

**Monitoring Results
Natural Gas Wells
Near Project Rulison
Fourth Quarter 2011**

**U.S. Department of Energy Office of Legacy Management
Grand Junction, Colorado**

Date Sampled:

6 December 2011

Purpose:

The purpose of this environmental sample collection is to monitor natural gas and production water from natural gas wells drilled near the Project Rulison test site. As part of the Department of Energy's (DOE's) directive to protect human health and the environment, samples are collected from producing gas wells and analyzed to ensure no Rulison related radionuclides have migrated outside the DOE institutional-control boundary. The *Rulison Monitoring Plan* provides guidance for sample collection frequency, based on distance from the Rulison detonation point, the types of analyses, and the reporting thresholds.

Background:

Project Rulison was the second Plowshare Program test to stimulate natural-gas recovery. On 10 September 1969, a 40-kiloton-yield nuclear device was detonated 8,426 feet (1.6 miles) below the ground surface in the Williams Fork Formation.

Samples Collected:

A gas sample was collected from each of ten producing natural-gas wells. A produced-water sample was collected from nine of the ten gas wells. The wells sampled are listed in Table 1.

Sample Locations:

The bottom-hole locations (BHLs) of the 10 gas wells sampled are between 0.75 and 1.07 miles from the Project Rulison detonation point. All wells sampled are producing gas from the Williams Fork Formation at the Rulison detonation horizon.

Summary of Results:

No analytical result exceeded its respective screening level (see Table 3).

Table 1. Sample Collection Locations

Pad	Collection Location	Well Name
26N	Well head separator	Battlement Mesa (BM) 26-33B, -33C, -33D; BM 26-34A, -34B, -34C, -34D
26K	Well head separator	BM 26-22B, -22C, -22D

Produced-water samples were collected from a tap on the common line connecting two gas-liquid separators and the accumulation tank. The produced water collected from one well separator was isolated from the other well separator by valves. Lines from each of the two separators were purged of produced water and condensate prior to sample collection.

Table 2 lists the wells in the order of gas-sample collection.

Table 2. Sample Collection Information

Seq.	Name	API # 05-045-	Location subtype	Sample Phase		BHL Data		Comments
				Gas	Liquid	T (°F)	P (psi)	
1	BM 26-33C	15742	NGSA	X	X	66	256	~25 psi gas in 18L bottle; ~2.5 L of produced water
2	BM 26-33B	15743	NGSA	X	X	87	257	~25 psi gas in 18L bottle; ~2.5 L of produced water
3	BM 26-33D	15739	NGSA	X	X	69	255	~25 psi gas in 18L bottle; ~2.5 L of produced water
4	BM 26-34A	15744	NGSA	X	NA	67	257	~25 psi gas in 18L bottle;
5	BM 26-34C	15741	NGSA	X	X	39	247	~25 psi gas in 18L bottle; ~2.5 L of produced water
6	BM 26-34B	15745	NGSA	X	X	45	246	~25 psi gas in 18L bottle; ~2.5 L of produced water
7	BM 26-34D	15748	NGSA	X	X	61	237	~25 psi gas in 18L bottle; ~2.5 L of produced water
8	BM 26-22B	16086	NGSA	X	X	65	258	~25 psi gas in 18L bottle; ~3.0 L of produced water
9	BM 26-22C	16087	NGSA	X	X	71	273	~28 psi gas in 18L bottle; ~2.5 L of produced water
10	BM 26-22D	16074	NGSV	X	X	88	277	~25 psi gas in 18L bottle; ~2.5 L of produced water

T: Temperature
L: liter

P: Pressure
NGSV: Vertical natural gas well

BM: Battlement Mesa

NGSA: Angled natural gas well
NA: Missing or not applicable

Monitoring Protocol:

The *Rulison Monitoring Plan* (July 2010, LMS/RUL/S06178) provides guidance regarding the type and frequency of sample collection as a function of distance and heading from the Rulison detonation point; it also specifies the types of analyses. A copy of the monitoring plan is available at <http://www.lm.doe.gov/Rulison/Documents.aspx>

Table 3a. Gas-Phase Screening and Action Concentrations for Tritium Sample Results

Analyte	Reporting Units	Screening Conc.	Action Conc.	Comment
Tritium	TU	19,293	TBD	5.183×10^{-6} pCi/cc/TU

Table 3b. Liquid-Phase Screening and Action Concentrations for Tritium and Various Analytical Method Results

Analyte	Reporting Units	Screening Conc.	Action Conc.	Comment
Tritium	pCi/L	800	TBD	20,000 pCi/L = EPA drinking water standard
Lab Method				
Gross alpha	pCi/L	3x background	TBD	
Gross beta	pCi/L	3x background	TBD	
High-resolution gamma spectroscopy	pCi/L	20	TBD	Based on cesium-137

Table 3 Notes: See the Rulison Monitoring Plan, Table 2, for response scenarios when the screening and/or action concentrations are exceeded.
 The derived air effluent concentration for 50 mrem-per-year dose from tritium exposure is 0.10 pCi (tritium) / (cc of methane).
 TU: tritium unit
 pCi/cc/TU: picocurie per cubic centimeter per tritium unit

Results:

Ten gas samples were collected from ten producing gas wells. Nine produced water samples were collected from nine of the ten wells.

