested	Test Name (for ACL use only)	Library (for ACL use only)
95-04976	FC B (W SAMPLE)		GAS SPECIES	Gas-Ana	Helv-Inorg
95-04977	FC-B12 (5) ✓	3-20-95 / 1818	GAS SPECIES		
95-04978	FC-B34 (2) ✓	3-25-95 / 2124	GAS		
95-04979	FC-B33 (3) ✓	3-25-95 / 2105	GAS	3 Runs	
95-04980	FC-B31 (4) ✓	3-25-95 / 1818	GAS		
95-04981	FC-B13 (1) ✓	3-20-95 / 1857	GAS SPECIES		

ASR Number (for ACL use only): _____ Page ___ of ___

ANALYSIS REPORTS

- CORRECTED FOR VIAL BACKGROUND
- UNCORRECTED FOR VIAL BACKGROUND

CORRECTED FOR VIAL BACKGROUND

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC B03		
Analysis Date	Apr. 3, 1995	Mole	Estimate of
Log-in No.	95-04777	Percent	Precision
Argon		0.173	± 0.005
Carbon dioxide		0.041	± 0.004
Carbon monoxide		<0.01	±
Helium		<0.001	±
Hydrogen		72	± 0.6
Methane		<0.001	±
Nitrogen		27.6	± 0.6
Oxygen		0.136	± 0.004
Nitrous oxide		<0.005	±
Other nitrogen oxides		<0.005	±
Ethane		<0.005	±
Other hydrocarbons		<0.01	±
Krypton 83		0.0011	± 0.0005
Krypton 84		0.0021	± 0.0005
Krypton 85		<0.0005	±
Krypton 86		0.0033	± 0.0005
Xenon 131		0.0043	± 0.0005
Xenon 132		0.0073	± 0.0007
Xenon 134		0.011	± 0.001
Xenon 136		0.017	± 0.002

Comments Results corrected by subtracting out gas found in new vial

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC BO4		
Analysis Date	Apr. 3, 1995	Mole	Estimate of
Log-in No.	95-04778	Percent	Precision
Argon		0.181 ±	0.005
Carbon dioxide		0.043 ±	0.004
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		65.7 ±	0.6
Methane		<0.001 ±	
Nitrogen		33.5 ±	0.6
Oxygen		0.56 ±	0.04
Nitrous oxide		<0.005 ±	
Other nitrogen oxides		<0.005 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.01 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0014 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0022 ±	0.0005
Xenon 131		0.0024 ±	0.0005
Xenon 132		0.0038 ±	0.0005
Xenon 134		0.0061 ±	0.0006
Xenon 136		0.0088 ±	0.0009

Comments Results corrected by subtracting out gas found in new vial

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC BO5		
Analysis Date	Apr. 3, 1995	Mole	Estimate of
Log-in No.	95-04781	Percent	Precision
Argon		1.23 ±	0.02
Carbon dioxide		1.21 ±	0.02
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		7.7 ±	0.2
Methane		0.055 ±	0.005
Nitrogen		61.3 ±	0.5
Oxygen		28.4 ±	0.5
Nitrous oxide		<0.005 ±	
Other nitrogen oxides		<0.005 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.01 ±	
Krypton 83		<0.0005 ±	
Krypton 84		<0.001 ±	
Krypton 85		<0.0005 ±	
Krypton 86		<0.001 ±	
Xenon 131		<0.001 ±	
Xenon 132		<0.001 ±	
Xenon 134		0.0057 ±	0.0005
Xenon 136		0.0081 ±	0.0005

Comments Results corrected by subtracting out gas found in new vial

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC BO6		
Analysis Date	Apr. 3, 1995	Mole	Estimate of
Log-in No.	95-04782	Percent	Precision
Argon		0.31 ±	0.01
Carbon dioxide		0.29 ±	0.01
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		72.7 ±	0.7
Methane		<0.001 ±	
Nitrogen		21 ±	0.7
Oxygen		5.7 ±	0.2
Nitrous oxide		<0.005 ±	
Other nitrogen oxides		<0.005 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.01 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0022 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0023 ±	0.0005
Xenon 131		0.0021 ±	0.0005
Xenon 132		0.0035 ±	0.0005
Xenon 134		0.0052 ±	0.0005
Xenon 136		0.0076 ±	0.0007

