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Rio Blanco Gas Composition LLL Data Summary Calibration and
Production Testing of RBE-Ø1

(U)

Charles F. Smith

August 15, 1974

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Rio Blanco Gas Composition LLL Data Summary
Calibration and Production Testing
of RBE-Ø1

October 1973 through February 1974

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ABSTRACT

The chemical composition and radionuclide concentration of Rio Blanco chimney gas samples collected during calibration and production testing of the RBE-Ø1 well is presented. A brief summary of the analytical procedures used, and of their attendant uncertainties is provided in conjunction with a description of the conventions adopted for the data presentation. Analytical data, as presently available, are included for each sample received for processing by LLL. Sufficient additional information is included to permit the reader to associate the analytical data with the progress of well testing operations.

*Work performed under the auspices of the U.S. Atomic Energy Commission

Introduction

Project Rio Blanco was the third experiment in the AEC's Flowshare Program to investigate the feasibility of nuclear explosive stimulation of low permeability natural gas bearing formations. Three nominal 30 kt explosives were detonated simultaneously in a single well-bore near Rifle, Colorado, on May 17, 1973. Re-entry drilling into the chimney region above the upper detonation point was begun on September 23, 1973. On October 10, after completion of the first phase of the alternate re-entry plan the well was allowed to flow, thus providing the first opportunity to collect chimney gas samples. Following some clean-up of the well and additional drilling, the RBE-Ø1 well was completed on October 24th. A short calibration test was conducted on October 25th, and provided our second set of chimney gas samples. The well head equipment was then re-configured in preparation for production testing. Two such tests were conducted. The first began on November 15, and continued until November 21. About 35 million cubic feet of gas were produced. The second test was conducted between January 28, 1974, and February 15, 1974. Some 62 million cubic feet of gas were produced. The well was then shut-in and has since been monitored for pressure and temperature changes. Samples were collected from the flowing gas at intervals during each of the production tests. A much more lucid description of the re-entry operations¹ and a detailed presentation of the production testing results² are available elsewhere.

This report is assembled as a vehicle for the dissemination of the basic gas composition data obtained from LLL analyses of RBE-Ø1 gas. As such, it is neither an inclusive report of all gas composition measurements made by LLL in support of the Rio Blanco experiment, nor is it a complete summary of all available

information regarding the composition of gas produced from RBE-Ø1. The additional information gathered from LLL analyses of gas from other sources and by other laboratories from analyses in support of the Rio Blanco program is summarized in separate topical reports.^{2,3,4}

Only a minimal evaluation of the significance of the data is within the scope of this report. A preliminary discussion of the pre production test data is available elsewhere³ and a general assessment of the Rio Blanco upper chimney gas quality is in preparation.⁴

The information contained here-in is complete as of the date of issue. Continuing assessment of the data may reveal the inclusion of erroneous analytical results in these data summaries. In addition, some additional processing of data from selected samples may be required to correct for compositional perturbations induced by the inclusion of water in the sample bottles (see text). Analyses for other components of the produced gas (e.g., heavier hydrocarbon gases, ³⁹Ar and ¹⁴CH₄) are in process as of this writing and results are not yet available. When these additional results, corrections and adjustments are made a revised version of this data summary report will be issued.

Sampling

Sampling operations were planned to provide unperturbed chimney gas at maximum pressure and without air inclusion. At the outset, specially designed single valved, 115 ml, high pressure cylinders were used to collect samples. When pressures within the allowable range for DOT-3E-1800 series cylinders were observed it became possible to employ commercial 500 ml, double valved vessels. To avoid potential alteration of gas composition the sampling point was chosen to be between the wellhead and the separator. Air inclusion in the sample was to be prevented by flushing the cylinder either by alternate filling and venting for single valved bottles or by flowing through the double valved bottles.

In actual practice the high water content of the gas combined with low ambient temperatures and adverse field operating conditions prevented adequate flushing of the bottles by the flow through technique. Alternate filling and venting resulted in the inclusion of significant quantities of liquid water in the sample bottle. This introduced a perturbation on the apparent gas composition due to the differing solubilities of the components. As of this writing the extent of the systematic errors in the reported data is still largely unresolved. We shall return to this topic later in this report (see section on specific gravity measurements).

In spite of these difficulties, alternatives were not available until the well was temporarily shut-in following the November 1973 production test. During the pause in testing the sampling location was moved downstream from the separator. Due to the absence of significant hydrocarbon liquids observed in the produced gas it was felt that the separator would have little effect on gas composition and would eliminate the problems associated with water in the sample train. Provision for flow through flushing of the double value cylinders was made by locating the sample inlet and outlet lines on the up-and downstream sides of the flow prover, respectively. This arrangement was used to collect high quality samples during the Jan-Feb, 1974, production test period.

Analytical Procedures

Samples received from the field are first subjected to a screening process in which their gross radionuclide content and chemical composition are measured. The measured total activity concentration is obtained by internal proportional counting of the dried sample gas. An estimate of the krypton-85 concentration is made by thin window beta counting a portion of the untreated sample. Mass spectrometric techniques are used to measure the chemical composition.

Results of the preliminary screening are used in conjunction with considerations of sampling time and gas production data to select appropriate samples for detailed radiochemical analyses. In this process, elution chromatography is used to obtain chemically pure component fractions of the samples for specific activity determination.⁵ Inactive carrier gases are introduced to the separation system to facilitate handling of trace components. The purified fractions are measured using either thin-window or internal fill beta proportional counters. Specific activity measurements are converted to concentrations using the known composition of the initial sample.

Concentrations of the noble gases are determined in most of the samples selected for detailed analyses.

We employ a sample enrichment process to gain sensitivity for the rare gases. As a first step the total noble gas concentration in a sample is measured by monitoring the pressure decrease caused by the gettering of all reactive gases in a titanium sublimation pump. Enough sample to provide about 2 cc (STP) of the noble gas mixture is metered into a reaction flask containing calcium metal. When molten, the calcium acts as a getter for all sample components except the noble gases. The residual gas from this concentration process is analyzed mass spectrometrically for the relative concentrations of the noble gases. In conjunction with the previously determined total noble gas concentration, this information is used to derive individual concentrations of each of the components. This technique has been applied to natural gas and chimney gas samples and has successfully been used to measure concentrations in the parts-per-billion range.⁶

Results & Discussion

Gas Analytical report sheets for all RBE-01 samples processed at LLL are appended to this report. A description of the data entries on these sheets and their uncertainties is also appended. As a unit the appendix constitutes a complete presentation of the currently available data. Some additional analyses are in progress, including ^{39}Ar and $^{14}\text{CH}_4$. Continued inspection of the significance of the results may lead to the identification of erroneous determinations requiring re-measurement. When these additional data become available a revised version of this data summary report will be issued. A detailed analysis of these data is in progress and will be published when completed.⁴ The following paragraphs constitute a preliminary assessment of the data.

The chemical composition of the gas is plotted as a function of cumulative production in Figure 1. The initial composition datum for each curve is the average obtained during calibration flaring. Little change in the concentrations of gas components is seen prior to the shut-in period between tests. During shut-in the chimney pressure increased as a consequence of natural gas influx. The resultant dilution of chimney gases is obvious. Formation gas continued to flow into the chimney during the second production test causing the observed increase in hydrocarbon gases and the corresponding decrease in CO_2 and H_2 . However, the concentration of CO_2 did not continue to decrease at a rate commensurate with the other chimney gas components. Evidently some "influx" of CO_2 into the chimney occurred at the lower chimney pressures attained during the second test. The most likely source of this excess CO_2 is ebullition of dissolved gas from the chimney water. Although not obvious from the curve in Figure 1, the hydrogen concentration behaved in a similar fashion.

Figure 1. Rio Blanco Gas Chemical Composition
RB-E-01 Well

Each of the Rio Blanco explosives can be associated with a different rare gas tracer. Neon was emplaced with the upper explosive, xenon traced the middle explosive and krypton traced the lower explosive. Neon was the

only detectable tracer material throughout most of the production testing. Toward the end of the second test, however, statistically non-zero concentrations of both xenon and krypton were observed. Taken at face value these measurements suggest that 0.25% (or less) of the produced gas may have been associated with the lower two chimneys. These values are upper limits even though contributions from air, natural gas, and fission product backgrounds have been subtracted from the observed signals. The remaining uncertainty, the background of the mass spectrometer, cannot be subtracted since it is variable over the mass ranges of interest, due in part to the sample itself, and is non-reproducible. These uncertainties are greater in the krypton mass range than in the xenon mass range. Therefore, all of these measurements must be considered to be upper limits with the krypton being most suspect. While we can thus affirm the likelihood that both lower chimney tracers have been detected in the upper chimney gas, it is not possible within the uncertainties in the data to obtain a realistic estimate of their true concentration or ratio.

Sampling time concentrations of the principal radionuclides in the produced gas are plotted in Figure 2. Dilution effects are small during the first production test, but become significant during the shut-in period and second production test. Argon-37 decay during the elapsed time required for the flow tests was significant. Its decay corrected concentration curve parallels that of ^{85}Kr . The tritiated ethane curve lies at about 0.5% of the CH_3T curve shown while the tritiated propane curve lies at about 0.2% of the CH_3T curve. All decrease as expected due to dilution and are in reasonably constant ratio to the ^{85}Kr line. No observable effects of tritium exchange reactions involving these species have been detected. The HT concentration behaves much like that of ^{85}Kr during the initial phases of testing.