Analytic results for each well sampled are listed after Table 6.

Laboratory Qualifiers:

A “detect” is a laboratory result greater than the laboratory’s reporting threshold or minimum detectable concentration (MDC).

A “nondetect” is a laboratory result that is less than the laboratory’s MDC for that sample. The laboratory qualifies a “nondetect” with a “U.”

Data Validation Qualifiers:

A “detect” result less than 3 times the sample MDC is assigned the data qualifier “J.”

A laboratory result less than three times the one-sigma total propagated uncertainty is considered a “nondetect” and assigned the data qualifier “U.” Three times the one-sigma propagated uncertainty is called the Decision Level Concentration.

Results Summaries:

Summary results for tritium in the gas and liquid phases are in Table 4a. Liquid-phase results for gross alpha/beta are summarized in Table 4b and potassium-40 results in Table 4c. Sample volumes not adequate for laboratory analysis are counted as missing or not applicable (NA).

Table 4a. Summary of Tritium Results for Samples, Based on Laboratory Assigned Qualifiers

Collection Location	Total Samples (gas/liquid)	Tritium Results (gas phase)			Tritium Results (liquid phase)		
		Detect	Nondetect	NA	Detect	Nondetect	NA
Natural gas wells	10/9	0	10	0	0	9	0

NA: Missing or not applicable

Table 4b. Summary of Gross Alpha/Beta Results for Liquid-Phase Samples, Based on Laboratory Assigned Qualifiers

Collection Location	Total Samples	Gross Alpha Results			Gross Beta Results		
		Detect	Nondetect	NA	Detect	Nondetect	NA
Natural gas wells	9	6	3	0	9	0	0

NA: Missing or not applicable

Data validation assigned “J” to all gross-alpha “detect” results and to six of the nine gross-beta “detect” results.

Table 4c. Summary of Potassium-40 Results for Liquid-Phase Samples, Based on Laboratory Assigned Qualifiers

Collection Location	Total Samples	Potassuim-40 Results		
		Detect	Nondetect	NA
Natural gas wells	9	2	7	0

NA: Missing or not applicable

Data validation assigned “J” to the two “detect” results.

Table 5 summarizes the statistics for gross-alpha and gross-beta results. Backgrounds for gross alpha or gross beta have not been established.

Table 5. Statistics for Detected Gross-Beta and Gross Potassium-40 Results

Counting Statistic	Gross Alpha	Gross Beta	Units
Number of detects	6	9	NA
Maximum	75.6	277.0	pCi/L
Third quartile	73.3	205.0	pCi/L
Mean	60.3	155.1	pCi/L
Median	64.5	136.0	pCi/L
First quartile	52.1	104.0	pCi/L
Minimum	33.1	41.2	pCi/L

NA: Missing or not applicable

The distance and heading from the Rulison emplacement well to the bottom-hole-locations of the wells sampled are listed in Table 6.

Table 6. Bottom-Hole Locations of Wells Sampled and Ground Zero

Pad	Well Name	Total Depth (ft)	Location				Rulison GZ to BHL		Comment
			Q-Q	S	Lat (NAD 83)	Long (NAD 83)	Distance (miles)	Heading (degrees)	
	25-95 (R-E)	8,701	NENW	25	39.405361	-107.948444	0		Ground zero (GZ), vertical well
26N	BM 26-33B	9,966	NWSE	26	39.406892	-107.962558	0.76	W9.5°N	
26N	BM 26-33C	10,072	NWSE	26	39.406006	-107.962544	0.76	W4.9°N	
26N	BM 26-33D	10,068	NWSE	26	39.405124	-107.962544	0.75	W0.3°N	
26N	BM 26-34A	10,087	SWSE	26	39.404311	-107.962565	0.76	S86.1°W	
26N	BM 26-34B	10,046	SWSE	26	39.403498	-107.962561	0.77	S81.9°W	
26N	BM 26-34C	9,986	SWSE	26	39.402515	-107.962576	0.78	S77.0°W	
26N	BM 26-34D	9,986	SWSE	26	39.401665	-107.964508	0.90	S75.0°W	
26K	BM 26-22B	10,094	SENW	26	39.410530	-107.967228	1.07	W21.1°N	
26K	BM 26-22C	10,047	SENW	26	39.409618	-107.967223	1.05	W17.8°N	
26K	BM 26-22D	10,057	SENW	26	39.408687	-107.967163	1.03	W14.6°N	

Q-Q: quarter-quarter section

S: Section

Lat: latitude

Long: longitude

NAD 83: North American Datum of 1983

Liquid Phase Sample Results

RESULTS REPORT
RIN: 11124229
Site: Rulison Site
Location: BM 26-22B
Ticket Number: JNX 239
Report Date: 2/15/2012