Comments Results corrected by subtracting out gas found in new vial

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B13		
Analysis Date	Apr. 3, 1995	Mole	Estimate of
Log-in No.	95-04981	Percent	Precision
Argon		1.62 ±	0.03
Carbon dioxide		4.09 ±	0.08
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		<0.001 ±	
Methane		<0.001 ±	
Nitrogen		57.1 ±	0.7
Oxygen		37.2 ±	0.7
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		<0.001 ±	
Krypton 85		<0.0005 ±	
Krypton 86		<0.001 ±	
Xenon 131		<0.001 ±	
Xenon 132		<0.001 ±	
Xenon 134		<0.001 ±	
Xenon 136		<0.001 ±	

Comments Results corrected by subtracting out gas found in new vial

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B31		
Analysis Date	Apr. 3, 1995	Mole	Estimate of
Log-in No.	95-04980	Percent	Precision
Argon		0.092 ±	0.003
Carbon dioxide		0.012 ±	0.001
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		94.5 ±	0.1
Methane		<0.001 ±	
Nitrogen		5.1 ±	0.1
Oxygen		0.22 ±	0.04
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0019 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0032 ±	0.0005
Xenon 131		0.0042 ±	0.0005
Xenon 132		0.0069 ±	0.0007
Xenon 134		0.011 ±	0.001
Xenon 136		0.016 ±	0.001

Comments Results corrected by subtracting out gas found in new vial

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B33 (First analysis)		
Analysis Date	Apr. 3, 1995	Mole	Estimate of
Log-in No.	95-04979	Percent	Precision
Argon		0.059 ±	0.003
Carbon dioxide		0.85 ±	0.003
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		86.3 ±	0.3
Methane		0.009 ±	0.001
Nitrogen		2.69 ±	0.05
Oxygen		10.8 ±	0.2
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0011 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0016 ±	0.0005
Xenon 131		0.0025 ±	0.0005
Xenon 132		0.0041 ±	0.0005
Xenon 134		0.0064 ±	0.0006
Xenon 136		0.0093 ±	0.0009

Comments Results corrected by subtracting out gas found in new vial

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B33 (Second analysis)		Estimate
Analysis Date	Apr. 3, 1995	Mole	of
Log-in No.	95-04979	Percent	Precision
Argon		0.057 ±	0.003
Carbon dioxide		0.087 ±	0.003
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		86.4 ±	0.3
Methane		0.008 ±	0.001
Nitrogen		2.61 ±	0.05
Oxygen		10.8 ±	0.2
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0012 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0018 ±	0.0005
Xenon 131		0.0026 ±	0.0005
Xenon 132		0.004 ±	0.0005
Xenon 134		0.0066 ±	0.0005
Xenon 136		0.0093 ±	0.0009

Comments Results corrected by subtracting out gas found in new vial

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B33 (Third analysis)		Estimate
Analysis Date	Apr. 3, 1995	Mole	of
Log-in No.	95-04979	Percent	Precision
Argon		0.056 ±	0.003
Carbon dioxide		0.087 ±	0.003
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		86.5 ±	0.3
Methane		0.008 ±	0.001
Nitrogen		2.48 ±	0.05
Oxygen		10.8 ±	0.2
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0014 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0017 ±	0.0005
Xenon 131		0.0027 ±	0.0005
Xenon 132		0.0041 ±	0.0005
Xenon 134		0.0065 ±	0.0006
Xenon 136		0.0094 ±	0.0009

Comments Results corrected by subtracting out gas found in new vial

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B34		
Analysis Date	Apr. 3, 1995	Mole	Estimate of
Log-in No.	95-04978	Percent	Precision
Argon		0.047 ±	0.003
Carbon dioxide		0.026 ±	0.002
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		98.57 ±	0.02
Methane		<0.001 ±	
Nitrogen		1.06 ±	0.02
Oxygen		0.27 ±	0.01
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0015 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0023 ±	0.0005
Xenon 131		0.0036 ±	0.0005
Xenon 132		0.0055 ±	0.0005
Xenon 134		0.0089 ±	0.0009
Xenon 136		0.013 ±	0.001

Comments Results corrected by subtracting out gas found in new vial

UNCORRECTED FOR VIAL BACKGROUND

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC BO3		
Analysis Date	Mar 23, 1995	Mole	Estimate of
Log-in No.	95-04777	Percent	Precision
Argon		0.243 ±	0.005
Carbon dioxide		0.098 ±	0.004
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		66.2 ±	0.6
Methane		0.018 ±	0.002
Nitrogen		31.6 ±	0.6
Oxygen		1.83 ±	0.04
Nitrous oxide		<0.005 ±	
Other nitrogen oxides		<0.005 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.01 ±	
Krypton 83		0.0011 ±	0.0005
Krypton 84		0.0019 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0031 ±	0.0005
Xenon 131		0.004 ±	0.0005
Xenon 132		0.0067 ±	0.0005
Xenon 134		0.0104 ±	0.0005
Xenon 136		0.0155 ±	0.0005