Figure 2. Rio Blanco Gas Radionuclide Concentration RB-E-01 Well

An increase in the HT/⁸⁵Kr ratio is, however, evident toward the end of production. This relative increase in the HT concentration is presumably due to ebullition effects and parallels the previously noted enhancement of H₂ in the gas. The HT/H₂ ratio is essentially constant throughout the observation period.

Acknowledgements

The work reported and discussed here is the combined result of efforts by a number of individuals. Samples were collected for our analyses by the Eberline Instrument Corporation field team. Gas composition measurements were made by C. Otto and rare gas measurements were made by E. Walter and J. Newton, all of the LLL Chemistry Material Science Department. Radiochemical Determinations were made by J. Rego and J. Fontanilla, also of the LLL Chemistry & Material Science Department. Beneficial suggestions, assistance and encouragement come from the Continental Oil Company, Eberline Instrument Corporation, USAEC-PAD, the LLL Earth Sciences and the Test Directors Office and Radiochemistry Divisions.

Appendix I

Gas Analysis Reports - Rio Blanco RBE-Ø1 Well

Calibration and Production Testing

October 1973 through February 1974

The attached sheets include all currently available analytical data from LLL analyses of samples collected during the RBE-Ø1 calibration and production tests. These reports may be revised from time to time as corrected or previously unreported data become available. The following description of the entries and their reliability should be considered a part of the reports and consulted during use of the data in order to avoid their misinterpretation.

Heading

Most entries are self explanatory. Samples are numbered in order of receipt at LLL - not necessarily in chronological order of sampling. Collection times are reported according to local convention (typically Mountain Daylight for these samples). Sample container, and pressure and temperature on receipt are of historical significance only and should not be confused with wellhead or chimney conditions.

Remarks

Information is given to assist the reader in placing the sample relative to field activities. Estimated production test data at the time of sampling have been obtained where possible by interpolation of daily reports. They should not be confused with, nor used in place of definitive tabulations of these data issued by the Continental Oil Company.

Calculated and measured specific gravity values for the samples are included to provide an indication of possible bias in the stated composition due to water inclusion in the sample bottle. Significant disparities in these two entries are due largely to the high solubility of CO_2 . Concentrations measured for species other than CO_2 would be artificially elevated by this effect over their "true" value in unperturbed gas. As a first approximation the data are twice as sensitive as the specific gravity measurements (i.e., a 1% specific gravity disparity would indicate a 2% correction should be applied to the composition data). Since the calculated specific gravity does not include water or heavy hydrocarbons while the field measurement could well include both, we have chosen not to attempt to correct the data on the basis of specific gravity disparities.

Report Basis

Chemical composition data are reported for each sample after correction for air. Oxygen is presumed not to be component of the produced gas and is therefore used as an indicator of the presence of air dilution in the sample. Normal air based

on accepted ratios to oxygen is subtracted from the sample and the residual is renormalized to 100 percent. Air corrections for these samples were quite small as a consequence of the sampling technique.

All radioactive components have been decay corrected to sample time.

Chemical Composition

Values reported are volume percent after air corrections and are determined by mass spectrometry. Their probable accuracy is one to five units in the last reported figure ($\pm 1\%$ to $\pm 20\%$ depending upon the concentration range).

Rare Gas Concentration

Values reported are parts per million by volume after background subtraction. Corrections have been made for contributions from air based on argon in the sample, natural gas rare gas content based on helium, and fission products based either on ^{85}Kr measured radiometrically or on measured ratios of xenon isotopes. Correction for non-reproducible background sources in the mass spectrometer have not been made. Therefore all krypton and xenon measurements are reported as upper limit values.

Individual mass peaks of krypton and xenon were measured and corrected individually. The reported values are the arithmetic average of these individual determinations. Masses 80 through 86 were averaged for krypton and 129 through 136 for xenon. The reported errors are one standard deviation of the measurement determined from the averaging. Large errors indicate the lack of agreement between composition estimates from individual masses presumably due to variable background at these very low signal intensities.

The estimated uncertainty of rare gas measurements is taken as $\pm 25\%$ of the reported value. The major source of uncertainty is in determination of the concentration factor.

Radionuclide Concentrations

Reported values are picocuries per standard milliliter (0°C, 760 mm Hg) of the air corrected sample. Indicated errors are one standard deviation of the mean of replicate samples, or $\pm 1\%$ whichever is greater.

Entries indicated as "estimated value" are obtained by interpolation from nearby samples and are included for reference only.

Sum total and total tritium entries are obtained by adding measured concentrations. Whenever approximate totals are obtained using estimated values these are so indicated.

Measured total is the total concentration of all radioactive components obtained by internal proportional counting of the dried but otherwise untreated sample. This technique is presumed to be uncertain by $\pm 5\%$ of the value. Comparison of sum and measured totals is a valid indicator of precision of the individual component analyses.

Project Rio Blanco Report Date 8/15/74
 Sample Source RB-E-01 LLL Sample No. 73-1-14-66
 Collection Time 0800 MDT Collection Date 10-13-73
 Sample Container 500 ml cylinder #3(W) Sample Pressure 720 psig @ 22 °C
 Remarks Initial EW sample taken at wellhead.

Sp.Gr (calc.) 0.530

(LLL Mst) 0.511

Report basis: ☐ Sample as received
☒ Sample less 14.8 % normal air
 (based on oxygen).

Decay Corrected to: ☒ Sample Time
☐

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>2.6</u>	
Oxygen		
Argon		
Carbon Monoxide	<u>1</u>	
Carbon Dioxide		
Hydrogen	<u>24.3</u>	
Methane	<u>70.5</u>	
Ethane	<u>1.62</u>	
Propane	<u>0.14</u>	
i - butane	<u>0.05</u>	
n - butane		
C ₅ + hydrocarbons	<u>0.01</u>	
Helium		
Neon		
Krypton		
Xenon		
Total	<u>99.2</u>	

probable accuracy of the above results is 1-5 units in the last
 reported figure unless otherwise indicated.

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	<u>310 + 10</u>
Argon-39	
Krypton-85	<u>595 + 5</u>
Xenon-133	
Xenon-131m	<u>5.9 ± 0.001</u>
Radon-222	<u>0.016 + 0.001</u>
Tritium as hydrogen	<u>5.73 + .06</u>
Tritium as methane	<u>51.0 ± .5</u>
Tritium as ethane	<u>1.44 ± .04</u>
Tritium as propane	<u>0.14 ± .01</u>
Total tritium	<u>(58.3 ± .5)</u>
Carbon-14 monoxide	
Carbon-14 dioxide	
Carbon-14 in methane	
Sum Total	<u>970 ± 15</u>
Measured Total	<u>945 ± 40</u>

Indicated errors are one standard deviation of the mean of
 replicate measurements. Absolute uncertainty is unknown,
 but is most probably less than ± 10% of the values given.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-68
Collection Time 1616 MDT Collection Date 10/17/73
Sample Container 500 ml cylinder #5(W) Sample Pressure 360 psig @ 22 °C
Remarks Sampled during initial EW bleed down through DWC(#1 of 3).

Average flow rate 0.5 MMCF/D Spec.Grav.(calc.) 1.097

Average tubing pressure 500 psig (LLL Mst) 1.096

Report basis: ☒ Sample as received
☐ Sample less _____ % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	0.7	
Oxygen		
Argon		
Carbon Monoxide		
Carbon Dioxide	60.8	
Hydrogen	10.2	
Methane	27.6	
Ethane	0.61	
Propane	0.03	
i - butane		
n - butane		
C ₅ + hydrocarbons		
Helium		
Neon		
Krypton		
Xenon		
Total	99.9	

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	
Argon-39	
Krypton-85	430 + 20
Xenon-133	
Xenon-131m	
Radon-222	
Tritium as hydrogen	
Tritium as methane	
Tritium as ethane	
Tritium as propane	
Total tritium	()
Carbon-14 monoxide	
Carbon-14 dioxide	
Carbon-14 in methane	
Measured Total	570 ± 30

probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

Indicated errors are one standard deviation of the mean of replicate measurements. Absolute uncertainty is unknown, but is most probably less than ± 10% of the values given.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-69
Collection Time 1647 Collection Date 10/17/73
Sample Container 500 ml cylinder #7(W) Sample Pressure 515 psig @ 22 °C
Remarks Sampled during initial EW bleed down through DWC(#2 of 3)
Avg. tubing pressure 500 psig Average flow rate 0.5 MMCF/D Calculated SpGr 1.082
LLL (Mst) SpGr. 1.014

Report basis: ☐ Sample as received
☒ Sample less 0.62 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.72</u>	
Oxygen		
Argon		<u>10 + 2</u>
Carbon Monoxide		
Carbon Dioxide	<u>59.4</u>	
Hydrogen	<u>10.4</u>	
Methane	<u>28.8</u>	
Ethane	<u>0.65</u>	
Propane	<u>0.04</u>	
i - butane		
n - butane		
C ₅ + hydrocarbons		
Helium		<u>25 + 5</u>
Neon		<u>4.4 ± 1.1*</u>
Krypton		<u><0.001*</u>
Xenon		<u><0.002*</u>
Total	<u>100.</u>	

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	<u>121 + 3</u>
Argon-39	
Krypton-85	<u>446 + 4</u>
Xenon-133	
Xenon-131m	<u>5.6 + 0.3</u>
Radon-222	<u>0.070 + 0.0001</u>
Tritium as hydrogen	<u>1.66 ± 0.07</u>
Tritium as methane	<u>36.7 + 0.4</u>
Tritium as ethane	
Tritium as propane	<u>0.47 + 0.03</u>
Total tritium	<u>(38.4 ± 0.4)</u>
Carbon-14 monoxide	
Carbon-14 dioxide	<u>0.19 + 0.01</u>
Carbon-14 in methane	
Sum Total	<u>611 + 6</u>
Measured Total	<u>590 + 30</u>

probable accuracy of the above results is 1-5 units in the last
rted figure unless otherwise indicated.