Parameter	Units	Sample Date	Sample ID	Result	TPU ¹	Lab	Qualifiers Data	QA
Actinium-228	pCi/L	12/06/2011	N001	39.7	23.1	TI	U	#
Americium-241	pCi/L	12/06/2011	N001	2.25	26.1	U		#
Antimony-125	pCi/L	12/06/2011	N001	-15.8	11.5	U		#
Cerium-144	pCi/L	12/06/2011	N001	-1.88	21.5	U		#
Cesium-134	pCi/L	12/06/2011	N001	-7.56	4.68	U		#
Cesium-137	pCi/L	12/06/2011	N001	-1.9	4.19	U		#
Chloride	mg/L	12/06/2011	N001	9100				#
Cobalt-60	pCi/L	12/06/2011	N001	-2.52	5	U		#
Europium-152	pCi/L	12/06/2011	N001	-8	25.8	U		#
Europium-154	pCi/L	12/06/2011	N001	17.6	23.5	U		#
Europium-155	pCi/L	12/06/2011	N001	9.22	10.9	U		#
Gross Alpha	pCi/L	12/06/2011	N001	49.8	26.3		J	#
Gross Beta	pCi/L	12/06/2011	N001	104	36.1		J	#
Lead-212	pCi/L	12/06/2011	N001	8.29	9.27	U		#
Potassium-40	pCi/L	12/06/2011	N001	57.5	88	U		#
Promethium-144	pCi/L	12/06/2011	N001	2	4.73	U		#
Promethium-146	pCi/L	12/06/2011	N001	-2.98	5.17	U		#
Ruthenium-106	pCi/L	12/06/2011	N001	-18	38.9	U		#
Technetium-99	pCi/L	12/06/2011	N001	89.1	42.6		J	#
Thorium-234	pCi/L	12/06/2011	N001	23.9	95.7	U		#
Tritium	pCi/L	12/06/2011	N001	176	198	U		#
Uranium-235	pCi/L	12/06/2011	N001	18.6	21.1	U		#
Uranium-238	pCi/L	12/06/2011	N001	23.9	95.7	U		#
Yttrium-88	pCi/L	12/06/2011	N001	-1.03	6.38	U		#

RESULTS REPORT
RIN: 11124229
Site: Rulison Site
Location: BM 26-22C
Ticket Number: JNX 240
Report Date: 2/15/2012

Parameter	Units	Sample Date	Sample ID	Result	TPU ¹	Lab	Qualifiers Data	QA
Actinium-228	pCi/L	12/06/2011	N001	41.6	24.1	TI	U	#
Americium-241	pCi/L	12/06/2011	N001	21.1	26.6	U		#
Antimony-125	pCi/L	12/06/2011	N001	-4.99	11.3	U		#
Cerium-144	pCi/L	12/06/2011	N001	18.5	21.2	U		#
Cesium-134	pCi/L	12/06/2011	N001	-9.12	4.82	U		#
Cesium-137	pCi/L	12/06/2011	N001	-0.254	4.59	U		#
Chloride	mg/L	12/06/2011	N001	13000				#
Cobalt-60	pCi/L	12/06/2011	N001	-1.36	4.83	U		#
Europium-152	pCi/L	12/06/2011	N001	-21.2	24.2	U		#
Europium-154	pCi/L	12/06/2011	N001	19.3	24.6	U		#
Europium-155	pCi/L	12/06/2011	N001	6.62	11.3	U		#
Gross Alpha	pCi/L	12/06/2011	N001	56.3	37	U		#
Gross Beta	pCi/L	12/06/2011	N001	277	62.8			#
Lead-212	pCi/L	12/06/2011	N001	9.24	9.04	U		#
Potassium-40	pCi/L	12/06/2011	N001	160	97.8		J	#
Promethium-144	pCi/L	12/06/2011	N001	2.21	4.78	U		#
Promethium-146	pCi/L	12/06/2011	N001	2.87	4.95	U		#
Ruthenium-106	pCi/L	12/06/2011	N001	-22.3	38.7	U		#
Technetium-99	pCi/L	12/06/2011	N001	123	60.7		J	#
Thorium-234	pCi/L	12/06/2011	N001	-21.2	90.8	U		#
Tritium	pCi/L	12/06/2011	N001	37.1	197	U		#
Uranium-235	pCi/L	12/06/2011	N001	-3.3	33.5	U		#
Uranium-238	pCi/L	12/06/2011	N001	-21.2	90.8	U		#
Yttrium-88	pCi/L	12/06/2011	N001	1.27	6.6	U		#

RESULTS REPORT
RIN: 11124229
Site: Rulison Site
Location: BM 26-22D
Ticket Number: JNX 241
Report Date: 2/15/2012