Comments

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC BO4		
Analysis Date	Mar 23, 1995	Mole	Estimate of
Log-in No.	95-04778	Percent	Precision
Argon		0.246 ±	0.005
Carbon dioxide		0.097 ±	0.004
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		60.8 ±	0.6
Methane		0.016 ±	0.005
Nitrogen		36.7 ±	0.6
Oxygen		2.11 ±	0.04
Nitrous oxide		<0.005 ±	
Other nitrogen oxides		<0.005 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.01 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0013 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.002 ±	0.0005
Xenon 131		0.0022 ±	0.0005
Xenon 132		0.0036 ±	0.0005
Xenon 134		0.0056 ±	0.0005
Xenon 136		0.0081 ±	0.0005

Comments

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC BO5		
Analysis Date	Mar 23, 1995	Mole	Estimate of
Log-in No.	95-04781	Percent	Precision
Argon		1.11 ±	0.02
Carbon dioxide		0.93 ±	0.02
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		3.56 ±	0.07
Methane		0.169 ±	0.005
Nitrogen		70.3 ±	0.5
Oxygen		23.9 ±	0.5
Nitrous oxide		<0.005 ±	
Other nitrogen oxides		<0.005 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.01 ±	
Krypton 83		<0.0005 ±	
Krypton 84		<0.0005 ±	
Krypton 85		<0.0005 ±	
Krypton 86		<0.0005 ±	
Xenon 131		<0.0005 ±	
Xenon 132		<0.0005 ±	
Xenon 134		0.0022 ±	0.0005
Xenon 136		0.0031 ±	0.0005

Comments

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC BO6		
Analysis Date	Mar 23, 1995	Mole	Estimate of
Log-in No.	95-04782	Percent	Precision
Argon		0.54 ±	0.01
Carbon dioxide		0.436 ±	0.009
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		50.7 ±	0.7
Methane		0.071 ±	0.005
Nitrogen		37.8 ±	0.7
Oxygen		10.4 ±	0.2
Nitrous oxide		<0.005 ±	
Other nitrogen oxides		<0.005 ±	
Ethane		<0.005 ±	
Other hydrocarbons		<0.01 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0016 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0016 ±	0.0005
Xenon 131		0.0015 ±	0.0005
Xenon 132		0.0025 ±	0.0005
Xenon 134		0.0037 ±	0.0005
Xenon 136		0.0053 ±	0.0005

Comments

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC BO8		Estimate
Analysis Date	Mar 23, 1995	Mole	of
Log-in No.	95-04779	Percent	Precision
Argon			±
Carbon dioxide			±
Carbon monoxide			±
Helium			±
Hydrogen			±
Methane			±
Nitrogen			±
Oxygen			±
Nitrous oxide			±
Other nitrogen oxides			±
Ethane			±
Other hydrocarbons			±
Krypton 83			±
Krypton 84			±
Krypton 85			±
Krypton 86			±
Xenon 131			±
Xenon 132			±
Xenon 134			±
Xenon 136			±

Comments Not enough sample for analysis

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 22
Measurement and test equipment WC38625

Sample Id.	FC BO9		Estimate
Analysis Date	Mar 23, 1995	Mole	of
Log-in No.	95-04780	Percent	Precision
Argon		±	
Carbon dioxide		±	
Carbon monoxide		±	
Helium		±	
Hydrogen		±	
Methane		±	
Nitrogen		±	
Oxygen		±	
Nitrous oxide		±	
Other nitrogen oxides		±	
Ethane		±	
Other hydrocarbons		±	
Krypton 83		±	
Krypton 84		±	
Krypton 85		±	
Krypton 86		±	
Xenon 131		±	
Xenon 132		±	
Xenon 134		±	
Xenon 136		±	

Comments Not enough sample for analysis

Pacific Northwest Laboratory

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Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B12		Estimate
Analysis Date	Mar 31, 1995	Mole	of
Log-in No.	95-04977	Percent	Precision
Argon			±
Carbon dioxide			±
Carbon monoxide			±
Helium			±
Hydrogen			±
Methane			±
Nitrogen			±
Oxygen			±
Nitrous oxide			±
Other nitrogen oxides			±
Ethane			±
Other hydrocarbons			±
Krypton 83			±
Krypton 84			±
Krypton 85			±
Krypton 86			±
Xenon 131			±
Xenon 132			±
Xenon 134			±
Xenon 136			±

Comments Not enough sample for analysis

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B13		
Analysis Date	Mar 31, 1995	Mole	Estimate of
Log-in No.	95-04981	Percent	Precision
Argon		1.17 ±	0.02
Carbon dioxide		1.51 ±	0.03
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		0.52 ±	0.01
Methane		0.184 ±	0.004
Nitrogen		71.8 ±	0.5
Oxygen		24.8 ±	0.5
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.01 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		<0.0005 ±	
Krypton 85		<0.0005 ±	
Krypton 86		<0.0005 ±	
Xenon 131		<0.0005 ±	
Xenon 132		<0.0005 ±	
Xenon 134		<0.0005 ±	
Xenon 136		<0.0005 ±	

Comments Analysis questionable do to sample size.