Value has been corrected for all appropriate
background sources.

Indicated errors are one standard deviation of the mean of
replicate measurements. Absolute uncertainty is unknown,
but is most probably less than ± 10% of the values given.

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Project Rio Blanco Report Date 8/15/74
 Sample Source RB-E-01 LLL Sample No. 73-1-14-70
 Collection Time 1702 Collection Date 10/17/73
 Sample Container 500 ml cylinder #6(W) Sample Pressure _____ psig @ 22 °C
 Remarks Sampled during initial EW bleed down through DWC(#30F3)
 Average tubing pressure 500 psig Average flow rate 0.5 MMCF/D Calculated SpGr 1.080
 LLL (Mst) SpGr 1.090

Report basis: ☒ Sample as received
☐ Sample less _____ % normal air
 (based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.7</u>	_____
Oxygen	_____	_____
Argon	_____	_____
Carbon Monoxide	_____	_____
Carbon Dioxide	<u>59.4</u>	_____
Hydrogen	<u>10.2</u>	_____
Methane	<u>28.9</u>	_____
Ethane	<u>0.66</u>	_____
Propane	<u>0.04</u>	_____
i - butane	_____	_____
n - butane	_____	_____
C ₅ + hydrocarbons	_____	_____
Helium	_____	_____
Neon	_____	_____
Krypton	_____	_____
Xenon	_____	_____
Total	<u>99.4</u>	_____

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	<u>133 ± 1</u>
Argon-39	_____
Krypton-85	<u>454 ± 5</u>
Xenon-133	_____
Xenon-131m	<u>5.35 ± 0.05</u>
Radon-222	<u>0.080 ± 0.002</u>
Tritium as hydrogen	<u>1.76 ± 0.02</u>
Tritium as methane	<u>23.9 ± 0.2</u>
Tritium as ethane	<u>0.75 ± 0.02</u>
Tritium as propane	<u>0.07 ± 0.01</u>
Total tritium	<u>(26.5 ± 0.3)</u>
Carbon-14 monoxide	_____
Carbon-14 dioxide	<u>0.17 ± 0.01</u>
Carbon-14 in methane	_____
Sum Total	<u>620 ± 5</u>
Measured Total	<u>610 ± 30</u>

probable accuracy of the above results is 1-5 units in the last
 reported figure unless otherwise indicated.

Indicated errors are one standard deviation of the mean of
 replicate measurements. Absolute uncertainty is unknown,
 but is most probably less than ± 10% of the values given.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-71
Collection Time 1719 Collection Date 10/17/73
Sample Container 500 ml cylinder #2(W) Sample Pressure 230 psig @ 22 °C
Remarks End of initial bleed down through DWC-well shut in.
final tubing pressure 500 psig calculated SpGr 1.068
cum dry gas this test 0.135 MMCF LLL(Mst) SpGr 1.097

Report basis: ☐ Sample as received
☒ Sample less 0.05 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.8</u>		Argon-37	<u>147 + 2</u>
Oxygen			Argon-39	
Argon		<u>14 + 3</u>	Krypton-85	<u>449 + 6</u>
Carbon Monoxide			Xenon-133	
Carbon Dioxide	<u>57.8</u>		Xenon-131m	<u>5.81 + 0.06</u>
Hydrogen	<u>10.3</u>		Radon-222	<u>0.018 + 0.001</u>
Methane	<u>30.3</u>		Tritium as hydrogen	<u>1.46 + 0.01</u>
Ethane	<u>0.69</u>		Tritium as methane	<u>22.5 + 0.6</u>
Propane	<u>0.05</u>		Tritium as ethane	<u>0.89 + 0.02</u>
i - butane			Tritium as propane	
n - butane			Total tritium	<u>(24.8 + 0.6)</u>
C ₅ + hydrocarbons			Carbon-14 monoxide	
Helium		<u>27 + 5</u>	Carbon-14 dioxide	<u>0.24 + 0.01</u>
Neon		<u>4.4 + 1.1*</u>	Carbon-14 in methane	
Krypton		<u><0.001*</u>	Sum Total	<u>626 + 6</u>
Xenon		<u><0.002*</u>	Measured Total	<u>630 + 30</u>
Total	<u>99.9</u>			

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.
Value has been corrected for all appropriate background sources.

Indicated errors are one standard deviation of the mean of replicate measurements. Absolute uncertainty is unknown, but is most probably less than $\pm 10\%$ of the values given.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-75
Collection Time 0856 Collection Date 10/25/73
Sample Container 500 ml cylinder #25 Sample Pressure 890 psig @ 22 °C
Remarks #1 of 3 during calibration flaring
Average tubing pressure ~ 1550 psig. Average flow rate ~ 5.5 MMCF/D. calculated SpGr 1.094
LLL (Mst) SpGr 1.158

Report basis: ☒ Sample as received
☐ Sample less _____ % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	0.6	
Oxygen		
Argon		6.8 ± 1.7
Carbon Monoxide		
Carbon Dioxide	60.5	
Hydrogen	10.0	
Methane	28.2	
Ethane	0.61	
Propane	0.03	
i - butane		
n - butane		
C ₅ + hydrocarbons		
H ₂ S	0.012	
Helium		25 ± 5
Neon		3.9 ± 1.0*
Krypton		<0.001*
Xenon		<0.002*
Total	99.9	

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	139 ± 2=
Argon-39	
Krypton-85	443 ± 4
Xenon-133	
Xenon-131m	3.88 ± 0.04
Radon-222	0.080 ± 0.001
Tritium as hydrogen	1.77 ± 0.02
Tritium as methane	25.0 ± 0.7
Tritium as ethane	0.91 ± 0.01
Tritium as propane	
Total tritium	(27.7 ± 0.7)
Carbon-14 monoxide	
Carbon-14 dioxide	0.18 ± 0.01
Carbon-14 in methane	
Sum Total	614 ± 6
Measured Total	590 ± 30

The probable accuracy of the above results is 1-5 units in the last ported figure unless otherwise indicated.
Value has been corrected for all appropriate background sources.

Indicated errors are one standard deviation of the mean of replicate measurements. Absolute uncertainty is unknown, but is most probably less than ± 10% of the values given.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-76
Collection Time 0946 Collection Date 10/25/73
Sample Container 500 ml cylinder #26 Sample Pressure 850 psig @ 22 °C
Remarks #2 of 3 during calibration flaring
Average Tubing pressure ~ 1550 psig. Average flow rate ~ 5.5 MMCF/D Calculated SpGr 1.110
LLL (Mst) SpGr 1.156

Report basis: ☒ Sample as received
☐ Sample less _____ % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.6</u>	
Oxygen		
Argon		
Carbon Monoxide		
Carbon Dioxide	<u>62.1</u>	
Hydrogen	<u>9.8</u>	
Methane	<u>26.8</u>	
Ethane	<u>0.57</u>	
Propane	<u>0.03</u>	
i - butane		
n - butane		
C ₅ + hydrocarbons		
Helium		
Neon		
Krypton		
Xenon		
Total	<u>99.9</u>	

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	
Argon-39	
Krypton-85	<u>410 ± 20</u>
Xenon-133	
Xenon-131m	
Radon-222	
Tritium as hydrogen	
Tritium as methane	
Tritium as ethane	
Tritium as propane	
Total tritium	()
Carbon-14 monoxide	
Carbon-14 dioxide	
Carbon-14 in methane	
Measured Total	<u>560 ± 30</u>

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-77
Collection Time 1025 Collection Date 10/25/73
Sample Container 500 ml cylinder #22 Sample Pressure 830 psig @ 22 °C
Remarks #3 of 3 during calibration flaring
Average tubing pressure ~ 1550 psig. Average flow rate 5.5 MMCF/D Calculated SpGr 1.114
cumulative gas produced 0.4 MMCF LLL(Mst) SpGr 1.151

Report basis: ☒ Sample as received
☐ Sample less _____ % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.6</u>		Argon-37	<u>114 + 1</u>
Oxygen			Argon-39	
Argon		<u>4.9 + 1.2</u>	Krypton-85	<u>411 + 4</u>
Carbon Monoxide			Xenon-133	
Carbon Dioxide	<u>61.9</u>		Xenon-131m	<u>3.56 + 0.04</u>
Hydrogen	<u>10.4</u>		Radon-222	<u>0.053 + 0.002</u>
Methane	<u>26.5</u>		Tritium as hydrogen	<u>2.43 + 0.06</u>
Ethane	<u>0.57</u>		Tritium as methane	<u>23.6 + 0.3</u>
Propane	<u>0.03</u>		Tritium as ethane	
i - butane			Tritium as propane	
n - butane			Total tritium	<u>(26.0 + 0.3)</u>
C ₅ + hydrocarbons			Carbon-14 monoxide	
H ₂ S	<u>< 0.012</u>		Carbon-14 dioxide	<u>0.18 + 0.01</u>
Helium		<u>23 ± 5</u>	Carbon-14 in methane	
Neon		<u>3.5 ± 0.9*</u>	Sum Total	<u>555 ± 6</u>
Krypton		<u>< 0.001*</u>	Measured Total	<u>550 ± 30</u>
Xenon		<u>< 0.002*</u>		
Total	<u>100.</u>			