Parameter	Units	Sample Date	Sample ID	Result	TPU ¹	Lab	Qualifiers Data	QA
Actinium-228	pCi/L	12/06/2011	N001	24.1	14	U		#
Americium-241	pCi/L	12/06/2011	N001	3.72	4.77	U		#
Antimony-125	pCi/L	12/06/2011	N001	2.06	7.91	U		#
Cerium-144	pCi/L	12/06/2011	N001	15.7	19.6	U		#
Cesium-134	pCi/L	12/06/2011	N001	0.377	3.79	U		#
Cesium-137	pCi/L	12/06/2011	N001	1.04	3.77	U		#
Chloride	mg/L	12/06/2011	N001	14000				#
Cobalt-60	pCi/L	12/06/2011	N001	-2.37	3.84	U		#
Europium-152	pCi/L	12/06/2011	N001	-10.8	21	U		#
Europium-154	pCi/L	12/06/2011	N001	-16.5	22.3	U		#
Europium-155	pCi/L	12/06/2011	N001	1.78	6.91	U		#
Gross Alpha	pCi/L	12/06/2011	N001	58.9	36		J	#
Gross Beta	pCi/L	12/06/2011	N001	258	63.2			#
Lead-212	pCi/L	12/06/2011	N001	7.24	8.28	U		#
Potassium-40	pCi/L	12/06/2011	N001	135	85.7		J	#
Promethium-144	pCi/L	12/06/2011	N001	-2.02	4.05	U		#
Promethium-146	pCi/L	12/06/2011	N001	-0.845	3.83	U		#
Ruthenium-106	pCi/L	12/06/2011	N001	-9.67	33.5	U		#
Technetium-99	pCi/L	12/06/2011	N001	82.6	56	U		#
Thorium-234	pCi/L	12/06/2011	N001	16.1	53.6	U		#
Tritium	pCi/L	12/06/2011	N001	42.3	197	U		#
Uranium-235	pCi/L	12/06/2011	N001	-12.2	21.5	U		#
Uranium-238	pCi/L	12/06/2011	N001	16.1	53.6	U		#
Yttrium-88	pCi/L	12/06/2011	N001	0.172	5.45	U		#

RESULTS REPORT
RIN: 11124229
Site: Rulison Site
Location: BM 26-33B
Ticket Number: JNX 228
Report Date: 2/15/2012

Parameter	Units	Sample Date	ID	Result	TPU ¹	Lab	Qualifiers Data	QA
Actinium-228	pCi/L	12/06/2011	N001	2.42	21.7	U		#
Americium-241	pCi/L	12/06/2011	N001	-7.38	24.6	U		#
Antimony-125	pCi/L	12/06/2011	N001	-4.08	9.04	U		#
Cerium-144	pCi/L	12/06/2011	N001	9.66	12	U		#
Cesium-134	pCi/L	12/06/2011	N001	6.85	3.76		U	#
Cesium-137	pCi/L	12/06/2011	N001	-2.5	3.72	U		#
Chloride	mg/L	12/06/2011	N001	12000				#
Cobalt-60	pCi/L	12/06/2011	N001	0.559	3.63	U		#
Europium-152	pCi/L	12/06/2011	N001	-8.63	21.5	U		#
Europium-154	pCi/L	12/06/2011	N001	-8.25	20.5	U		#
Europium-155	pCi/L	12/06/2011	N001	2.34	11.2	U		#
Gross Alpha	pCi/L	12/06/2011	N001	74.4	30.6		J	#
Gross Beta	pCi/L	12/06/2011	N001	136	40.9		J	#
Lead-212	pCi/L	12/06/2011	N001	0.865	8.24	U		#
Potassium-40	pCi/L	12/06/2011	N001	55.9	82	U		#
Promethium-144	pCi/L	12/06/2011	N001	-0.312	4.4	U		#
Promethium-146	pCi/L	12/06/2011	N001	-1.99	4.09	U		#
Ruthenium-106	pCi/L	12/06/2011	N001	-49.2	34.4	U		#
Technetium-99	pCi/L	12/06/2011	N001	126	43.2		J	#
Thorium-234	pCi/L	12/06/2011	N001	-4.54	93.7	U		#
Tritium	pCi/L	12/06/2011	N001	-19.8	202	U		#
Uranium-235	pCi/L	12/06/2011	N001	-21.4	21.8	U		#
Uranium-238	pCi/L	12/06/2011	N001	-4.54	93.7	U		#
Yttrium-88	pCi/L	12/06/2011	N001	-5.7	6.31	U		#

RESULTS REPORT
RIN: 11124229
Site: Rulison Site
Location: BM 26-33C
Ticket Number: JNX 229
Report Date: 2/15/2012

