

**Monitoring Results for  
Natural Gas Wells  
near Project Rulison  
Fourth Quarter 2012 and First Quarter 2013**

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

**Date Sampled:** January 10, 2013

**Background:**

Project Rulison was the second Plowshare Program test to stimulate natural-gas recovery from deep and low-permeability formations. On September 10, 1969, a 40-kiloton-yield nuclear device was detonated 8,426 feet (1.6 miles) below the ground surface in the Williams Fork Formation, at what is now the Rulison, Colorado, Site. Following the detonation, a series of production tests were conducted. Afterward, the site was shut down and then remediated, and the emplacement well (R-E) and the reentry well (R-Ex) were plugged.

**Purpose:**

As part of the U.S. Department of Energy (DOE) Office of Legacy Management (LM) mission to protect human health and the environment, LM will monitor natural gas wells that are near the Rulison site for radionuclides associated with the detonation. While the very low permeability of Williams Fork Formation limits migration, institutional-control restrictions limit subsurface access in the detonation zone. Oversight is permitted for wells within 3 miles of the site, which allows the State of Colorado and DOE to review drilling permits and gas-well development practices to help protect human health and the environment from the Rulison-related contaminants. The DOE *Rulison Monitoring Plan* (LMS/RUL/S06178) provides guidance for sample collection frequency, based on distance from the Rulison detonation point, the types of analyses, and the reporting thresholds.

**Summary of Results:**

Of the 13 wells sampled for gas and water, no analytical result exceeded the screening levels specified in the DOE *Rulison Monitoring Plan*. The gas- and liquid-phase levels are shown in Table 3a and Table 3b, respectively.

**Samples Collected:**

The fourth quarter sampling was delayed twice—once due to operational road construction in September 2012, and once due to a winter storm on December 18, 2012. As a result, the sampling scheduled for the fourth quarter of 2012 did not occur until early in the first quarter of 2013. During the sampling event conducted on January 10, 2013, 13 gas samples and 10 produced-water samples were collected from 13 gas wells identified in the fourth-quarter

sample plan. Two of the wells on Pad 26N and one well on Pad 26K produced no water. The 13 wells are listed in Table 1. Sample collection information is listed in Table 2, ordered by sample collection sequence.

*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
35C	Well head separator	BM 35-32A
36L	Well head separator	BM 36-13B
36B	Well head separator	BM 36-13

*Table 2. Sample Collection Information*

Seq.	Pad	Well Name	Location			Sample Phase		Well	
			API # 05-045-	Type	Subtype	Gas	Liquid	T (°F)	P (psi)
1	26N	BM 26-33B	15743	WL	NGSA	Yes	Yes	60.8	177.7
2	26N	BM 26-33C	15742	WL	NGSA	Yes	Yes	68.8	241.7
3	26N	BM 26-33D	15739	WL	NGSA	Yes	No	77.5	287.4
4	26N	BM 26-34A	15744	WL	NGSA	Yes	No	74.4	285.4
5	26N	BM 26-34B	15745	WL	NGSA	Yes	Yes	59.5	285.8
6	26N	BM 26-34C	15741	WL	NGSA	Yes	Yes	56.6	261.8
7	26N	BM 26-34D	15748	WL	NGSA	Yes	Yes	56.6	237.4
8	26K	BM 26-22B	16086	WL	NGSA	Yes	No	68.7	266.7
9	26K	BM 26-22C	16087	WL	NGSA	Yes	Yes	66.8	262.7
10	26K	BM 26-22D	16074	WL	NGSA	Yes	Yes	76.0	287.1
11	35C	BM 35-32A	10919	WL	NGSV	Yes	Yes	65.5	274.5
12	36L	BM 36-13B	15469	WL	NGSV	Yes	Yes	67.5	286.0
13	36B	BM 36-13	10840	WL	NGSV	Yes	Yes	61.1	308.1

**Abbreviations:**

API American Petroleum Institute  
 BM Battlement Mesa  
 NGSA natural gas well – angle  
 P pressure  
 psi pounds per square inch  
 Seq. sequence  
 T temperature  
 WL well location

**Sample Locations:**

The bottom-hole locations of the 13 gas wells sampled in January are between 0.55 and 1.07 miles from the Project Rulison detonation point. All gas wells sampled were producing gas from the Williams Fork Formation at a depth near the Rulison detonation point.

*Rulison Surface Collection Locations*

Pad	Location				Pad Elevation (feet)	Surface Location		Comment
	Q-Q	S	T	R		Latitude (NAD 83)	Longitude (NAD 83)	
26K	NWSW	26	7S	95W	8,983.5	39.405750	-107.970095	Surface location is for BM 26-22D well head.
26N	SESW	26	7S	95W	8,964	39.404547	-107.967268	BM 26-33B well head location; some well heads are in NESW.
35C	NENW	36	7S	95W	9,236	39.398911	-107.966542	Surface location is for BM 35-32A well head.
36L	NWSW	36	7S	95W	8,901	39.392146	-107.952819	Surface location is for BM 36-13B well head.
36B	NWNE	36	7S	95W	8,683	39.398165	-107.943943	Surface location is for BM 36-13 well head.