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.
Value has been corrected for all appropriate background sources

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-104
Collection Time 1300 Collection Date 11/14/73
Sample Container 115 ml cylinder #23 Sample Pressure 1530 psig @ 22 °C
Remarks During start up operations prior to first production test.
Bottom hole pressure ~1000 psig Dryflow rate 5.3 MMCF/D Calculated SpGr 1.104
Flowing temperature 300 °F Cum. Dryflow 1.1 MMCF Ranarex SpGr 1.130

Report basis: ☐ Sample as received
☒ Sample less 1.24 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.64</u>	
Oxygen		
Argon		
Carbon Monoxide		
Carbon Dioxide	<u>61.4</u>	
Hydrogen	<u>9.4</u>	
Methane	<u>27.8</u>	
Ethane	<u>0.59</u>	
Propane	<u>0.03</u>	
i - butane		
n - butane		
C ₅ + hydrocarbons		
H ₂ S	<u>0.02</u>	
Helium		
Neon		
Krypton		
Xenon		
Total	<u>99.9</u>	

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	
Argon-39	
Krypton-85	<u>(~ 430) value estimated</u>
Xenon-133	
Xenon-131m	
Radon-222	
Tritium as hydrogen	
Tritium as methane	
Tritium as ethane	
Tritium as propane	
Total tritium	<u>()</u>
Carbon-14 monoxide	
Carbon-14 dioxide	
Carbon-14 in methane	
Measured Total	<u>500 + 30</u>

Indicated errors are one standard deviation of the mean of replicate measurements. Absolute uncertainty is unknown, but is most probably less than ± 10% of the values given.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-84
Collection Time 1345 Collection Date 11/15/73
Sample Container 115 ml cylinder #20 Sample Pressure _____ psig @ 22 °C
Remarks _____

Bottom hole pressure 1949 psig. Dryflow rate shut in. Calculated SpGr. 1073
Flowing temperature 225 °F Cum. Dryflow 5.1 MMCF

Report basis: ☐ Sample as received
☒ Sample less 0.05 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	0.9		Argon-37	
Oxygen			Argon-39	
Argon				
Carbon Monoxide			Krypton-85	(~ 430) value estimated
Carbon Dioxide	58.2		Xenon-133	
			Xenon-131m	
Hydrogen	10.0		Radon-222	
Methane	30.1			
Ethane	0.63		Tritium as hydrogen	
Propane	0.03		Tritium as methane	
i - butane			Tritium as ethane	
n - butane			Tritium as propane	
C ₅ + hydrocarbons				
			Total tritium	()
Helium			Carbon-14 monoxide	
Neon			Carbon-14 dioxide	
Krypton			Carbon-14 in methane	
Xenon				
Total	99.9		Measured Total	520 + 30

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-85
Collection Time 1300 Collection Date 11/16/73
Sample Container 500 ml cylinder # 17 Sample Pressure 1480 psig @ 46 °C
Remarks _____

Bottom hole pressure 1934 psig. Dryflow rate 11.1 MMCF/D Calculated SpGr 1.088
Flowing temperature 370 °F Cum. Dryflow 5.7 MMCF Ranarex SpGr 1.137

Report basis: ☐ Sample as received
☒ Sample less 0.14 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.7</u>	_____
Oxygen	_____	_____
Argon	_____	<u>2.6 + 0.7</u>
Carbon Monoxide	_____	_____
Carbon Dioxide	<u>59.7</u>	_____
Hydrogen	<u>9.9</u>	_____
Methane	<u>29.1</u>	_____
Ethane	<u>0.6</u>	_____
Propane	<u>0.03</u>	_____
i - butane	_____	_____
n - butane	_____	_____
C ₅ + hydrocarbons	_____	_____
Helium	_____	<u>23 + 5</u>
Neon	_____	<u>4.0 + 1.0*</u>
Krypton	_____	<u><0.001*</u>
Xenon	_____	<u><0.002*</u>
Total	<u>100</u>	_____

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	<u>76.7 + 0.8</u>
Argon-39	_____
Krypton-85	<u>425 + 5</u>
Xenon-133	_____
Xenon-131m	<u>1.05 + 0.02</u>
Radon-222	<u>0.058 + 0.001</u>
Tritium as hydrogen	<u>2.44 + 0.03</u>
Tritium as methane	<u>27.5 + 0.5</u>
Tritium as ethane	<u>0.83 + 0.01</u>
Tritium as propane	<u>0.53 + 0.01</u>
Total tritium	<u>(30.8 + 0.5)</u>
Carbon-14 monoxide	_____
Carbon-14 dioxide	_____
Carbon-14 in methane	_____
Sum Total	<u>534 + 6</u>
Measured Total	<u>530 + 30</u>

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.
Value has been corrected for all appropriate background sources.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-86
Collection Time 1331 Collection Date 11/16/73
Sample Container 115 ml cylinder #10 Sample Pressure 1480 psig @ 52 °C
Remarks _____

Bottom hole pressure 1920psig. Dryflow rate 10.9 MMCF/D Calculated SpGr 1.067
Flowing temperature 370°F Cum. Dryflow 5.9 MMCF Ranarex SpGr 1.138

Report basis: ☐ Sample as received
☒ Sample less 0.38 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.7</u>	_____
Oxygen	_____	_____
Argon	_____	_____
Carbon Monoxide	_____	_____
Carbon Dioxide	<u>57.8</u>	_____
Hydrogen	<u>10.3</u>	_____
Methane	<u>30.4</u>	_____
Ethane	<u>0.62</u>	_____
Propane	<u>0.04</u>	_____
i - butane	_____	_____
n - butane	_____	_____
C ₅ + hydrocarbons	_____	_____
H ₂ S	<u>0.01</u>	_____
Helium	_____	_____
Neon	_____	_____
Krypton	_____	_____
Xenon	_____	_____
Total	<u>99.9</u>	_____

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	_____
Argon-39	_____
Krypton-85	<u>(~ 430)</u> Value Estimated
Xenon-133	_____
Xenon-131m	_____
Radon-222	_____
Tritium as hydrogen	_____
Tritium as methane	_____
Tritium as ethane	_____
Tritium as propane	_____
Total tritium	<u>()</u>
Carbon-14 monoxide	_____
Carbon-14 dioxide	_____
Carbon-14 in methane	_____
Measured Total	<u>500 ± 30</u>

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Lawrence Livermore Laboratory
Chemistry & Materials Science Department
Livermore, California

Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-90
Injection Time 1230 Collection Date 11/17/73
Sample Container 115 ml cylinder #22 Sample Pressure 1370 psig @ 22 °C
Remarks _____

Bottom hole pressure 1706 psig. Dryflow rate 8.5 MMCF/D Calculated SpGr 1.074
Flowing temperature 420 °F Cum. Dryflow 15.1 MMCF Ranarex SpGr 1.131

Report basis: ☐ Sample as received
☒ Sample less 0.24 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.7</u>	_____
Oxygen	_____	_____
Argon	_____	_____
Carbon Monoxide	_____	_____
Carbon Dioxide	<u>58.2</u>	_____
Hydrogen	<u>9.9</u>	_____
Methane	<u>30.5</u>	_____
Ethane	<u>0.65</u>	_____
Propane	<u>0.04</u>	_____
i - butane	_____	_____
n - butane	_____	_____
C ₅ + hydrocarbons	_____	_____
Helium	_____	_____
Neon	_____	_____
Krypton	_____	_____
Xenon	_____	_____
Total	<u>100</u>	_____

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	_____
Argon-39	_____
Krypton-85	<u>(~ 410) value estimated</u>
Xenon-133	_____
Xenon-131m	_____
Radon-222	_____
Tritium as hydrogen	_____
Tritium as methane	_____
Tritium as ethane	_____
Tritium as propane	_____
Total tritium	<u>()</u>
Carbon-14 monoxide	_____
Carbon-14 dioxide	_____
Carbon-14 in methane	_____
Measured	<u>500 + 30</u>

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-91
Collection Time 1235 Collection Date 11/17/73
Sample Container 500 ml cylinder #24 Sample Pressure _____ psig @ 22 °C
Remarks _____

Bottom hole pressure 1706 psig. Dryflow rate 8.5 MMCF/D Calculated SpGr 1.067
Flowing temperature 420 °F Cum. Dryflow 15.1 MMCF Ranarex SpGr 1.138

