PROJECT RIO BLANCO
ALTERNATE REENTRY WELL RB-AR-2
HOLE HISTORY

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I. INTRODUCTION

Project Rio Blanco was the first phase of a program to determine the commercial development potential of a low-permeability, gas-bearing formation by fracturing the formation with nuclear explosives. A well (RB-E-01) was drilled for this purpose in the Piceance Basin in Rio Blanco County, Colorado. The well penetrated a formation consisting of gas-bearing sandy shale sections too impermeable for commercial gas production by conventional methods.

The following organizations participated in the program:

Continental Oil Company (CONOCO)
U.S. Energy Research and Development Administration (ERDA)
(formerly the U.S. Atomic Energy Commission)
Lawrence Livermore Laboratory (LLL)
Equity Oil Company (Equity)
EG&G, Inc. (EG&G)
CER Geonuclear Corporation (CER)

Three 30-kt nuclear explosives were emplaced in the well, one each at depths of 5838, 6230, and 6689 feet below ground level. All were detonated simultaneously on May 17, 1973, in an attempt to fracture a vertical section approximately 1300 feet high. The resultant fractured zone through this section was expected to be several hundred feet in diameter.

Reentry drilling through the emplacement casing was not begun until nearly four months after the detonation in order to allow short-lived radionuclides to decay. Crushed or displaced casing was encountered near the chimney and it became necessary to direct (by whipstocking) the reentry hole to the side of the original emplacement hole and then parallel to it until the fractured zone was encountered. Reentry drilling was completed on October 12, 1973.

Calibration tests were conducted and then on November 14, drawdown testing began and continued until November 20. These tests indicated that production characteristics were below expectations. A different rare gas tracer was emplaced with each explosive for the purpose of identifying gas from each respective zone. Only the top tracer was detected, indicating that interconnection of the top chimney with the lower regions had not been accomplished.

Mechanical difficulties created by high temperatures necessitated that testing be interrupted to permit modification of the equipment. Testing was resumed on January 28, 1974, and continued until the well was shut in on February 15, 1974. A total of 98 million cubic feet of dry chimney gas had been produced during both phases of testing.

The second phase of testing (January-February) confirmed that the upper chimney is not well connected with others and that the stimulated reservoir adjacent to the top chimney has a much lower flow capacity than expected.

In order to completely evaluate the reservoir stimulation effects of the detonation, additional data were required. An alternate reentry hole (RB-AR-2) was planned to obtain this data by entering the middle chimney region. The hole was to be drilled directionally from the Fawn Creek Government Number 1 well pad approximately 1200 feet to the southwest.

II. DRILLING OPERATION

A. DRILLING CONTRACTOR

Signal Drilling Company, Inc., under ERDA Prime Contract AT(26-1)-629.

B. DRILLING RIG SPECIFICATIONS

<u>Rig</u>	National 55 drawworks with 2-engine type BT-24 compound and 2 pump drive.
<u>Power</u>	2--Waukesha F2895 diesel engines with Series 16000 Twin torque converters, rated at 1200 hp, hoisting, 1200 rpm, equipped with Air-x-changers.
<u>Pump No. 1</u>	National K-700 (8" x 16") 700 hp.
<u>Pump No. 2</u>	Emsco DA-500 (7 1/2" x 16") 500 hp.
<u>Mast</u>	131' Lee C. Moore Cantilever, 550,000 lb. capacity.
<u>Substructure</u>	Additional "pony base" increased total substructure height to 20 feet.
<u>Mud Tanks</u>	3 steel mud pits 750 bbl. total capacity equipped with Thompson shale shaker.

C. DRILLING SUMMARY

Conductor casing (24-inch diameter) was set and cemented at a depth of 25 feet. A 12 1/4-inch hole was drilled from 25 feet to 166 feet (all depths are from ground level). The 12 1/4-inch hole was enlarged to 22 inches and 16-inch O.D. casing was landed at 166 feet. The casing annulus was filled to surface with cement.

A 9 7/8-inch hole was drilled from the 16-inch casing shoe to 3461 feet with a conventional drilling assembly. Hole deviation, as determined by single-shot surveys, was 3 1/4° at 3419 feet and 3 1/2° at 3461 feet.

Directional control with Turbo-drill assembly was commenced at 3461 feet and continued to a measured depth (MD) of 6124 feet or

5956 feet true vertical depth (TVD). A magnetic multishot survey confirmed that the accumulated deviation had reached approximately 46° with a target azimuth of N 20° E at 6009 feet MD or approximately 5871 feet TVD and had decreased to approximately 40° at 6103 feet MD with an azimuth of N 12° E. This accumulated deviation was not sufficient at this depth to allow the hole to ultimately reach the target (middle chimney area).