**Abbreviations:**

BM Battlement Mesa  
 NAD 83 North American Datum of 1983  
 Q-Q Quarter-quarter section  
 R Range  
 S Section  
 T Township

*Rulison Bottom-Hole Locations*

Pad	Well Name	API # 05-045	Total Depth (ft)	Location				Rulison GZ to BHL		Comment
				Q-Q	S	Latitude (NAD 83)	Longitude (NAD 83)	Distance (miles)	Heading (degs)	
	25-95 (R-E)	06002	8,701	NENW	25	39.405361	-107.948444	0		Ground Zero (GZ); vertical well
26N	BM 26-33B	15743	9,966	NWSE	26	39.406892	-107.962558	0.76	W9.5°N	
26N	BM 26-33C	15742	10,072	NWSE	26	39.406006	-107.962544	0.76	W4.9°N	
26N	BM 26-33D	15739	10,068	NWSE	26	39.405124	-107.962544	0.75	W0.3°N	
26N	BM 26-34A	15744	10,087	SWSE	26	39.404311	-107.962565	0.76	S86.1°W	
26N	BM 26-34B	15745	10,046	SWSE	26	39.403498	-107.962561	0.77	S81.9°W	
26N	BM 26-34C	15741	9,986	SWSE	26	39.402515	-107.962576	0.78	S77.0°W	
26N	BM 26-34D	15748	9,986	SWSE	26	39.401665	-107.964508	0.90	S75.0°W	
26K	BM 26-22B	16086	10,094	SESW	26	39.410530	-107.967228	1.07	W21.1°N	
26K	BM 26-22C	16087	10,047	SESW	26	39.409618	-107.967223	1.05	W17.8°N	
26K	BM 26-22D	16074	10,057	SESW	26	39.408687	-107.967163	1.03	W14.6°N	
35C	BM 35-32A	10919	10,278	SWNE	35	39.397066	-107.962633	0.95	S54.5°W	
36L	BM 36-13B	15469	10,123	NWSW	36	39.392109	-107.952831	0.94	S16.0°W	
36B	BM 36-13	10840	8,903	NWNE	36	39.398165	-107.943943	0.55	S24.3°E	

**Abbreviations:**

API American Petroleum Institute  
 BHL Bottom-hole location  
 degs degrees  
 ft feet  
 BM Battlement Mesa  
 GZ Ground Zero

**Sample Collection:**

A produced-water sample is collected at the well head from a tap on the common line connecting two gas-liquid separators and the accumulation tank. The produced water collected from one well separator is isolated from the other well separator by valves. Lines from each of the two separators are purged of produced water and condensate prior to sample collection. Each sample is collected in a new 1-gallon plastic container.

A gas sample is collected from a tap on the gas line at the separator output. The line between the tap and the sample bottle is purged before sample collection. Each gas sample is collected in an evacuated 18-liter bottle furnished by the laboratory.

**Monitoring Protocol:**

The *Rulison Monitoring Plan* 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 Concentrations for Tritium Sample Results*

Analyte	Reporting Units	Screening Concentration	Action Concentration	Comment
Tritium	TU	19,293	TBD	$5.183 \times 10^{-6}$ pCi/cc/TU

**Abbreviations:**

pCi/cc/TU    picocuries per cubic centimeter of methane gas per tritium unit  
 TBD        to be determined  
 TU         tritium unit

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

Analyte	Reporting Units	Screening Concentration	Action Concentration	Comment
Tritium	pCi/L	800	TBD	20,000 pCi/L = EPA drinking water standard
<b>Lab Method</b>				
Gross alpha	pCi/L	3 × background	TBD	
Gross beta	pCi/L	3 × background	TBD	
High-resolution gamma spectrometry	pCi/L	20	TBD	Based on cesium-137

**Notes:**

See the *Rulison Monitoring Plan*, Table 2, for response scenarios to use when the screening and/or action concentrations are exceeded.  
 The derived air effluent concentration for a 50 millirems per year (mrem/year) dose from tritium exposure is 0.10 pCi (tritium) /cc (methane).

**Abbreviations:**

EPA        U.S. Environmental Protection Agency  
 pCi/L     picocuries per liter of water  
 TBD        to be determined

**Results:**

Thirteen gas samples were collected from 13 producing gas wells within the monitoring area. Ten produced water samples were collected from 10 of the 13 gas wells.

Gas and water analytic results are tabulated by well in Appendix A and Appendix B, respectively.

**Laboratory Qualifiers:**

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

A “non-detect” is a result that is less than the laboratory’s MDC for that sample. The laboratory assigns the qualifier “U” to a “non-detect” result.

**Data Validation Qualifiers:**

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

A laboratory “detect” result less than three times the one-sigma total propagated uncertainty is considered a “non-detect.” Data validation assigns qualifier “U” to that type of result.

**Results Summaries:**

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

*Table 4a. Summary of Tritium and 14C Samples, Based on Laboratory-Assigned Qualifiers*

Collection Location	Total Samples (gas/liquid)	Tritium and 14C Results (gas phase)			Tritium and 14C Results (liquid phase)		
		Detect	Non-Detect	NA	Detect	Non-Detect	NA
Natural gas wells	13/13	0	13	0	0	10	0
Collection Location	Total Samples (gas/liquid)	14C Results (gas phase)			14C Results (liquid phase)		
Natural gas wells	13	1	12	0	0	0	0

**Abbreviation:**

NA Missing or not applicable

Data validation assigned “J” to the gas detect result.