Report basis: ☐ Sample as received
☒ Sample less 0.14 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.7</u>	_____	Argon-37	_____
Oxygen	_____	_____	Argon-39	_____
Argon	_____	_____	_____	_____
Carbon Monoxide	_____	_____	Krypton-85	<u>(~410)</u> value estimated
Carbon Dioxide	<u>57.6</u>	_____	Xenon-133	_____
_____	_____	_____	Xenon-131m	_____
Hydrogen	<u>10.1</u>	_____	Radon-222	_____
Methane	<u>30.9</u>	_____	_____	_____
Ethane	<u>0.65</u>	_____	Tritium as hydrogen	_____
Propane	<u>0.04</u>	_____	Tritium as methane	_____
i - butane	_____	_____	Tritium as ethane	_____
n - butane	_____	_____	Tritium as propane	_____
C ₅ + hydrocarbons	_____	_____	_____	_____
_____	_____	_____	Total tritium	(_____)
Helium	_____	_____	Carbon-14 monoxide	_____
Neon	_____	_____	Carbon-14 dioxide	_____
Krypton	_____	_____	Carbon-14 in methane	_____
Xenon	_____	_____	_____	_____
_____	_____	_____	_____	_____
Total	<u>100</u>	_____	Measured Total	<u>510 ± 30</u>

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-105
Collection Time 1400 Collection Date 11/17/73
Sample Container 500 ml cylinder #9 Sample Pressure 1370 psig @ 22 °C

Remarks _____
Bottom hole pressure 1690 psig Dryflow rate 7.2 MMCF/D Calculated SpGr 1.059
Flowing temperature 420 °F Cum. Dryflow 15.6 MMCF Ranarex SpGr 1.132

Report basis: ☐ Sample as received
☒ Sample less 0.67 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.6</u>	_____
Oxygen	_____	_____
Argon	_____	_____
Carbon Monoxide	_____	_____
Carbon Dioxide	<u>57.0</u>	_____
Hydrogen	<u>10.5</u>	_____
Methane	<u>31.3</u>	_____
Ethane	<u>0.66</u>	_____
Propane	<u>0.04</u>	_____
i - butane	_____	_____
n - butane	_____	_____
C ₅ + hydrocarbons	_____	_____
Helium	_____	_____
Neon	_____	_____
Krypton	_____	_____
Xenon	_____	_____
Total	<u>100</u>	_____

± probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	_____
Argon-39	_____
Krypton-85	<u>(~ 410) value estimated</u>
Xenon-133	_____
Xenon-131m	_____
Radon-222	_____
Tritium as hydrogen	_____
Tritium as methane	_____
Tritium as ethane	_____
Tritium as propane	_____
Total tritium	<u>()</u>
Carbon-14 monoxide	_____
Carbon-14 dioxide	_____
Carbon-14 in methane	_____
Measured Total	<u>490 ± 20</u>

Indicated errors are one standard deviation of the mean of replicate measurements. Absolute uncertainty is unknown, but is most probably less than ± 10% of the values given.

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Chemistry & Materials Science Department
Livermore, California

Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-92
Injection Time 0930 MDT Collection Date 11/18/73
Sample Container 500 ml cylinder #16 Sample Pressure _____ psig @ 22 °C

Remarks _____

Bottom hole pressure 1565 psig. Dryflow rate 7.3 MMCF/D Calculated SpGr 1.037
Flowing temperature 420 °F Cum. Dryflow 21.7 MMCF Ranarex SpGr 1.130

Report basis: ☐ Sample as received
☒ Sample less 0.53 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.7</u>	
Oxygen		
Argon		<u>4.3 + 1.1</u>
Carbon Monoxide		
Carbon Dioxide	<u>54.6</u>	
Hydrogen	<u>10.5</u>	
Methane	<u>33.5</u>	
Ethane	<u>0.73</u>	
Propane	<u>0.05</u>	
i - butane		
n - butane	<u>0.01</u>	
C ₅ + hydrocarbons		
Helium		<u>27 + 5</u>
Neon		<u>3.8 + 0.9*</u>
Krypton		<u><0.001*</u>
Xenon		<u><0.001*</u>
Total	<u>100</u>	

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

Value has been corrected for all appropriate background sources.

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	<u>69.7 + 0.7</u>
Argon-39	
Krypton-85	<u>402 + 4</u>
Xenon-133	
Xenon-131m	<u>0.93 + 0.01</u>
Radon-222	<u>0.060 + 0.002</u>
Tritium as hydrogen	<u>2.70 + 0.1</u>
Tritium as methane	<u>27.5 + 0.3</u>
Tritium as ethane	<u>0.77 + 0.01</u>
Tritium as propane	<u>0.05 + 0.01</u>
Total tritium	<u>(31.1 + 0.3)</u>
Carbon-14 monoxide	
Carbon-14 dioxide	
Carbon-14 in methane	
Sum Total	<u>504 + 4</u>
Measured Total	<u>510 + 30</u>

Indicated errors are one standard deviation of the mean of replicate measurements. Absolute uncertainty is unknown, but is most probably less than $\pm 10\%$ of the values given.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-106
Collection Time 0930 Collection Date 11/18/73
Sample Container 500 ml cylinder # 12 Sample Pressure 1260 psig @ 22 °C
Remarks _____

Bottom hole pressure 1565 psig Dryflow rate 7.3 MMCF/D Calculated SpGr 1.111
Flowing temperature 420 °F Cum. Dryflow 21.7 MMCF Ranarex SpGr 1.125

Report basis: ☐ Sample as received
☒ Sample less 0.53 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.5</u>	_____
Oxygen	_____	_____
Argon	_____	_____
Carbon Monoxide	_____	_____
Carbon Dioxide	<u>61.7</u>	_____
Hydrogen	<u>8.9</u>	_____
Methane	<u>28.1</u>	_____
Ethane	<u>0.64</u>	_____
Propane	<u>0.03</u>	_____
i - butane	_____	_____
n - butane	<u>0.02</u>	_____
C ₅ + hydrocarbons	_____	_____
Helium	_____	_____
Neon	_____	_____
Krypton	_____	_____
Xenon	_____	_____
Total	<u>99.9</u>	_____

probable accuracy of the above results is 1-5 units in the last
reported figure unless otherwise indicated.

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	_____
Argon-39	_____
Krypton-85	<u>(~ 390)</u> value estimated
Xenon-133	_____
Xenon-131m	_____
Radon-222	_____
Tritium as hydrogen	_____
Tritium as methane	_____
Tritium as ethane	_____
Tritium as propane	_____
Total tritium	<u>()</u>
Carbon-14 monoxide	_____
Carbon-14 dioxide	_____
Carbon-14 in methane	_____
Measured Total	<u>450 ± 20</u>

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but is most probably less than ± 10% of the values given.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-93
Collection Time 1005 Collection Date 11-18-73
Sample Container 115 ml cylinder #16 Sample Pressure ~ 60 psig @ 22 °C
Remarks _____

Bottom hole pressure 1567 psig. Dryflow rate 7.3 MMCF/D Calculated SpGr 1.071
Flowing temperature 420 °F Cum. Dryflow 21.9 MMCF Ranarex SpGr 1.129

Report basis: ☐ Sample as received
☒ Sample less 0.10 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.7</u>	_____	Argon-37	_____
Oxygen	_____	_____	Argon-39	_____
Argon	_____	_____	_____	_____
Carbon Monoxide	_____	_____	Krypton-85	<u>(~ 400)</u> value estimated
Carbon Dioxide	<u>57.8</u>	_____	Xenon-133	_____
_____	_____	_____	Xenon-131m	_____
Hydrogen	<u>9.8</u>	_____	Radon-222	_____
Methane	<u>31.0</u>	_____	_____	_____
Ethane	<u>0.69</u>	_____	Tritium as hydrogen	_____
Propane	<u>0.05</u>	_____	Tritium as methane	_____
i - butane	_____	_____	Tritium as ethane	_____
n - butane	<u>0.01</u>	_____	Tritium as propane	_____
C ₅ + hydrocarbons	_____	_____	_____	_____
H ₂ S	<u>0.01</u>	_____	_____	_____
_____	_____	_____	Total tritium	<u>(_____)</u>
Helium	_____	_____	Carbon-14 monoxide	_____
Neon	_____	_____	Carbon-14 dioxide	_____
Krypton	_____	_____	Carbon-14 in methane	_____
Xenon	_____	_____	_____	_____
_____	_____	_____	_____	_____
Total	<u>100</u>	_____	Measured Total	<u>510 ± 30</u>

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-94
Collection Time 1020 Collection Date 11/18/73
Sample Container 115 ml cylinder # 8 Sample Pressure 1260 psig @ 22 °C
Remarks _____

Bottom hole pressure 1710psig Dryflow rate 9.5 MMCF/D Calculated SpGr 1.076
Flowing temperature 420°F Cum. Dryflow 14.8 MMCF Ranarex SpGr 1.129

Report basis: ☐ Sample as received
☒ Sample less 0.10 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	0.6		Argon-37	
Oxygen			Argon-39	
Argon				
			Krypton-85	(~ 400) value estimated
Carbon Monoxide	58.3			
Carbon Dioxide			Xenon-133	
			Xenon-131m	
Hydrogen	9.6			
Methane	30.8		Radon-222	
Ethane	0.69			
Propane	0.05		Tritium as hydrogen	
i - butane			Tritium as methane	
n - butane	0.01		Tritium as ethane	
C ₅ + hydrocarbons			Tritium as propane	
			Total tritium	()
Helium			Carbon-14 monoxide	
Neon			Carbon-14 dioxide	
Krypton			Carbon-14 in methane	
Xenon				
Total	100		Measured Total	500 + 30

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-96
Collection Time 0950 Collection Date 11/19/73
Sample Container 115 ml cylinder # 17 Sample Pressure 1120 psig @ 22 °C
Remarks _____

Bottom hole pressure 1400psig Dryflow rate 7.2 MMCF/D Calculated SpGr 1.044
Flowing temperature 420°F Cum. Dryflow 28.9 MMCF Ranarex SpGr 1.112