Parameter	Units	Sample Date	Sample ID	Result	TPU ¹	Lab	Qualifiers Data	QA
Actinium-228	pCi/L	12/06/2011	N001	20	21.1	U		#
Americium-241	pCi/L	12/06/2011	N001	9.04	31.2	U		#
Antimony-125	pCi/L	12/06/2011	N001	-5.39	12.2	U		#
Cerium-144	pCi/L	12/06/2011	N001	1.35	20	U		#
Cesium-134	pCi/L	12/06/2011	N001	2.72	4.47	U		#
Cesium-137	pCi/L	12/06/2011	N001	-3.96	5.01	U		#
Chloride	mg/L	12/06/2011	N001	10000				#
Cobalt-60	pCi/L	12/06/2011	N001	-2.17	4.43	U		#
Europium-152	pCi/L	12/06/2011	N001	5.26	26.4	U		#
Europium-154	pCi/L	12/06/2011	N001	0	27.2	U		#
Europium-155	pCi/L	12/06/2011	N001	3.35	14.1	U		#
Gross Alpha	pCi/L	12/06/2011	N001	75.6	33.4		J	#
Gross Beta	pCi/L	12/06/2011	N001	205	48.8			#
Lead-212	pCi/L	12/06/2011	N001	7.55	9.73	U		#
Potassium-40	pCi/L	12/06/2011	N001	7.38	92	U		#
Promethium-144	pCi/L	12/06/2011	N001	5.34	5.27	U		#
Promethium-146	pCi/L	12/06/2011	N001	3.24	5.15	U		#
Ruthenium-106	pCi/L	12/06/2011	N001	-29.5	45.2	U		#
Technetium-99	pCi/L	12/06/2011	N001	29.7	64.1	U		#
Thorium-234	pCi/L	12/06/2011	N001	11.9	111	U		#
Tritium	pCi/L	12/06/2011	N001	-48.1	196	U		#
Uranium-235	pCi/L	12/06/2011	N001	6.72	20.6	U		#
Uranium-238	pCi/L	12/06/2011	N001	11.9	111	U		#
Yttrium-88	pCi/L	12/06/2011	N001	1.77	6.99	U		#

RESULTS REPORT
RIN: 11124229
Site: Rulison Site
Location: BM 26-33D
Ticket Number: JNX 230
Report Date: 2/15/2012

Parameter	Units	Sample Date	Sample ID	Result	TPU ¹	Lab	Qualifiers Data	QA
Actinium-228	pCi/L	12/06/2011	N001	-0.663	28.9	U		#
Americium-241	pCi/L	12/06/2011	N001	-37.2	51.9	U		#
Antimony-125	pCi/L	12/06/2011	N001	-5.01	14.5	U		#
Cerium-144	pCi/L	12/06/2011	N001	-4.21	23.5	U		#
Cesium-134	pCi/L	12/06/2011	N001	-0.91	5.43	U		#
Cesium-137	pCi/L	12/06/2011	N001	-3.9	5.48	U		#
Chloride	mg/L	12/06/2011	N001	2600				#
Cobalt-60	pCi/L	12/06/2011	N001	0.0229	5.69	U		#
Europium-152	pCi/L	12/06/2011	N001	-15	26.9	U		#
Europium-154	pCi/L	12/06/2011	N001	-4.88	29.9	U		#
Europium-155	pCi/L	12/06/2011	N001	13.9	14.3	U		#
Gross Alpha	pCi/L	12/06/2011	N001	9.22	9.69	U		#
Gross Beta	pCi/L	12/06/2011	N001	41.2	14.8		J	#
Lead-212	pCi/L	12/06/2011	N001	-1.45	9.86	U		#
Potassium-40	pCi/L	12/06/2011	N001	-16.9	133	U		#
Promethium-144	pCi/L	12/06/2011	N001	2.52	5.81	U		#
Promethium-146	pCi/L	12/06/2011	N001	-2.84	6.41	U		#
Ruthenium-106	pCi/L	12/06/2011	N001	3.11	51.1	U		#
Technetium-99	pCi/L	12/06/2011	N001	1	7.32	U		#
Thorium-234	pCi/L	12/06/2011	N001	-22.3	112	U		#
Tritium	pCi/L	12/06/2011	N001	84.5	203	U		#
Uranium-235	pCi/L	12/06/2011	N001	16.8	23	U		#
Uranium-238	pCi/L	12/06/2011	N001	-22.3	112	U		#
Yttrium-88	pCi/L	12/06/2011	N001	8.04	5.91	U		#

RESULTS REPORT
RIN: 11124229
Site: Rulison Site
Location: BM 26-34B
Ticket Number: JNX 231
Report Date: 2/15/2012