The decision was made to move back up the hole and begin a sidetrack hole from a point which would allow the deviation angle to increase at the proper rate so that the hole would reach the target. The hole was plugged back to an approximate depth of 5800 feet MD. The cement plug was dressed off to 5834 feet and a 9 5/8-inch sidetrack hole was drilled from that point to 5996 feet MD. A single-shot survey taken at 5975 feet MD indicated an accumulated deviation of 39 1/4° with an azimuth of N 20° E. The maximum possible rate of angle buildup between this point and the intended 7-inch casing point would be insufficient to accumulate a deviation of 63°. Hole deviation of 63° would be required at the 7-inch casing point in order for the hole to ultimately hit the target (middle chimney).

It was decided at this point to try for an intersection with the bottom chimney. The 9 7/8-inch hole was drilled ahead to 6488 feet MD (6232 feet TVD) where the 7-inch O.D. casing was set at 6476 feet MD and cemented in two stages. See Section II-F for details of initial cementing and Section G, Remedial Cementing Operations, for squeeze cementing behind 7-inch casing.

Cement was drilled out from inside the 7-inch O.D. casing following the remedial squeezing and a 6 1/4-inch hole was drilled to 6975 feet MD. Circulation loss first occurred at this depth on October 21, 1974, indicating communication with the lower fracture region. The circulating media was changed over to a super visbes-tos mud system and drilling continued to 7045 feet MD.

Two cores were taken between the 7-inch O.D. casing point and the depth of lost circulation. Core No. 3 was cut from 7045 feet MD to 7057 feet MD (6677 feet TVD), where the coring assembly became stuck. While trying to work it free, the coring assembly parted, leaving the diamond core bit and bottom 2 feet of the core barrel assembly in the hole with the top at 7055 feet MD.

The 677 feet of 5-inch O.D. liner with liner hanger was run and set at 7049 feet MD with the top at 6372 feet MD inside the 7-inch O.D. casing.

The 6144.5 feet of 4 1/2-inch O.D. casing was set at 6150 feet MD and the annulus was filled with cement to the surface. The cement shoe was drilled out of the 4 1/2-inch O.D. casing with a 3 5/8-inch bit and a string of 2 3/8-inch O.D. tubing was run and landed at 6494 feet MD.

Following installation of the production wellhead, the 5-inch O.D. liner was perforated from 6937 feet to 7037 feet MD with one shot per foot. Nitrogen was injected in the annulus to induce gas flow. The well was shut in and the rig released on November 2, 1974.

D. DRILLING MUD

The well was drilled with approximately 9 pounds per gallon mud, viscosity of approximately ± 60 seconds, water loss ± 4 cc and 2% to 4% oil was added to the system from 5313' to 6488' or to the bottom of the 9 7/8" hole. During drilling of the 6 1/4" hole, the mud weight remained about the same, water loss was not controlled appreciably, and the viscosity changed to 40+ seconds. Circulation was completely lost at 6977', at which time bentonite, visbestos, and caustic soda were added to the mud system. A desander and shale shaker were used to reduce solids in the system.

E. CASING AND DOWNHOLE EQUIPMENT (All depths measure from ground level)

1. Conductor Casing

24" casing was set and cemented to the surface at 25' in a 12' x 8' x 9' deep steel-lined cellar.

2. Surface Casing

16" O.D., 65 #/ft, H-40, 8 round thread ST&C casing was set at 166' with a guide shoe on bottom and a baffle plate on top of the bottom joint. The shoe and 3 collars were tack welded. A centralizer was located at 146'.

3. Intermediate Casing

10 3/4" O.D., 45.50 #/ft, P-110 buttress thread casing was set at 2186' with a float shoe on bottom, a float collar at 2134', and a stage cementing collar at 1032'. Ran 3 metal petal baskets above and below the collar. 20 centralizers were used throughout the string. A thread locking compound was used on the float shoe and float collar.

4. 7" Long String

7" O.D., 23 #/ft, CYS-95 buttress thread casing was set at 6476' with a float shoe on bottom and a float collar at 6426'. The Lamb JAM system was used on the buttress threads. 2 centralizers were placed on the bottom joint, 1 centralizer on each joint of casing to the 50th joint from bottom. 1 centralizer on every other joint from the 50th to 90th joint. 1 centralizer on every 3rd joint to the 140th joint.

A stage cementing collar was located at 3984'. 5 molded cement baskets were placed from 4094' to 6125'. 6 molded cement baskets were placed from 1990' to 3605'.