Report basis: ☐ Sample as received
☒ Sample less 0.10 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.6</u>	_____	Argon-37	_____
Oxygen	_____	_____	Argon-39	_____
Argon	_____	_____	_____	_____
Carbon Monoxide	_____	_____	Krypton-85	<u>(~ 400)</u> value estimated
Carbon Dioxide	<u>55.1</u>	_____	_____	_____
_____	_____	_____	Xenon-133	_____
Hydrogen	<u>9.9</u>	_____	Xenon-131m	_____
Methane	<u>33.5</u>	_____	_____	_____
Ethane	<u>0.78</u>	_____	Radon-222	_____
Propane	<u>0.06</u>	_____	_____	_____
i - butane	_____	_____	Tritium as hydrogen	_____
n - butane	<u>0.02</u>	_____	Tritium as methane	_____
C ₅ + hydrocarbons	_____	_____	Tritium as ethane	_____
_____	_____	_____	Tritium as propane	_____
_____	_____	_____	_____	_____
Helium	_____	_____	Total tritium	<u>(_____)</u>
Neon	_____	_____	Carbon-14 monoxide	_____
Krypton	_____	_____	Carbon-14 dioxide	_____
Xenon	_____	_____	Carbon-14 in methane	_____
_____	_____	_____	_____	_____
Total	<u>100</u>	_____	Measured Total	<u>480 + 20</u>

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-97
Collection Time 1010 Collection Date 11/19/73
Sample Container 500 ml cylinder # 15 Sample Pressure 1120 psig @ 22 °C
Remarks _____

Bottom hole pressure 1400psig Dryflow rate 7.1 MMCF/D Calculated SpGr 1.040
Flowing temperature 420°F Cum. Dryflow 29.3 MMCF Ranarex SpGr 1.112

Report basis: ☐ Sample as received
☒ Sample less 0.05 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	0.6		Argon-37	
Oxygen			Argon-39	
Argon				
			Krypton-85	(~ 390) value estimated
Carbon Monoxide				
Carbon Dioxide	54.6		Xenon-133	
			Xenon-131m	
Hydrogen	9.9			
Methane	33.9		Radon-222	
Ethane	0.8			
Propane	0.07		Tritium as hydrogen	
i - butane			Tritium as methane	
n - butane	0.03		Tritium as ethane	
C ₅ + hydrocarbons			Tritium as propane	
			Total tritium	()
Helium			Carbon-14 monoxide	
Neon			Carbon-14 dioxide	
Krypton			Carbon-14 in methane	
Xenon				
Total	99.9		Measured Total	500 + 30

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14- 101
Collection Time 1531 Collection Date 11/19/73
Sample Container 500 ml cylinder # 20 Sample Pressure 1100 psig @ 22 °C
Remarks _____

Bottom hole pressure 1380psig Dryflow rate 7.1 MMCF/D Calculated SpGr 1.101
Flowing temperature 420°F Cum. Dryflow 30.7 MMCF Ranarex SpGr 1.116

Report basis: ☐ Sample as received
☒ Sample less 0.05 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.8</u>		Argon-37	<u>65.8 + 0.9</u>
Oxygen			Argon-39	
Argon		<u>4.5 + 1.1</u>	Krypton-85	<u>382 + 5</u>
Carbon Monoxide			Xenon-133	
Carbon Dioxide	<u>60.0</u>		Xenon-131m	<u>0.71 + 0.02</u>
Hydrogen	<u>8.4</u>		Radon-222	<u>0.046 + 0.001</u>
Methane	<u>30.0</u>		Tritium as hydrogen	<u>2.28 + 0.03</u>
Ethane	<u>0.73</u>		Tritium as methane	<u>21.8 + 0.4</u>
Propane	<u>0.08</u>		Tritium as ethane	<u>0.72 + 0.01</u>
i - butane	<u>0.03</u>		Tritium as propane	<u>0.05 + 0.01</u>
n - butane			Total tritium	<u>(24.8 + 0.4)</u>
C ₅ + hydrocarbons			Carbon-14 monoxide	
Helium		<u>20 + 4</u>	Carbon-14 dioxide	
Neon		<u>2.6 + 0.6*</u>	Carbon-14 in methane	
Krypton		<u><0.001*</u>	Sum Total	<u>473 + 5</u>
Xenon		<u><0.001*</u>	Measured Total	<u>460 + 20</u>
Total	<u>100</u>			

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14- 102
Collection Time 0905 Collection Date 11/20/73
Sample Container 500 ml cylinder # 14 Sample Pressure 1125 psig @ 22 °C
Remarks _____

Bottom hole pressure 1270psig Dryflow rate 6.8 MMCF/D Calculated SpGr 1.084
Flowing temperature 430°F Cum. Dryflow 35.1 MMCF Ranarex SpGr 1.106

Report basis: ☒ Sample as received
☐ Sample less _____ % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.62</u>	
Oxygen		
Argon		<u>5.8 + 1.4</u>
Carbon Monoxide		
Carbon Dioxide	<u>58.2</u>	
Hydrogen	<u>8.1</u>	
Methane	<u>32.1</u>	
Ethane	<u>0.82</u>	
Propane	<u>0.10</u>	
i - butane	<u>0.40</u>	
n - butane		
C ₅ + hydrocarbons		
Helium		<u>28 + 6</u>
Neon		<u>3.8 + 0.9*</u>
Krypton		<u><0.001*</u>
Xenon		<u><0.001*</u>
Total	<u>99.9</u>	

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	<u>61.8 + 2</u>
Argon-39	
Krypton-85	<u>383 + 5</u>
Xenon-133	
Xenon-131m	<u>0.80 + 0.01</u>
Radon-222	<u>0.060 + 0.001</u>
Tritium as hydrogen	<u>2.27 + 0.03</u>
Tritium as methane	<u>20.0 + 0.3</u>
Tritium as ethane	<u>0.68 + 0.03</u>
Tritium as propane	<u>0.040 + 0.004</u>
Total tritium	<u>(23.0 + 0.3)</u>
Carbon-14 monoxide	
Carbon-14 dioxide	<u>0.17 + 0.01</u>
Carbon-14 in methane	
Sum Total	<u>469 + 5</u>
Measured Total	<u>450 + 20</u>

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-112
Collection Time 1745 Collection Date 28 JAN. 1974
Sample Container 500 ml cylinder #4 Sample Pressure 410 psig @ 22 °C
Remarks _____

Bottom hole pressure 1650 psig Dryflow rate 6.66 MMCF/D Calculated SpGr: 0.983
Flowing temperature 350 °F Cum. Dryflow 36.0 MMCF Ranarex SpGr 0.99

Report basis: ☐ Sample as received
☒ Sample less 0.38 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.3</u>	
Oxygen		
Argon		<u>7.3 + 1.8</u>
Carbon Monoxide		
Carbon Dioxide	<u>45.9</u>	
Hydrogen	<u>5.3</u>	
Methane	<u>46.6</u>	
Ethane	<u>1.55</u>	
Propane	<u>1.19</u>	
i - butane		
n - butane	<u>0.09</u>	
C ₅ + hydrocarbons	<u>0.04</u>	
H ₂ S	<u>0.02</u>	
Helium		<u>46 + 10</u>
Neon		<u>3.2 ± 0.8*</u>
Krypton		<u><0.004 ± 0.004*</u>
Xenon		<u><0.001 ± 0.001</u>
Total	<u>100</u>	

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	<u>11.6 + 0.1</u>
Argon-39	
Krypton-85	<u>251 ± 3</u>
Xenon-133	
Xenon-131m	<u>0.03 + 0.01</u>
Radon-222	<u>0.018 + 0.001</u>
Tritium as hydrogen	<u>(~ 1.5) value estimated</u>
Tritium as methane	<u>15.8 + 0.2</u>
Tritium as ethane	<u>0.84 ± 0.01</u>
Tritium as propane	<u>0.08 ± 0.01</u>
Total tritium	<u>(~ 18 ± 1 value) estimated</u>
Carbon-14 monoxide	
Carbon-14 dioxide	<u>0.14 ± 0.01</u>
Carbon-14 in methane	
Sum Total	<u>281 + 3</u>
Measured Total	<u>300 ± 20</u>

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

Value has been corrected for all appropriate background sources.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14- 113
Collection Time 1515 Collection Date 29 Jan 1974
Sample Container 500 ml cylinder #2 Sample Pressure 375 psig @ 22 °C
Remarks _____

Bottom hole pressure 1550 psig Dryflow rate 6.3 MMCF/D Calculated SpGr 0.992
Flowing temperature 425 °F Cum. Dryflow 41.5 MMCF Ranarex SpGr 1.000