Parameter	Units	Sample Date	Sample ID	Result	TPU ¹	Lab	Qualifiers Data	QA
Actinium-228	pCi/L	12/06/2011	N001	6.74	23.9	U		#
Americium-241	pCi/L	12/06/2011	N001	-1.13	32	U		#
Antimony-125	pCi/L	12/06/2011	N001	-2.49	13.9	U		#
Cerium-144	pCi/L	12/06/2011	N001	3.67	21.8	U		#
Cesium-134	pCi/L	12/06/2011	N001	-0.39	5.34	U		#
Cesium-137	pCi/L	12/06/2011	N001	-3.1	5.38	U		#
Chloride	mg/L	12/06/2011	N001	11000				#
Cobalt-60	pCi/L	12/06/2011	N001	1.42	5.41	U		#
Europium-152	pCi/L	12/06/2011	N001	-15.7	29.5	U		#
Europium-154	pCi/L	12/06/2011	N001	-28.3	28	U		#
Europium-155	pCi/L	12/06/2011	N001	-11.1	15.1	U		#
Gross Alpha	pCi/L	12/06/2011	N001	70.1	28.3		J	#
Gross Beta	pCi/L	12/06/2011	N001	118	37.6		J	#
Lead-212	pCi/L	12/06/2011	N001	-0.85	9.95	U		#
Potassium-40	pCi/L	12/06/2011	N001	0.176	91	U		#
Promethium-144	pCi/L	12/06/2011	N001	-1.35	6.26	U		#
Promethium-146	pCi/L	12/06/2011	N001	-0.725	5.48	U		#
Ruthenium-106	pCi/L	12/06/2011	N001	24	48	U		#
Technetium-99	pCi/L	12/06/2011	N001	-1280	537	U		#
Thorium-234	pCi/L	12/06/2011	N001	-68.9	100	U		#
Tritium	pCi/L	12/06/2011	N001	-21.7	200	U		#
Uranium-235	pCi/L	12/06/2011	N001	-24.5	27.5	U		#
Uranium-238	pCi/L	12/06/2011	N001	-68.9	100	U		#
Yttrium-88	pCi/L	12/06/2011	N001	3.71	7.66	U		#

RESULTS REPORT
RIN: 11124229
Site: Rulison Site
Location: BM 26-34C
Ticket Number: JNX 232
Report Date: 2/15/2012

Parameter	Units	Sample Date	Sample ID	Result	TPU ¹	Lab	Qualifiers Data	QA
Actinium-228	pCi/L	12/06/2011	N001	10.5	20.7	U		#
Americium-241	pCi/L	12/06/2011	N001	-12.7	32.9	U		#
Antimony-125	pCi/L	12/06/2011	N001	-2.61	11.2	U		#
Cerium-144	pCi/L	12/06/2011	N001	13.7	21.1	U		#
Cesium-134	pCi/L	12/06/2011	N001	-4.3	4.58	U		#
Cesium-137	pCi/L	12/06/2011	N001	1.76	4.33	U		#
Chloride	mg/L	12/06/2011	N001	7300				#
Cobalt-60	pCi/L	12/06/2011	N001	0.91	5.18	U		#
Europium-152	pCi/L	12/06/2011	N001	6.28	24.6	U		#
Europium-154	pCi/L	12/06/2011	N001	16.1	23.9	U		#
Europium-155	pCi/L	12/06/2011	N001	-2.09	13.5	U		#
Gross Alpha	pCi/L	12/06/2011	N001	33.1	19.7		J	#
Gross Beta	pCi/L	12/06/2011	N001	86.6	30.1		J	#
Lead-212	pCi/L	12/06/2011	N001	3.02	11.1	U		#
Potassium-40	pCi/L	12/06/2011	N001	19.1	93	U		#
Promethium-144	pCi/L	12/06/2011	N001	3.56	4.37	U		#
Promethium-146	pCi/L	12/06/2011	N001	1.82	4.98	U		#
Ruthenium-106	pCi/L	12/06/2011	N001	31.6	40.3	U		#
Technetium-99	pCi/L	12/06/2011	N001	-54.7	153	U		#
Thorium-234	pCi/L	12/06/2011	N001	-1.91	97.6	U		#
Tritium	pCi/L	12/06/2011	N001	-145	201	U		#
Uranium-235	pCi/L	12/06/2011	N001	13.1	20.8	U		#
Uranium-238	pCi/L	12/06/2011	N001	-1.91	97.6	U		#
Yttrium-88	pCi/L	12/06/2011	N001	2.8	4.96	U		#

RESULTS REPORT
RIN: 11124229
Site: Rulison Site
Location: BM 26-34D
Ticket Number: JNX 233
Report Date: 2/15/2012