5. 5" Liner

5" O.D. liner was run in the hole to 7049' with the top set inside the 7" O.D. casing at 6372'. The liner was run as follows:

<u>Depth-Ft.</u>	<u>No. Joints</u>	<u>Grade</u>	<u>Weight Per Ft.</u>	<u>Thread</u>	
6372'-6375'					Float Shoe and Collar
6375'-6528'	5	J-55	15.50#	FJ Hydril	
6528'-6529'					Crossover Sub
6529'-7034'	12	J-55	14.78#	Atlas Bradford	
7034'-7035'					Crossover Sub
7035'-7038'					Hanger Swivel
7038'-7049'					Hanger and Slips

The liner was not cemented and later perforated from 6937' to 7049' with 1 hole per foot.

6. 4 1/2" Inner String

After the 5" O.D. liner was run, a Baker Model FA retainer production packer was set in the 7" O.D. casing at 6150'. 4 1/2" O.D., 13.50 #/ft, N-80 buttress thread casing was run inside the 7" O.D. casing with a latch-in type stinger on bottom and a Baker Model J stage cementing collar 1' off bottom. The stinger was run into the retainer at 6150' to anchor the 4 1/2" O.D. casing with the stage collar being located at 6149'.

7. 2 3/8" Production Tubing

Prior to running the tubing, the stage collar in the 4 1/2" O.D. casing and the retainer packer were drilled through with a 3 5/8" bit. Ran 2 3/8" O.D., 4.70 #/ft, J-55, EUE tubing open ended to 6494' with an Otis Type S nipple 2 joints from bottom.

F. INITIAL CEMENTING OPERATIONS

1. Surface Casing

16" O.D. casing was cemented out the shoe at 166' using Dowell with 235 sacks of RFC cement with good returns to surface. Total slurry volume was 375 ft³. The calculated annular volume was 202 ft³.

2. Intermediate Casing

10 3/4" O.D. casing was cemented out the shoe 2186' using Dowell with 350 sacks of Class C cement, 20% cement silica, and 12% gel followed by 100 sacks of Class C cement and 35% cement silica. The slurry volume was 1089 ft³. Stage #2 was cemented out the stage collar at 1032' with 350 sacks of Class C cement, 20% cement silica, and 12% gel followed by 50 sacks of Class C cement and 35% cement silica. The slurry volume was 1005 ft³. The total calculated annular volume was 1307 ft³. Total volume used was 2094 ft³.

3. Long String

7" O.D. casing was cemented out of the shoe at 6476' using Dowell with 950 sacks of Class G cement, 35% silica sand, 10% salt, 0.7% D-13 retarder, and 0.25% D-65 antifoamant. The slurry volume was 1398 ft³. Good to partial returns with intermittent complete loss of returns during cementing and displacing. Cemented stage #2 out the collar at 3984' with 1250 sacks of the same slurry as used out the shoe. Good returns at the start of mixing, decreasing to partial returns at the time mixing was completed. No returns after dropping plug to displace. The slurry volume was 2178 ft³. The total calculated annular volume was 2272 ft³. Total cement slurry used was 3576 ft³.

4. 4 1/2" Inner String

4 1/2" O.D. casing was set inside the 7" O.D. casing at 6150' and cemented out a stage collar at 6149' using Dowell with 500 sacks of Class G cement with 35% silica sand, 10% salt, and 0.5% D-13 retarder. An estimated 7 barrels of slurry was circulated out at the surface. The calculated volume of cement left in the annulus was 709 ft³. The calculated annular volume was 679 ft³.

G. REMEDIAL CEMENTING OPERATIONS

Eleven (11) remedial squeeze operations were performed on the 7" O.D. casing after which the casing was pressure tested to 3000 psi. Pressure testing of the squeeze jobs can be found in the Hole History in Appendix A. See Table No. 1, Summary of Remedial Cementing, page B-1.

1. Remedial Cementing Job #1 (9/11/74)

The 7" O.D. casing was perforated from 2110' to 2111' with 4 holes (bottom of the 10 3/4" O.D. casing at 2186'). The perforations were cemented with 135 barrels of slurry made up of 500 sacks of Class G cement with 35% silica sand and 10% salt. Good returns to the surface.

2. Remedial Cementing Job #2 (9/18/74)

The stage cement collar at 3984' was squeezed with a Baker retrievable packer set at 3025' using 13.5 barrels of slurry made up of 50 sacks of Class G cement, 35% silica sand, 10% salt, and 0.7% D-60 fluid loss additive. Final squeeze pressure was 3750 psi.

3. Remedial Cementing Job #3 (9/21/74)

The perforations from 2110' to 2111' were squeezed with a Baker retrievable packer set at 1713' using 6 barrels of mud acid with radioactive tracer ahead of 68 barrels of cement slurry made up of 250 sacks of Class G cement with 35% silica sand, 10% salt, and 0.7% D-60 fluid loss additive. Pumped 56 barrels of slurry into the perforations at 1000 psi. Stage squeezed 6 barrels of slurry at the rate of 1/2 barrel every 30 minutes leaving 6 barrels inside the 7" O.D. casing. Final squeeze pressure was 3000 psi.