Report basis: ☐ Sample as received
☒ Sample less 0.24 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.3</u>	_____	Argon-37	<u>11.4 ± 0.1</u>
Oxygen	_____	_____	Argon-39	_____
Argon	_____	_____	Krypton-85	<u>258 ± 3</u>
Carbon Monoxide	_____	_____	Xenon-133	_____
Carbon Dioxide	<u>46.9</u>	_____	Xenon-131m	_____
Hydrogen	<u>5.46</u>	_____	Radon-222	<u>0.073 ± 0.004</u>
Methane	<u>45.5</u>	_____	Tritium as hydrogen	<u>1.48 ± 0.02</u>
Ethane	<u>1.49</u>	_____	Tritium as methane	<u>15.7 ± 0.3</u>
Propane	<u>0.18</u>	_____	Tritium as ethane	<u>0.86 ± 0.04</u>
i - butane	_____	_____	Tritium as propane	_____
n - butane	<u>0.10</u>	_____	Total tritium	<u>(18.1 ± 0.3)</u>
C ₅ + hydrocarbons	_____	_____	Carbon-14 monoxide	_____
H ₂ S	<u>0.02</u>	_____	Carbon-14 dioxide	<u>0.34 ± 0.01</u>
Helium	_____	_____	Carbon-14 in methane	_____
Neon	_____	_____	Sum Total	<u>288 ± 3</u>
Krypton	_____	_____	Measured Total	<u>300 ± 20</u>
Xenon	_____	_____		
Total	<u>99.9</u>	_____		

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-114
Collection Time 1055 Collection Date 30 Jan. 1974
Sample Container 500 ml cylinder # 15 Sample Pressure 350 psig @ 22 °C
Remarks _____

Bottom hole pressure 1425psig Dryflow rate 6.3 MMCF/D Calculated SpGr: 0.981
Flowing temperature 435°F Cum. Dryflow 46.4 MMCF Ranarex SpGr 0.991

Report basis: ☐ Sample as received
☒ Sample less 0.33 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.2</u>		Argon-37	<u>10.2 ± 0.2</u>
Oxygen			Argon-39	
Argon		<u>7.3</u>		
Carbon Monoxide			Krypton-85	<u>246 ± 4</u>
Carbon Dioxide	<u>45.6</u>		Xenon-133	
			Xenon-131m	<u>0.03 ± 0.01</u>
Hydrogen	<u>5.20</u>		Radon-222	<u>0.074 ± 0.001</u>
Methane	<u>47.0</u>			
Ethane	<u>1.61</u>		Tritium as hydrogen	<u>1.36 ± 0.02</u>
Propane	<u>0.25</u>		Tritium as methane	<u>14.4 ± 0.3</u>
i - butane	<u>0.10</u>		Tritium as ethane	<u>0.78 ± 0.01</u>
n - butane			Tritium as propane	<u>0.10 ± 0.01</u>
C ₅ + hydrocarbons	<u>0.01</u>			
			Total tritium	<u>(16.6 ± 0.3)</u>
H ₂ S	<u>0.04</u>		Carbon-14 monoxide	
Helium		<u>44 ± 10</u>	Carbon-14 dioxide	<u>0.26 ± 0.03</u>
Neon		<u>3.2 ± 0.8*</u>	Carbon-14 in methane	
Krypton		<u><0.001*</u>		
Xenon		<u><0.002 ± 0.001*</u>	Sum Total	<u>273 ± 5</u>
			Measured Total	<u>280 ± 10</u>
Total	<u>100</u>			

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*value has been corrected for all appropriate background sources.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-136
Collection Time 1400 Collection Date 1 Feb. 1974
Sample Container 500 ml cylinder #6 Sample Pressure 415 psig @ 22 °C
Remarks _____

Bottom hole pressure 1151psig Dryflow rate 4.0 MMCF/D Calculated SpGr 0.944
Flowing temperature 444 °F Cum. Dryflow 58.7 MMCF Ranarex SpGr 0.963

Report basis: ☐ Sample as received
☒ Sample less 0.38 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.3</u>	_____	Argon-37	_____
Oxygen	_____	_____	Argon-39	_____
Argon	_____	_____	_____	_____
Carbon Monoxide	_____	_____	Krypton-85	<u>250 + 3</u>
Carbon Dioxide	<u>41.4</u>	_____	Xenon-133	_____
_____	_____	_____	Xenon-131m	_____
Hydrogen	<u>4.96</u>	_____	_____	_____
Methane	<u>51.3</u>	_____	Radon-222	_____
Ethane	<u>1.76</u>	_____	_____	_____
Propane	<u>0.24</u>	_____	Tritium as hydrogen	_____
i - butane	_____	_____	Tritium as methane	_____
n - butane	<u>0.10</u>	_____	Tritium as ethane	_____
C ₅ + hydrocarbons	<u>0.06</u>	_____	Tritium as propane	_____
_____	_____	_____	_____	_____
_____	_____	_____	Total tritium	(_____)
Helium	_____	_____	Carbon-14 monoxide	_____
Neon	_____	_____	Carbon-14 dioxide	_____
Krypton	_____	_____	Carbon-14 in methane	_____
Xenon	_____	_____	_____	_____
_____	_____	_____	Sum Total	_____
Total	<u>100</u>	_____	Measured Total	<u>270 + 10</u>

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.
Value has been corrected for all appropriate background sources.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14- 137
Collection Time 1415 Collection Date 3 Feb. 1974
Sample Container 500 ml cylinder # 5 Sample Pressure 375 psig @ 22 °C
Remarks _____

Bottom hole pressure 992 psig Dryflow rate 4.5 MMCF/D Calculated SpGr 0.934
Flowing temperature 449 °F Cum. Dryflow 66.8 MMCF Ranarex SpGr 0.950

Report basis: ☐ Sample as received
☒ Sample less 0.09 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	0.3		Argon-37	
Oxygen			Argon-39	
Argon				
Carbon Monoxide			Krypton-85	<u>244 + 3</u>
Carbon Dioxide	40.4		Xenon-133	
			Xenon-131m	
Hydrogen	4.89		Radon-222	
Methane	52.2			
Ethane	1.83		Tritium as hydrogen	
Propane	0.28		Tritium as methane	
i - butane	0.04		Tritium as ethane	
n - butane	0.07		Tritium as propane	
C ₅ + hydrocarbons	0.04			
			Total tritium	(_____)
Helium			Carbon-14 monoxide	
Neon			Carbon-14 dioxide	
Krypton			Carbon-14 in methane	
Xenon				
			Sum Total	
Total	100		Measured Total	<u>250 + 10</u>

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14- 139
Collection Time 1425 Collection Date 5 Feb. 1974
Sample Container 500 ml cylinder # 3(W) Sample Pressure 390 psig @ 22 °C

Remarks _____

Bottom hole pressure 825 psig Dryflow rate 3.9 MMCF/D Calculated SpGr 0.928
Flowing temperature 449°F Cum. Dryflow 75.1 MMCF Ranarex SpGr 0.938

Report basis: ☐ Sample as received
☒ Sample less 0.10 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	0.2		Argon-37	
Oxygen			Argon-39	
Argon				
			Krypton-85	212 ± 5
Carbon Monoxide			Xenon-133	
Carbon Dioxide	38.6		Xenon-131m	
			Radon-222	
Hydrogen	4.70		Tritium as hydrogen	
Methane	54.0		Tritium as methane	
Ethane	1.90		Tritium as ethane	
Propane	0.29		Tritium as propane	
i - butane				
n - butane	0.14		Total tritium	()
C ₅ + hydrocarbons	0.07		Carbon-14 monoxide	
			Carbon-14 dioxide	
			Carbon-14 in methane	
Helium				
Neon			Sum Total	
Krypton			Measured Total	220 ± 10
Xenon				
Total	99.9			

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14- 140
Collection Time 1300 Collection Date 7 Feb. 1974
Sample Container 500 ml cylinder #5(W) Sample Pressure 300 psig @ 22 °C
Remarks _____

Bottom hole pressure 699 psig Dryflow rate 2.85 MMCF/D Calculated SpGr. 0.913
Flowing temperature 445 °F Cum. Dryflow 81.6 MMCF Ranarex SpGr 0.925

Report basis: ☐ Sample as received
☒ Sample less 0.10 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.2</u>		Argon-37	<u>5.78 + 0.06</u>
Oxygen			Argon-39	
Argon			Krypton-85	<u>156 + 2</u>
Carbon Monoxide			Xenon-133	
Carbon Dioxide	<u>37.6</u>		Xenon-131m	<u>0.031 + .001</u>
Hydrogen	<u>4.42</u>		Radon-222	<u>0.55 + 0.02</u>
Methane	<u>55.2</u>		Tritium as hydrogen	<u>1.12 + 0.03</u>
Ethane	<u>1.99</u>		Tritium as methane	<u>11 + 4</u>
Propane	<u>0.30</u>		Tritium as ethane	<u>0.37 + 0.01</u>
i - butane			Tritium as propane	<u>0.031 + 0.004</u>
n - butane	<u>0.15</u>		Total tritium	<u>(12 + 4.0)</u>
C ₅ + hydrocarbons	<u>0.10</u>		Carbon-14 monoxide	
			Carbon-14 dioxide	
Helium			Carbon-14 in methane	
Neon				
Krypton			Sum Total	<u>175 + 5</u>
Xenon			Measured Total	<u>190 + 10</u>
Total	<u>100</u>			

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Project Rio Blanco Report Date 8/15/74
 Sample Source RB-E-01 LLL Sample No. 73-1-14- 141
 Collection Time 1310 Collection Date 7 Feb. 1974
 Sample Container 500 ml cylinder # 26 Sample Pressure 300 psig @ 22 °C

Remarks _____
 Bottom hole pressure 698 psig Dryflow rate 2.85 MMCF/D Calculated SpGr: 0.895
 Flowing temperature 445°F Cum. Dryflow 81.6 MMCF Ranarex SpGr 0.925