Pacific Northwest Laboratory

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Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B31		Estimate
Analysis Date	Mar 31, 1995	Mole	of
Log-in No.	95-04980	Percent	Precision
Argon		0.17 ±	0.003
Carbon dioxide		0.073 ±	0.001
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		86.8 ±	0.4
Methane		0.017 ±	0.001
Nitrogen		11 ±	0.2
Oxygen		1.95 ±	0.04
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.01 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0017 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0029 ±	0.0005
Xenon 131		0.0039 ±	0.0005
Xenon 132		0.0063 ±	0.0006
Xenon 134		0.010 ±	0.001
Xenon 136		0.015 ±	0.001

Comments

Pacific Northwest Laboratory

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Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B33		
Analysis Date	Mar 31, 1995	Mole	Estimate of
Log-in No.	95-04979	Percent	Precision
Argon		0.125 ±	0.003
Carbon dioxide		0.13 ±	0.003
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		80.5 ±	0.3
Methane		0.024 ±	0.001
Nitrogen		7.6 ±	0.2
Oxygen		11.5 ±	0.2
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.01 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.001 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0015 ±	0.0005
Xenon 131		0.0023 ±	0.0005
Xenon 132		0.0038 ±	0.0005
Xenon 134		0.006 ±	0.0005
Xenon 136		0.0087 ±	0.0005

Comments First Analysis

Pacific Northwest Laboratory

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Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B33		
Analysis Date	Mar 31, 1995	Mole	Estimate of
Log-in No.	95-04979	Percent	Precision
Argon		0.124 ±	0.003
Carbon dioxide		0.133 ±	0.003
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		80.6 ±	0.3
Methane		0.024 ±	0.001
Nitrogen		7.6 ±	0.2
Oxygen		11.5 ±	0.2
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.01 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0012 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0017 ±	0.0005
Xenon 131		0.0024 ±	0.0005
Xenon 132		0.0038 ±	0.0005
Xenon 134		0.0061 ±	0.0005
Xenon 136		0.0087 ±	0.0005

Comments Second Analysis

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B33		
Analysis Date	Mar 31, 1995	Mole Percent	Estimate of Precision
Log-in No.	95-04979		
Argon		0.123 ±	0.003
Carbon dioxide		0.133 ±	0.003
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		80.6 ±	0.3
Methane		0.024 ±	0.001
Nitrogen		7.6 ±	0.2
Oxygen		11.5 ±	0.2
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.01 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0013 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0016 ±	0.0005
Xenon 131		0.0025 ±	0.0005
Xenon 132		0.0038 ±	0.0005
Xenon 134		0.006 ±	0.0005
Xenon 136		0.0087 ±	0.0005

Comments Third Analysis

Pacific Northwest Laboratory

From: Inorganic Mass Spectrometry Lab.
Phone: (509) 376-3358 / mail slot P7-22
Date: April 17, 1995
Subject: Gas Species Analysis

To: D.J. Trimble

Analytical procedure: PNL-MA-599 ALO-284
Record book 6 Page 25
Measurement and test equipment WC38625

Sample Id.	FC B34		
Analysis Date	Mar 31, 1995	Mole	Estimate of
Log-in No.	95-04978	Percent	Precision
Argon		0.128 ±	0.003
Carbon dioxide		0.085 ±	0.002
Carbon monoxide		<0.01 ±	
Helium		<0.001 ±	
Hydrogen		90.6 ±	0.2
Methane		0.018 ±	0.001
Nitrogen		7.2 ±	0.2
Oxygen		1.97 ±	0.04
Nitrous oxide		<0.01 ±	
Other nitrogen oxides		<0.001 ±	
Ethane		<0.01 ±	
Other hydrocarbons		<0.001 ±	
Krypton 83		<0.0005 ±	
Krypton 84		0.0014 ±	0.0005
Krypton 85		<0.0005 ±	
Krypton 86		0.0021 ±	0.0005
Xenon 131		0.0033 ±	0.0005
Xenon 132		0.0051 ±	0.0005
Xenon 134		0.0082 ±	0.0008
Xenon 136		0.012 ±	0.002

Comments