Parameter	Units	Sample Date	ID	Result	TPU ¹	Lab	Qualifiers Data	QA
Actinium-228	pCi/L	12/06/2011	N001	8.14	26.8	U		#
Americium-241	pCi/L	12/06/2011	N001	-7.49	21.1	U		#
Antimony-125	pCi/L	12/06/2011	N001	5.46	9.02	U		#
Cerium-144	pCi/L	12/06/2011	N001	4.02	16.1	U		#
Cesium-134	pCi/L	12/06/2011	N001	-0.11	4.13	U		#
Cesium-137	pCi/L	12/06/2011	N001	-4.32	3.95	U		#
Chloride	mg/L	12/06/2011	N001	13000				#
Cobalt-60	pCi/L	12/06/2011	N001	1.66	4.41	U		#
Europium-152	pCi/L	12/06/2011	N001	1.84	18.2	U		#
Europium-154	pCi/L	12/06/2011	N001	-9.29	20.9	U		#
Europium-155	pCi/L	12/06/2011	N001	-3.6	11.5	U		#
Gross Alpha	pCi/L	12/06/2011	N001	36.9	28.5	U		#
Gross Beta	pCi/L	12/06/2011	N001	170	50.4		J	#
Lead-212	pCi/L	12/06/2011	N001	3.85	7.79	U		#
Potassium-40	pCi/L	12/06/2011	N001	87.1	81.3	U		#
Promethium-144	pCi/L	12/06/2011	N001	2.08	4.33	U		#
Promethium-146	pCi/L	12/06/2011	N001	-1.7	4.59	U		#
Ruthenium-106	pCi/L	12/06/2011	N001	-15.8	36.3	U		#
Technetium-99	pCi/L	12/06/2011	N001	-585	321	U		#
Thorium-234	pCi/L	12/06/2011	N001	-23.6	84.1	U		#
Tritium	pCi/L	12/06/2011	N001	-13.2	196	U		#
Uranium-235	pCi/L	12/06/2011	N001	4.35	14.5	U		#
Uranium-238	pCi/L	12/06/2011	N001	-23.6	84.1	U		#
Yttrium-88	pCi/L	12/06/2011	N001	5.56	4.38	U		#

Gas Phase Sample Results

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-33B
Ticket Number: JNX 218
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.014		#
Nitrogen	percent	12/6/2011	0001	0.093		#
Carbon Dioxide	percent	12/6/2011	0001	3.10		#
Methane	percent	12/6/2011	0001	89.91		#
Ethane	percent	12/6/2011	0001	4.56		#
Ethene	percent	12/6/2011	0001	0.0008		#
Propane	percent	12/6/2011	0001	1.24		#
Propene	percent	12/6/2011	0001	0.0005		#
Isobutane	percent	12/6/2011	0001	0.275		#
Butane	percent	12/6/2011	0001	0.262		#
Isopentane	percent	12/6/2011	0001	0.114		#
Pentane	percent	12/6/2011	0001	0.0858		#
Hexanes	percent	12/6/2011	0001	0.344		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0514	U	#

¹ Not detected.

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-33C
Ticket Number: JNX 219
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.021		#
Nitrogen	percent	12/6/2011	0001	0.12		#
Carbon Dioxide	percent	12/6/2011	0001	5.30		#
Methane	percent	12/6/2011	0001	88.04		#
Ethane	percent	12/6/2011	0001	4.77		#
Ethene	percent	12/6/2011	0001	0.0009		#
Propane	percent	12/6/2011	0001	0.965		#
Propene	percent	12/6/2011	0001	0.0002		#
Isobutane	percent	12/6/2011	0001	0.242		#
Butane	percent	12/6/2011	0001	0.166		#
Isopentane	percent	12/6/2011	0001	0.0786		#
Pentane	percent	12/6/2011	0001	0.0552		#
Hexanes	percent	12/6/2011	0001	0.245		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0540	U	#

¹ Not detected.

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-33D
Ticket Number: JNX 220
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.006		#
Nitrogen	percent	12/6/2011	0001	0.074		#
Carbon Dioxide	percent	12/6/2011	0001	3.26		#
Methane	percent	12/6/2011	0001	89.46		#
Ethane	percent	12/6/2011	0001	4.77		#
Ethene	percent	12/6/2011	0001	0.0009		#
Propane	percent	12/6/2011	0001	1.36		#
Propene	percent	12/6/2011	0001	0.0002		#
Isobutane	percent	12/6/2011	0001	0.270		#
Butane	percent	12/6/2011	0001	0.261		#
Isopentane	percent	12/6/2011	0001	0.113		#
Pentane	percent	12/6/2011	0001	0.0871		#
Hexanes	percent	12/6/2011	0001	0.335		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0514	U	#

¹ Not detected.

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-34A
Ticket Number: JNX 221
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.016		#
Nitrogen	percent	12/6/2011	0001	0.091		#
Carbon Dioxide	percent	12/6/2011	0001	2.64		#
Methane	percent	12/6/2011	0001	90.21		#
Ethane	percent	12/6/2011	0001	4.53		#
Ethene	percent	12/6/2011	0001	0.0010		#
Propane	percent	12/6/2011	0001	1.33		#
Propene	percent	12/6/2011	0001	0.0002		#
Isobutane	percent	12/6/2011	0001	0.293		#
Butane	percent	12/6/2011	0001	0.343		#
Isopentane	percent	12/6/2011	0001	0.121		#
Pentane	percent	12/6/2011	0001	0.0914		#
Hexanes	percent	12/6/2011	0001	0.333		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0514	U	#

¹ Not detected.

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-34B
Ticket Number: JNX 222
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.052		#
Nitrogen	percent	12/6/2011	0001	0.23		#
Carbon Dioxide	percent	12/6/2011	0001	3.16		#
Methane	percent	12/6/2011	0001	89.65		#
Ethane	percent	12/6/2011	0001	4.50		#
Ethene	percent	12/6/2011	0001	0.0007		#
Propane	percent	12/6/2011	0001	1.24		#
Propene	percent	12/6/2011	0001	0.0006		#
Isobutane	percent	12/6/2011	0001	0.281		#
Butane	percent	12/6/2011	0001	0.276		#
Isopentane	percent	12/6/2011	0001	0.127		#
Pentane	percent	12/6/2011	0001	0.100		#
Hexanes	percent	12/6/2011	0001	0.386		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0514	U	#

¹ Not detected.