14C from well BM 36-13 will be resampled to confirm results from this sampling event.

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

Collection Location	Total Liquid Samples	Gross Alpha Results			Gross Beta Results		
		Detect	Non-detect	NA	Detect	Non-detect	NA
Natural gas wells	10	7	2	10	9	0	1

**Abbreviation:**

NA Missing or not applicable

Data validation assigned “J” to seven of the nine gross-alpha “detect” results.

Data validation assigned “J” to five of the nine gross-beta “detect” results.

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

Collection Location	Total Samples	Potassium-40 Results		
		Detect	Non-Detect	NA
Natural gas wells	10	9	0	1

**Abbreviation:**

NA Missing or not applicable

Data validation assigned “J” to four of the nine potassium-40 detect results.

## **Appendix A**

### **Liquid-Phase Sample Results**

**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-10840 WELL Battlement Mesa 36-13**

Parameter	Units	Sample		Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID		Lab	Data	QA		
Actinium-228	pCi/L	01/10/2013	N001	18.3	U		#	37	22.6
Americium-241	pCi/L	01/10/2013	N001	-536	U		#	6.4	3.71
Antimony-125	pCi/L	01/10/2013	N001	1.61	U		#	15	7.58
Cerium-144	pCi/L	01/10/2013	N001	-814	U		#	22	12.7
Cesium-134	pCi/L	01/10/2013	N001	-1.07	U		#	6	3.47
Cesium-137	pCi/L	01/10/2013	N001	1.21	U		#	5.8	3.41
Chloride	mg/L	01/10/2013	N001	9800			#	200	
Cobalt-60	pCi/L	01/10/2013	N001	1.22	U		#	6.9	4.04
Europium-152	pCi/L	01/10/2013	N001	-2.6	U		#	33	18.3
Europium-154	pCi/L	01/10/2013	N001	10.5	U		#	33	19.9
Europium-155	pCi/L	01/10/2013	N001	3.41	U		#	11	6.58
Gross Alpha	pCi/L	01/10/2013	N001	47.1	U		#	48	31.5
Gross Beta	pCi/L	01/10/2013	N001	133		J	#	55	41.1
Lead-212	pCi/L	01/10/2013	N001	-1	U		#	12	7.39
Potassium-40	pCi/L	01/10/2013	N001	83.4	U		#	140	83.3
Promethium-144	pCi/L	01/10/2013	N001	1.32	U		#	6.2	3.66
Promethium-146	pCi/L	01/10/2013	N001	-.33	U		#	6.6	3.8
Ruthenium-106	pCi/L	01/10/2013	N001	-6.49	U		#	56	32.1
Thorium-234	pCi/L	01/10/2013	N001	30	U		#	80	41.4
Tritium	pCi/L	01/10/2013	N001	-3.01	U		#	370	217
Uranium-235	pCi/L	01/10/2013	N001	-11.2	U		#	41	24.3
Yttrium-88	pCi/L	01/10/2013	N001	-1.76	U		#	12	6.96



**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-10919 WELL Battlement Mesa 35-32A**

Parameter	Units	Sample		Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID		Lab	Data	QA		
Actinium-228	pCi/L	01/10/2013	N001	10.9	U		#	38	17.5
Americium-241	pCi/L	01/10/2013	N001	-8.35	U		#	43	25.2
Antimony-125	pCi/L	01/10/2013	N001	-.24	U		#	18	10.3
Cerium-144	pCi/L	01/10/2013	N001	4.09	U		#	35	20.7
Cesium-134	pCi/L	01/10/2013	N001	-3.8	U		#	7.6	4.29
Cesium-137	pCi/L	01/10/2013	N001	-1.47	U		#	7.3	4.17
Chloride	mg/L	01/10/2013	N001	9500			#	200	
Cobalt-60	pCi/L	01/10/2013	N001	-3.29	U		#	8.7	4.74
Europium-152	pCi/L	01/10/2013	N001	-2.62	U		#	43	24.4
Europium-154	pCi/L	01/10/2013	N001	-29.1	U		#	59	31.7
Europium-155	pCi/L	01/10/2013	N001	3.28	U		#	18	10.7
Gross Alpha	pCi/L	01/10/2013	N001	73.6		J	#	45	33.1
Gross Beta	pCi/L	01/10/2013	N001	194			#	51	46
Lead-212	pCi/L	01/10/2013	N001	-.536	U		#	13	7.94
Potassium-40	pCi/L	01/10/2013	N001	126	U		#	150	92.5
Promethium-144	pCi/L	01/10/2013	N001	0.677	U		#	7.6	4.47
Promethium-146	pCi/L	01/10/2013	N001	0.857	U		#	8.1	4.77
Ruthenium-106	pCi/L	01/10/2013	N001	-40.3	U		#	69	38.2
Thorium-234	pCi/L	01/10/2013	N001	51.1	U		#	150	89.7
Tritium	pCi/L	01/10/2013	N001	-24.2	U		#	370	217
Uranium-235	pCi/L	01/10/2013	N001	11.2	U		#	33	20.1
Yttrium-88	pCi/L	01/10/2013	N001	0.892	U		#	10	6.09