Report basis: ☐ Sample as received
☒ Sample less 0.14 % normal air
 (based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION		
Component	Volume %	ppm by Vol.
Nitrogen	<u>0.2</u>	
Oxygen		
Argon		<u>7.3 ± 1.8</u>
Carbon Monoxide		
Carbon Dioxide	<u>35.8</u>	
Hydrogen	<u>4.48</u>	
Methane	<u>57.0</u>	
Ethane	<u>2.02</u>	
Propane	<u>0.32</u>	
i - butane		
n - butane	<u>0.15</u>	
C ₅ + hydrocarbons	<u>0.09</u>	
Helium		<u>49 ± 10</u>
Neon		<u>2.7 ± 0.7*</u>
Krypton		<u><0.004 ± 0.002*</u>
Xenon		<u><0.005 ± 0.001*</u>
Total	<u>100</u>	

RADIONUCLIDE CONCENTRATION	
Component	☒ pCi/ml (STP) ☐
Argon-37	<u>6.31 ± 0.08</u>
Argon-39	
Krypton-85	<u>167 ± 3</u>
Xenon-133	
Xenon-131m	
Radon-222	
Tritium as hydrogen	
Tritium as methane	
Tritium as ethane	
Tritium as propane	
Total tritium	()
Carbon-14 monoxide	
Carbon-14 dioxide	
Carbon-14 in methane	
Sum Total	
Measured Total	<u>(~ 180) value estimated</u>

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*Value has been corrected for all appropriate background sources.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-122
Collection Time 1400 Collection Date 9 Feb. 1974
Sample Container 500 ml cylinder #11(W) Sample Pressure 220 psig @ 22 °C
Remarks _____

Bottom hole pressure 624 psig Dryflow rate 2.20 MMCF/D Calculated SpGr 0.903
Flowing temperature 445 °F Cum. Dryflow 86.5 MMCF Ranarex SpGr 0.921

Report basis: ☐ Sample as received
☒ Sample less 0.24 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	0.1		Argon-37	<u>4.37 ± 0.04</u>
Oxygen			Argon-39	
Argon		<u>7.1 ± 1.8</u>	Krypton-85	<u>125 ± 2</u>
Carbon Monoxide			Xenon-133	
Carbon Dioxide	36.5		Xenon-131m	<u>0.05 ± 0.02</u>
Hydrogen	4.13		Radon-222	<u>0.40 ± 0.01</u>
Methane	56.6		Tritium as hydrogen	<u>1.06 ± 0.04</u>
Ethane	2.03		Tritium as methane	<u>5.2 ± 0.1</u>
Propane	0.32		Tritium as ethane	<u>0.30 ± 0.01</u>
i - butane			Tritium as propane	<u>0.055 ± 0.001</u>
n - butane	0.16		Total tritium	<u>(6.6 ± 0.1)</u>
C ₅ + hydrocarbons	0.08		Carbon-14 monoxide	
Helium		<u>52 ± 10</u>	Carbon-14 dioxide	<u>0.25 ± 0.01</u>
Neon		<u>2.8 ± 0.7*</u>	Carbon-14 in methane	
Krypton		<u><0.03 ± 0.01*</u>	Sum Total	<u>137 ± 2</u>
Xenon		<u><0.014 ± 0.001*</u>	Measured Total	<u>150 ± 10</u>
Total	100			

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-124
Collection Time 1440 Collection Date 12 Feb. 1974
Sample Container 500 ml cylinder #9 (W) Sample Pressure 190 psig @ 22 °C
Remarks _____

Bottom hole pressure 530 psig Dryflow rate 1.9 MMCF/D Calculated SpGr: 0.914
Flowing temperature 440°F Cum. Dryflow 92.9 MMCF Ranarex SpGr 0.934

Report basis: ☒ Sample as received
☐ Sample less _____ % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION			RADIONUCLIDE CONCENTRATION	
Component	Volume %	ppm by Vol.	Component	☒ pCi/ml (STP) ☐
Nitrogen	<u>0.2</u>	_____	Argon-37	_____
Oxygen	_____	_____	Argon-39	_____
Argon	_____	_____	_____	_____
Carbon Monoxide	_____	_____	Krypton-85	<u>100 + 2</u>
Carbon Dioxide	<u>37.3</u>	_____	Xenon-133	_____
Hydrogen	<u>3.52</u>	_____	Xenon-131m	_____
Methane	<u>56.3</u>	_____	Radon-222	_____
Ethane	<u>2.06</u>	_____	Tritium as hydrogen	_____
Propane	<u>0.34</u>	_____	Tritium as methane	_____
i - butane	_____	_____	Tritium as ethane	_____
n - butane	<u>0.18</u>	_____	Tritium as propane	_____
C ₅ + hydrocarbons	<u>0.13</u>	_____	_____	_____
_____	_____	_____	Total tritium (_____)	
Helium	_____	_____	Carbon-14 monoxide	_____
Neon	_____	_____	Carbon-14 dioxide	_____
Krypton	_____	_____	Carbon-14 in methane	_____
Xenon	_____	_____	_____	_____
_____	_____	_____	Sum Total	_____
Total	<u>100</u>	_____	Measured Total	<u>104 + 5</u>

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14-128
Collection Time 1320 Collection Date 14 Feb. 1974
Sample Container 500 ml cylinder # 12 (W) Sample Pressure 175 psig @ 22 °C

Remarks _____
Bottom hole pressure 488 psig Dryflow rate 1.52 MMCF/D Calculated SpGr 0.922
Flowing temperature 438 °F Cum. Dryflow 96.3 MMCF Ranarex SpGr 0.942

Report basis: ☐ Sample as received
☒ Sample less 0.10 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.1</u>	
Oxygen		
Argon		<u>11.5 ± 0.3</u>
Carbon Monoxide		
Carbon Dioxide	<u>37.9</u>	
Hydrogen	<u>3.26</u>	
Methane	<u>56.0</u>	
Ethane	<u>2.04</u>	
Propane	<u>0.35</u>	
i - butane		
n - butane	<u>0.16</u>	
C ₅ + hydrocarbons	<u>0.10</u>	
H ₂ S	<u>0.03</u>	
Helium		<u>64 ± 12</u>
Neon		<u>2.7 ± 0.7*</u>
Krypton		<u><0.008±0.002*</u>
Xenon		<u><0.002±0.001*</u>
Total	<u>100</u>	

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	<u>2.3 ± 0.2</u>
Argon-39	
Krypton-85	<u>74.3 ± 0.9</u>
Xenon-133	
Xenon-131m	
Radon-222	
Tritium as hydrogen	<u>0.89 ± 0.01</u>
Tritium as methane	<u>2.55 ± 0.04</u>
Tritium as ethane	
Tritium as propane	
Total tritium	<u>(3.5 ± 0.1) value est.</u>
Carbon-14 monoxide	
Carbon-14 dioxide	
Carbon-14 in methane	
Sum Total	<u>80 ± 1</u>
Measured Total	<u>84 ± 4</u>

The probable accuracy of the above results is 1-5 units in the last reported figure unless otherwise indicated.

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Project Rio Blanco Report Date 8/15/74
Sample Source RB-E-01 LLL Sample No. 73-1-14- 130
Collection Time 0745 Collection Date 15 Feb. 1974
Sample Container 500 ml cylinder. #8(W) & 10(W) Sample Pressure 100&130 psig @ 22 °C
Remarks _____

Bottom hole pressure 454 psig Dryflow rate 1.44 MMCF/D Calculated SpGr 0.9306
Flowing temperature 438° F Cum. Dryflow 97.4 MMCF Ranarex SpGr 0.944

Report basis: ☐ Sample as received
☒ Sample less 0.52 % normal air
(based on oxygen).

Decay Corrected to: ☒ Sample Time
☐ _____

CHEMICAL COMPOSITION

Component	Volume %	ppm by Vol.
Nitrogen	<u>0.02</u>	
Oxygen		
Argon		<u>16 + 4</u>
Carbon Monoxide		
Carbon Dioxide	<u>38.8</u>	
Hydrogen	<u>3.19</u>	
Methane	<u>55.3</u>	
Ethane	<u>2.02</u>	
Propane	<u>0.36</u>	
i - butane	<u>0.03</u>	
n - butane	<u>0.13</u>	
C ₅ + hydrocarbons	<u>0.09</u>	
H ₂ S	<u>0.05</u>	
Helium		<u>49 ± 10</u>
Neon		<u>1.8 + 0.5*</u>
Krypton		<u><0.03+0.02*</u>
Xenon		<u><0.012+0.002*</u>
Total	<u>100</u>	

RADIONUCLIDE CONCENTRATION

Component	☒ pCi/ml (STP) ☐
Argon-37	<u>2.14 + 0.02</u>
Argon-39	
Krypton-85	<u>66 + 2</u>
Xenon-133	
Xenon-131m	<u>0.011 + 0.002</u>
Radon-222	<u>0.23 + 0.01</u>
Tritium as hydrogen	<u>1.41 + 0.03</u>
Tritium as methane	<u>3.34 + 0.03</u>
Tritium as ethane	<u>0.104 + 0.004</u>
Tritium as propane	<u>0.021 + 0.001</u>
Total tritium	<u>(4.88 + 0.05)</u>
Carbon-14 monoxide	
Carbon-14 dioxide	<u>0.30± 0.01</u>
Carbon-14 in methane	
Sum Total	<u>74 + 2</u>
Measured Total	<u>79 + 4</u>

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