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-34C
Ticket Number: JNX 223
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.020		#
Nitrogen	percent	12/6/2011	0001	0.10		#
Carbon Dioxide	percent	12/6/2011	0001	3.46		#
Methane	percent	12/6/2011	0001	89.85		#
Ethane	percent	12/6/2011	0001	4.46		#
Ethene	percent	12/6/2011	0001	0.0009		#
Propane	percent	12/6/2011	0001	1.23		#
Propene	percent	12/6/2011	0001	0.0005		#
Isobutane	percent	12/6/2011	0001	0.247		#
Butane	percent	12/6/2011	0001	0.236		#
Isopentane	percent	12/6/2011	0001	0.0909		#
Pentane	percent	12/6/2011	0001	0.0651		#
Hexanes	percent	12/6/2011	0001	0.236		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0514	U	#

¹ Not detected.

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-34D
Ticket Number: JNX 224
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.015		#
Nitrogen	percent	12/6/2011	0001	0.079		#
Carbon Dioxide	percent	12/6/2011	0001	4.32		#
Methane	percent	12/6/2011	0001	89.45		#
Ethane	percent	12/6/2011	0001	4.18		#
Ethene	percent	12/6/2011	0001	0.0009		#
Propane	percent	12/6/2011	0001	1.03		#
Propene	percent	12/6/2011	0001	0.0002		#
Isobutane	percent	12/6/2011	0001	0.251		#
Butane	percent	12/6/2011	0001	0.220		#
Isopentane	percent	12/6/2011	0001	0.104		#
Pentane	percent	12/6/2011	0001	0.0729		#
Hexanes	percent	12/6/2011	0001	0.280		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0514	U	#

¹ Not detected.

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-22B
Ticket Number: JNX 225
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.013		#
Nitrogen	percent	12/6/2011	0001	0.099		#
Carbon Dioxide	percent	12/6/2011	0001	5.30		#
Methane	percent	12/6/2011	0001	89.03		#
Ethane	percent	12/6/2011	0001	3.84		#
Ethene	percent	12/6/2011	0001	0.0010		#
Propane	percent	12/6/2011	0001	0.772		#
Propene	percent	12/6/2011	0001	0.0001		#
Isobutane	percent	12/6/2011	0001	0.194		#
Butane	percent	12/6/2011	0001	0.134		#
Isopentane	percent	12/6/2011	0001	0.0718		#
Pentane	percent	12/6/2011	0001	0.0495		#
Hexanes	percent	12/6/2011	0001	0.492		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0514	U	#

¹ Not detected.

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-22C
Ticket Number: JNX 226
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.011		#
Nitrogen	percent	12/6/2011	0001	0.084		#
Carbon Dioxide	percent	12/6/2011	0001	3.60		#
Methane	percent	12/6/2011	0001	89.71		#
Ethane	percent	12/6/2011	0001	4.32		#
Ethene	percent	12/6/2011	0001	0.0011		#
Propane	percent	12/6/2011	0001	1.23		#
Propene	percent	12/6/2011	0001	nd ¹		#
Isobutane	percent	12/6/2011	0001	0.263		#
Butane	percent	12/6/2011	0001	0.260		#
Isopentane	percent	12/6/2011	0001	0.111		#
Pentane	percent	12/6/2011	0001	0.0813		#
Hexanes	percent	12/6/2011	0001	0.329		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0514	U	#

¹ Not detected.

RESULTS REPORT
RIN: 11124228
Site: Rulison Site
Location: BM 26-22D
Ticket Number: JNX 227
Report Date: 2/15/2012

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	percent	12/6/2011	0001	nd ¹		#
Argon+Oxygen	percent	12/6/2011	0001	0.009		#
Nitrogen	percent	12/6/2011	0001	0.083		#
Carbon Dioxide	percent	12/6/2011	0001	3.93		#
Methane	percent	12/6/2011	0001	89.72		#
Ethane	percent	12/6/2011	0001	4.11		#
Ethene	percent	12/6/2011	0001	0.0010		#
Propane	percent	12/6/2011	0001	1.06		#
Propene	percent	12/6/2011	0001	nd ¹		#
Isobutane	percent	12/6/2011	0001	0.237		#
Butane	percent	12/6/2011	0001	0.240		#
Isopentane	percent	12/6/2011	0001	0.112		#
Pentane	percent	12/6/2011	0001	0.0893		#
Hexanes	percent	12/6/2011	0001	0.405		#
Carbon-14	Percent modern carbon	12/6/2011	0001	0.2	U	#
Tritium	pCi/L methane	12/6/2011	0001	0.0514	U	#

¹ Not detected.