**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-15469 WELL Battlement Mesa 36-13B**

Parameter	Units	Sample		Result	Qualifiers		Detection Limit	Uncertainty
		Date	ID		Lab	Data QA		
Actinium-228	pCi/L	01/10/2013	N001	21.2	U	#	31	16.8
Americium-241	pCi/L	01/10/2013	N001	-469	U	#	8.4	4.94
Antimony-125	pCi/L	01/10/2013	N001	6.13	U	#	15	9.08
Cerium-144	pCi/L	01/10/2013	N001	-9.23	U	#	29	16.7
Cesium-134	pCi/L	01/10/2013	N001	-1.25	U	#	7.1	4.09
Cesium-137	pCi/L	01/10/2013	N001	-2.09	U	#	7.5	4.2
Chloride	mg/L	01/10/2013	N001	8000		#	200	
Cobalt-60	pCi/L	01/10/2013	N001	1.57	U	#	7.4	4.29
Europium-152	pCi/L	01/10/2013	N001	-3.39	U	#	41	22.7
Europium-154	pCi/L	01/10/2013	N001	-29	U	#	45	23.4
Europium-155	pCi/L	01/10/2013	N001	2.27	U	#	12	7.14
Gross Alpha	pCi/L	01/10/2013	N001	63.5		J #	45	31
Gross Beta	pCi/L	01/10/2013	N001	136		#	45	36.3
Lead-212	pCi/L	01/10/2013	N001	-.473	U	#	14	8.54
Potassium-40	pCi/L	01/10/2013	N001	49.1	U	#	150	89.1
Promethium-144	pCi/L	01/10/2013	N001	-.375	U	#	12	7.08
Promethium-146	pCi/L	01/10/2013	N001	-1.52	U	#	7.7	4.38
Ruthenium-106	pCi/L	01/10/2013	N001	-5.87	U	#	62	35.2
Thorium-234	pCi/L	01/10/2013	N001	-31.1	U	#	98	58.3
Tritium	pCi/L	01/10/2013	N001	-127	U	#	370	218
Uranium-235	pCi/L	01/10/2013	N001	13.9	U	#	35	17.9
Yttrium-88	pCi/L	01/10/2013	N001	4.99	U	#	7.6	4.77

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**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-15741 WELL Battlement Mesa 26-34C**

Parameter	Units	Sample		Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID		Lab	Data	QA		
Chloride	mg/L	01/10/2013	N001	9500			#	200	
Tritium	pCi/L	01/10/2013	N001	-80.1	U		#	370	220

**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-15742 WELL Battlement Mesa 26-33C**

Parameter	Units	Sample		Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID		Lab	Data	QA		
Actinium-228	pCi/L	01/10/2013	N001	25.6	U		#	30	15.8
Americium-241	pCi/L	01/10/2013	N001	3.87	U		#	8.5	5.15
Antimony-125	pCi/L	01/10/2013	N001	4.76	U		#	15	7.58
Cerium-144	pCi/L	01/10/2013	N001	-12.1	U		#	29	16.9
Cesium-134	pCi/L	01/10/2013	N001	0.792	U		#	6.7	3.95
Cesium-137	pCi/L	01/10/2013	N001	-3.9	U		#	7.4	4.04
Chloride	mg/L	01/10/2013	N001	10000			#	200	
Cobalt-60	pCi/L	01/10/2013	N001	-585	U		#	8.6	4.78
Europium-152	pCi/L	01/10/2013	N001	1.13	U		#	40	22.3
Europium-154	pCi/L	01/10/2013	N001	-5.8	U		#	42	23.2
Europium-155	pCi/L	01/10/2013	N001	0.574	U		#	12	6.92
Gross Alpha	pCi/L	01/10/2013	N001	79.4		J	#	49	35.5
Gross Beta	pCi/L	01/10/2013	N001	194			#	58	48.8
Lead-212	pCi/L	01/10/2013	N001	-.161	U		#	14	8.5
Potassium-40	pCi/L	01/10/2013	N001	128	U		#	150	96.3
Promethium-144	pCi/L	01/10/2013	N001	0.575	U		#	12	7.33
Promethium-146	pCi/L	01/10/2013	N001	-3.08	U		#	7.5	4.19
Ruthenium-106	pCi/L	01/10/2013	N001	-3.51	U		#	67	38.8
Thorium-234	pCi/L	01/10/2013	N001	-18.1	U		#	94	56.2
Tritium	pCi/L	01/10/2013	N001	-200	U		#	370	215
Uranium-235	pCi/L	01/10/2013	N001	10.3	U		#	34	20.3
Yttrium-88	pCi/L	01/10/2013	N001	2.46	U		#	7.7	4.61

**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-15743 WELL Battlement Mesa 26-33B**

Parameter	Units	Sample		Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID		Lab	Data	QA		
Actinium-228	pCi/L	01/10/2013	N001	17	U		#	34	16.2
Americium-241	pCi/L	01/10/2013	N001	-3.59	U		#	6.7	3.8
Antimony-125	pCi/L	01/10/2013	N001	2.23	U		#	14	8.47
Cerium-144	pCi/L	01/10/2013	N001	16.3	U		#	22	13.4
Cesium-134	pCi/L	01/10/2013	N001	-1.79	U		#	6.4	3.65
Cesium-137	pCi/L	01/10/2013	N001	-1.21	U		#	6.3	3.56
Chloride	mg/L	01/10/2013	N001	9400			#	200	
Cobalt-60	pCi/L	01/10/2013	N001	0	U		#	7.1	4.02
Europium-152	pCi/L	01/10/2013	N001	-8.66	U		#	33	18
Europium-154	pCi/L	01/10/2013	N001	-9.74	U		#	37	20.5
Europium-155	pCi/L	01/10/2013	N001	-.991	U		#	11	6.39
Gross Alpha	pCi/L	01/10/2013	N001	55		J	#	40	27.8
Gross Beta	pCi/L	01/10/2013	N001	86.4		J	#	47	32.6
Lead-212	pCi/L	01/10/2013	N001	1.42	U		#	12	7.43
Potassium-40	pCi/L	01/10/2013	N001	45.4	U		#	130	80.8
Promethium-144	pCi/L	01/10/2013	N001	1.01	U		#	6.2	3.67
Promethium-146	pCi/L	01/10/2013	N001	-2.47	U		#	7.2	4.08
Ruthenium-106	pCi/L	01/10/2013	N001	10.2	U		#	57	33.7
Thorium-234	pCi/L	01/10/2013	N001	35.9	U		#	80	48.9
Tritium	pCi/L	01/10/2013	N001	-220	U		#	370	216
Uranium-235	pCi/L	01/10/2013	N001	11.8	U		#	22	13.7
Yttrium-88	pCi/L	01/10/2013	N001	-.47	U		#	12	6.86

**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-15745 WELL Battlement Mesa 26-34B**

Parameter	Units	Sample		Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID		Lab	Data	QA		
Actinium-228	pCi/L	01/10/2013	N001	12.4	U		#	44	26.3
Americium-241	pCi/L	01/10/2013	N001	-4.7	U		#	36	20.9
Antimony-125	pCi/L	01/10/2013	N001	-3.84	U		#	17	9.32
Cerium-144	pCi/L	01/10/2013	N001	1.3	U		#	30	17.5
Cesium-134	pCi/L	01/10/2013	N001	-887	U		#	6.9	3.97
Cesium-137	pCi/L	01/10/2013	N001	-.54	U		#	6.9	3.91
Chloride	mg/L	01/10/2013	N001	10000			#	200	
Cobalt-60	pCi/L	01/10/2013	N001	-606	U		#	8.5	4.8
Europium-152	pCi/L	01/10/2013	N001	12	U		#	34	20.5
Europium-154	pCi/L	01/10/2013	N001	-13.4	U		#	40	21.9
Europium-155	pCi/L	01/10/2013	N001	5.08	U		#	16	9.78
Gross Alpha	pCi/L	01/10/2013	N001	68.5		J	#	42	31.2
Gross Beta	pCi/L	01/10/2013	N001	125		J	#	54	40.1
Lead-212	pCi/L	01/10/2013	N001	0.188	U		#	13	7.88
Potassium-40	pCi/L	01/10/2013	N001	104	U		#	130	82
Promethium-144	pCi/L	01/10/2013	N001	-2.73	U		#	7.6	4.24
Promethium-146	pCi/L	01/10/2013	N001	0.394	U		#	7.7	4.49
Ruthenium-106	pCi/L	01/10/2013	N001	-17.2	U		#	65	36.5
Thorium-234	pCi/L	01/10/2013	N001	4	U		#	150	88.7
Tritium	pCi/L	01/10/2013	N001	-16.3	U		#	370	221
Uranium-235	pCi/L	01/10/2013	N001	4.28	U		#	35	21.1
Yttrium-88	pCi/L	01/10/2013	N001	0.172	U		#	8.6	4.93

**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-15748 WELL Battlement Mesa 26-34D**

Parameter	Units	Sample		Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID		Lab	Data	QA		
Actinium-228	pCi/L	01/10/2013	N001	21.7	U		#	31	12.9
Americium-241	pCi/L	01/10/2013	N001	-28.6	U		#	85	49.7
Antimony-125	pCi/L	01/10/2013	N001	4.27	U		#	17	9.04
Cerium-144	pCi/L	01/10/2013	N001	5.2	U		#	36	21.2
Cesium-134	pCi/L	01/10/2013	N001	-2.65	U		#	7.6	4.28
Cesium-137	pCi/L	01/10/2013	N001	1.08	U		#	7.4	4.38
Chloride	mg/L	01/10/2013	N001	9800			#	200	
Cobalt-60	pCi/L	01/10/2013	N001	-508	U		#	8.1	4.55
Europium-152	pCi/L	01/10/2013	N001	37.3	NQ	U	#	37	24.4
Europium-154	pCi/L	01/10/2013	N001	9.17	U		#	41	24.1
Europium-155	pCi/L	01/10/2013	N001	8.12	U		#	20	12.3
Gross Alpha	pCi/L	01/10/2013	N001	61		J	#	43	30.4
Gross Beta	pCi/L	01/10/2013	N001	122		J	#	53	38.8
Lead-212	pCi/L	01/10/2013	N001	2.62	U		#	15	8.78
Potassium-40	pCi/L	01/10/2013	N001	119	U		#	140	86.8
Promethium-144	pCi/L	01/10/2013	N001	-4.14	U		#	19	11.2
Promethium-146	pCi/L	01/10/2013	N001	-2.59	U		#	8.2	4.66
Ruthenium-106	pCi/L	01/10/2013	N001	-2.06	U		#	64	36.8
Thorium-234	pCi/L	01/10/2013	N001	-54.6	U		#	190	111
Tritium	pCi/L	01/10/2013	N001	-186	U		#	370	215
Uranium-235	pCi/L	01/10/2013	N001	17	U		#	32	19.5
Yttrium-88	pCi/L	01/10/2013	N001	-2.04	U		#	14	8.13

**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-16074 WELL Battlement Mesa 26-22D**

Parameter	Units	Sample		Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID		Lab	Data	QA		
Actinium-228	pCi/L	01/10/2013	N001	30.3	TI	J	#	26	11.5
Americium-241	pCi/L	01/10/2013	N001	26.2	U		#	36	22.7
Antimony-125	pCi/L	01/10/2013	N001	0.343	U		#	15	8.58
Cerium-144	pCi/L	01/10/2013	N001	2.74	U		#	42	24.9
Cesium-134	pCi/L	01/10/2013	N001	-1.28	U		#	7.6	4.38
Cesium-137	pCi/L	01/10/2013	N001	-3.52	U		#	7.1	3.91
Chloride	mg/L	01/10/2013	N001	13000			#	200	
Cobalt-60	pCi/L	01/10/2013	N001	3.29	U		#	6.8	4.18
Europium-152	pCi/L	01/10/2013	N001	10.9	U		#	40	23.7
Europium-154	pCi/L	01/10/2013	N001	-5.78	U		#	40	22.2
Europium-155	pCi/L	01/10/2013	N001	-6.13	U		#	18	10
Gross Alpha	pCi/L	01/10/2013	N001	76.6		J	#	66	44.4
Gross Beta	pCi/L	01/10/2013	N001	297			#	78	69.8
Lead-212	pCi/L	01/10/2013	N001	5.95	U		#	14	8.2
Potassium-40	pCi/L	01/10/2013	N001	162		J	#	130	85.2
Promethium-144	pCi/L	01/10/2013	N001	0.475	U		#	7.1	4.17
Promethium-146	pCi/L	01/10/2013	N001	2.21	U		#	6.8	4.08
Ruthenium-106	pCi/L	01/10/2013	N001	-15.6	U		#	65	37
Thorium-234	pCi/L	01/10/2013	N001	-19.2	U		#	140	85.8
Tritium	pCi/L	01/10/2013	N001	-202	U		#	360	213
Uranium-235	pCi/L	01/10/2013	N001	-2.78	U		#	37	21.6
Yttrium-88	pCi/L	01/10/2013	N001	0.643	U		#	7.7	4.46



**General Water Quality Data by Location (USEE105) FOR SITE RUL01, Rulison Site**  
**REPORT DATE: 04/24/2013**  
**Location: 05-045-16087 WELL Battlement Mesa 26-22C**

Parameter	Units	Sample		Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID		Lab	Data	QA		
Actinium-228	pCi/L	01/10/2013	N001	16.4	U	#	40	18.2	
Americium-241	pCi/L	01/10/2013	N001	29.7	U	#	70	42.7	
Antimony-125	pCi/L	01/10/2013	N001	1.35	U	#	20	11	
Cerium-144	pCi/L	01/10/2013	N001	-5.77	U	#	36	21	
Cesium-134	pCi/L	01/10/2013	N001	-3.75	U	#	8	4.46	
Cesium-137	pCi/L	01/10/2013	N001	2.58	U	#	7.8	4.65	
Chloride	mg/L	01/10/2013	N001	10000	N	#	200		
Cobalt-60	pCi/L	01/10/2013	N001	-2.89	U	#	8.5	4.5	
Europium-152	pCi/L	01/10/2013	N001	5.68	U	#	20	10.6	
Europium-154	pCi/L	01/10/2013	N001	-15.1	U	#	46	25.1	
Europium-155	pCi/L	01/10/2013	N001	8.24	U	#	22	13.1	
Gross Alpha	pCi/L	01/10/2013	N001	55.5	U	#	56	36.7	
Gross Beta	pCi/L	01/10/2013	N001	200		#	60	50.3	
Lead-212	pCi/L	01/10/2013	N001	10.7	U	#	11	6.86	
Potassium-40	pCi/L	01/10/2013	N001	164	U	#	180	116	
Promethium-144	pCi/L	01/10/2013	N001	-5.31	U	#	8.8	4.86	
Promethium-146	pCi/L	01/10/2013	N001	-2.89	U	#	9.3	5.27	
Ruthenium-106	pCi/L	01/10/2013	N001	3.86	U	#	71	41.3	
Thorium-234	pCi/L	01/10/2013	N001	69.7	U	#	110	66.2	
Tritium	pCi/L	01/10/2013	N001	-130	U	#	370	218	
Uranium-235	pCi/L	01/10/2013	N001	-11.6	U	#	34	19.7	
Yttrium-88	pCi/L	01/10/2013	N001	5.59	U	#	8.4	5.25	

SAMPLE ID CODES: 000X = Filtered sample (0.45 µm). N00X = Unfiltered sample. X = replicate number.

LAB QUALIFIERS:

- \* Replicate analysis not within control limits.
- > Result above upper detection limit.
- A TIC is a suspected aldol-condensation product.
- B Inorganic: Result is between the IDL and CRDL. Organic: Analyte also found in method blank.
- C Pesticide result confirmed by GC-MS.
- D Analyte determined in diluted sample.
- E Inorganic: Estimate value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
- H Holding time expired, value suspect.
- I Increased detection limit due to required dilution.
- J Estimated
- N Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: Tentatively identified compound (TIC).
- P > 25% difference in detected pesticide or Aroclor concentrations between 2 columns.
- U Analytical result below detection limit.
- W Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
- X,Y,Z Laboratory defined qualifier, see case narrative.

DATA QUALIFIERS:

- F Low flow sampling method used.
- G Possible grout contamination, pH > 9.
- Estimated value.
- L Less than 3 bore volumes purged prior to sampling.
- Q Qualitative result due to sampling technique.
- R Unusable result.
- U Parameter analyzed for but was not detected.
- X Location is undefined.

QA QUALIFIER:

- # Validated according to quality assurance guidelines.

## **Gas-Phase Sample Results**

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 26-22B**  
**Ticket Number: KNY 868**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0056		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.086		#
Carbon Dioxide	Percent	1/10/2013	0001	2.78		#
Methane	Percent	1/10/2013	0001	91.34		#
Ethane	Percent	1/10/2013	0001	4.01		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	0.98		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.213		#
Butane	Percent	1/10/2013	0001	0.192		#
Isopentane	Percent	1/10/2013	0001	0.0817		#
Pentane	Percent	1/10/2013	0001	0.0592		#
Hexanes	Percent	1/10/2013	0001	0.244		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0601	U	#

**Notes:**

<sup>1</sup> Not detected

**Abbreviations:**

U Analytical result below detection limit.

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 26-22C**  
**Ticket Number: KNY 869**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0069		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.080		#
Carbon Dioxide	Percent	1/10/2013	0001	3.26		#
Methane	Percent	1/10/2013	0001	90.16		#
Ethane	Percent	1/10/2013	0001	4.35		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.17		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.246		#
Butane	Percent	1/10/2013	0001	0.245		#
Isopentane	Percent	1/10/2013	0001	0.0986		#
Pentane	Percent	1/10/2013	0001	0.0704		#
Hexanes	Percent	1/10/2013	0001	0.311		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0514	U	#

<sup>1</sup> Not detected

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**RESULTS REPORT****RIN: 12125025****Site: Rulison Site****Location: BM 26-22D****Ticket Number: KNY 870****Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0030		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.063		#
Carbon Dioxide	Percent	1/10/2013	0001	4.58		#
Methane	Percent	1/10/2013	0001	88.74		#
Ethane	Percent	1/10/2013	0001	4.65		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.02		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.244		#
Butane	Percent	1/10/2013	0001	0.163		#
Isopentane	Percent	1/10/2013	0001	0.0733		#
Pentane	Percent	1/10/2013	0001	0.0535		#
Hexanes	Percent	1/10/2013	0001	0.405		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0514	U	#

<sup>1</sup> Not detected

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 26-33B**  
**Ticket Number: KNY 861**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0040		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.081		#
Carbon Dioxide	Percent	1/10/2013	0001	2.16		#
Methane	Percent	1/10/2013	0001	90.92		#
Ethane	Percent	1/10/2013	0001	4.49		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.29		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.270		#
Butane	Percent	1/10/2013	0001	0.276		#
Isopentane	Percent	1/10/2013	0001	0.112		#
Pentane	Percent	1/10/2013	0001	0.0833		#
Hexanes	Percent	1/10/2013	0001	0.309		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0560	U	#

<sup>1</sup> Not detected

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 26-33C**  
**Ticket Number: KNY 862**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0059		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.085		#
Carbon Dioxide	Percent	1/10/2013	0001	2.30		#
Methane	Percent	1/10/2013	0001	90.88		#
Ethane	Percent	1/10/2013	0001	4.48		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.26		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.266		#
Butane	Percent	1/10/2013	0001	0.266		#
Isopentane	Percent	1/10/2013	0001	0.103		#
Pentane	Percent	1/10/2013	0001	0.0751		#
Hexanes	Percent	1/10/2013	0001	0.275		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0797	U	#

<sup>1</sup> Not detected



**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 26-33D**  
**Ticket Number: KNY 863**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0096		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.071		#
Carbon Dioxide	Percent	1/10/2013	0001	3.40		#
Methane	Percent	1/10/2013	0001	89.33		#
Ethane	Percent	1/10/2013	0001	4.73		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.32		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.286		#
Butane	Percent	1/10/2013	0001	0.283		#
Isopentane	Percent	1/10/2013	0001	0.125		#
Pentane	Percent	1/10/2013	0001	0.0924		#
Hexanes	Percent	1/10/2013	0001	0.347		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0514	U	#

<sup>1</sup> Not detected

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 26-34A**  
**Ticket Number: KNY 864**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0177		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.067		#
Carbon Dioxide	Percent	1/10/2013	0001	3.71		#
Methane	Percent	1/10/2013	0001	89.30		#
Ethane	Percent	1/10/2013	0001	4.65		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.26		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.266		#
Butane	Percent	1/10/2013	0001	0.247		#
Isopentane	Percent	1/10/2013	0001	0.102		#
Pentane	Percent	1/10/2013	0001	0.0763		#
Hexanes	Percent	1/10/2013	0001	0.304		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0514	U	#

<sup>1</sup> Not detected

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 26-34B**  
**Ticket Number: KNY 865**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0048		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.089		#
Carbon Dioxide	Percent	1/10/2013	0001	2.80		#
Methane	Percent	1/10/2013	0001	90.36		#
Ethane	Percent	1/10/2013	0001	4.54		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.24		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.265		#
Butane	Percent	1/10/2013	0001	0.255		#
Isopentane	Percent	1/10/2013	0001	0.098		#
Pentane	Percent	1/10/2013	0001	0.0704		#
Hexanes	Percent	1/10/2013	0001	0.274		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0643	U	#

<sup>1</sup> Not detected

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 26-34C**  
**Ticket Number: KNY 866**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0591		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.15		#
Carbon Dioxide	Percent	1/10/2013	0001	4.67		#
Methane	Percent	1/10/2013	0001	88.66		#
Ethane	Percent	1/10/2013	0001	4.37		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.12		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.246		#
Butane	Percent	1/10/2013	0001	0.228		#
Isopentane	Percent	1/10/2013	0001	0.0911		#
Pentane	Percent	1/10/2013	0001	0.0658		#
Hexanes	Percent	1/10/2013	0001	0.333		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0514	U	#

<sup>1</sup> Not detected

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 26-34D**  
**Ticket Number: KNY 867**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0044		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.071		#
Carbon Dioxide	Percent	1/10/2013	0001	2.72		#
Methane	Percent	1/10/2013	0001	90.66		#
Ethane	Percent	1/10/2013	0001	4.41		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.19		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.242		#
Butane	Percent	1/10/2013	0001	0.244		#
Isopentane	Percent	1/10/2013	0001	0.0948		#
Pentane	Percent	1/10/2013	0001	0.0692		#
Hexanes	Percent	1/10/2013	0001	0.290		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0514	U	#

<sup>1</sup> Not detected

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 35-32A**  
**Ticket Number: KNY 871**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0019		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.086		#
Carbon Dioxide	Percent	1/10/2013	0001	3.48		#
Methane	Percent	1/10/2013	0001	89.23		#
Ethane	Percent	1/10/2013	0001	4.86		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.35		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.278		#
Butane	Percent	1/10/2013	0001	0.273		#
Isopentane	Percent	1/10/2013	0001	0.105		#
Pentane	Percent	1/10/2013	0001	0.0747		#
Hexanes	Percent	1/10/2013	0001	0.261		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0514	U	#

<sup>1</sup> Not detected

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 36-13**  
**Ticket Number: KNY 872**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0050		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.12		#
Carbon Dioxide	Percent	1/10/2013	0001	1.23		#
Methane	Percent	1/10/2013	0001	91.75		#
Ethane	Percent	1/10/2013	0001	4.71		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.31		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.256		#
Butane	Percent	1/10/2013	0001	0.244		#
Isopentane	Percent	1/10/2013	0001	0.0904		#
Pentane	Percent	1/10/2013	0001	0.0649		#
Hexanes	Percent	1/10/2013	0001	0.212		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.5		#
Tritium	pCi/L methane	1/10/2013	0001	0.0643	U	#

<sup>1</sup> Not detected

**RESULTS REPORT**  
**RIN: 12125025**  
**Site: Rulison Site**  
**Location: BM 36-13B**  
**Ticket Number: KNY 873**  
**Report Date: 4/24/2013**

Parameter	Units	Sample		Result	Qualifiers	
		Date	ID		Lab	Data QA
Hydrogen	Percent	1/10/2013	0001	0.0029		#
Argon+Oxygen	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Nitrogen	Percent	1/10/2013	0001	0.060		#
Carbon Dioxide	Percent	1/10/2013	0001	4.98		#
Methane	Percent	1/10/2013	0001	87.69		#
Ethane	Percent	1/10/2013	0001	5.46		#
Ethene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Propane	Percent	1/10/2013	0001	1.04		#
Propene	Percent	1/10/2013	0001	nd <sup>1</sup>		#
Isobutane	Percent	1/10/2013	0001	0.226		#
Butane	Percent	1/10/2013	0001	0.165		#
Isopentane	Percent	1/10/2013	0001	0.068		#
Pentane	Percent	1/10/2013	0001	0.0471		#
Hexanes	Percent	1/10/2013	0001	0.263		#
Carbon-14	Percent modern carbon	1/10/2013	0001	0.2	U	#
Tritium	pCi/L methane	1/10/2013	0001	0.0514	U	#

<sup>1</sup> Not detected