4. Remedial Cementing Job #4 (9/23/74)

The perforations from 2110' to 2111' were squeezed again with a Baker retrievable packer set at 1716' using 250 gallons of mud acid ahead of 100 sacks of Class G cement with 35% silica sand, 10% salt, and 0.75% D-60 fluid loss additive. Squeezed 20 barrels into the perforations leaving 7 barrels inside the 7" O.D. casing. Final squeeze pressure 3000 psi.

5. Remedial Cementing Job #5 (9/26/74)

The stage cement collar at 3984' was squeezed again with a Baker retrievable packer set at 3134' using 6 barrels of mud acid ahead of 5.3 barrels of Class G cement with 2% calcium chloride followed by 13.4 barrels of Class G cement with 35% silica sand, 5% salt, and 0.75% D-60 fluid loss additive. Displaced 12 barrels into the collar at a final pressure of 3000 psi leaving 6.7 barrels inside the 7" O.D. casing.

6. Remedial Cementing Job #6 (9/27/74)

The stage cement collar at 3984' was squeezed for the third time with a Baker retrievable packer set at 3315' using 250

gallons of mud acid ahead of 10 barrels of Class G cement with 2% calcium chloride followed by 13.5 barrels of Class G cement with 35% silica sand, 5% salt, and 0.75% of D-60 fluid loss additive. Squeezed 17.3 barrels into the collar leaving 6.2 barrels in the 7" O.D. casing. Final squeeze pressure was 3400 psi.

7. Remedial Cementing Job #7 (9/28/74)

The 7" O.D. casing was perforated at 2920' with 4 holes and at 2290' with 4 holes. A Baker Model K cement retainer was set at 2741' and the perforations at 2920' were squeezed with 10 barrels of Class G cement with 2% calcium chloride and a radioactive tracer followed by 57 barrels of Class G cement with 35% silica sand, 5% salt, and 0.75% of D-60 fluid loss additive. Squeezed 61.5 barrels of slurry into the perforations leaving 5.5 barrels in the 7" O.D. casing.

8. Remedial Cementing Job #8 (9/29/74)

The 7" O.D. casing was perforated at 2626' with 4 holes. A Baker Model K cement retainer was set at 2461'. An injection rate of 2 barrels per minute was established with no circulation out of the upper perforations at 2290'. The perforations at 2626' were squeezed with 10 barrels of Class G cement with 2% calcium chloride and a radioactive tracer followed by 57 barrels of Class G cement with 35% silica sand, 5% salt, and 0.75% D-60 fluid loss additive. Displaced all the cement out the perforations and pumped in an additional 10 barrels of water. Maximum pumping pressure was 1200 psi.

9. Remedial Cementing Job #9 (9/29/74)

The perforations at 2626' were squeezed again with 10 barrels of Class G cement with 2% calcium chloride and a radioactive tracer followed by 42.7 barrels of Class G cement with 35% silica sand, 5% salt, and 0.75% D-60 fluid loss additive. Squeezed 46.7 barrels into the perforations leaving 6 barrels inside the 7" O.D. casing. Final squeeze pressure was 3000 psi.

10. Remedial Cementing Job #10 (9/30/74)

The perforations at 2290' were squeezed with a Baker retrievable packer set at 2157' using 20.3 barrels of Class G cement with 2% calcium chloride followed by 42.7 barrels of Class G cement with 35% silica sand and 5% salt. Displaced 58.7 barrels through the perforations leaving 4.3 barrels in the 7" O.D. casing. Final squeeze pressure was 3200 psi.

11. Remedial Cementing Job #11 (10/5/74)

The perforations at 2110' to 2111' were squeezed again with a Baker retrievable packer set at 1905' with 250 gallons of mud acid ahead of 20.3 barrels of Class G cement with 2% calcium chloride followed by 38.7 barrels of Class G cement, 35% silica sand, and 3% salt. Displaced 54.7 barrels into the perforations leaving 4.3 barrels inside the 7" O.D. casing. Final squeeze pressure was 3300 psi.

H. CORING AND SAMPLING

1. Coring

Three core runs were made at the intervals selected by LLL as follows:

Core No. 1--6723' to 6750' with 27' recovery.

Core No. 2--6911' to 6925.5' with 13.5' recovery.

Core No. 3--7045' to 7057' with core bit and core barrel bit subparted and left in hole. No core recovery. No additional hole drilled beyond this point.

2. Cutting Samples

Sample cuttings were collected from drilling fluid returns from the surface to total depth as follows:

Surface to 5000'--single samples every 30'.

5000' to 6476' (7" casing setting point)--duplicate samples every 10'.

6476' to T.D.--every 5' or as directed by LLL.

3. Sidewall Sampling

Drilling was discontinued at 7057' MD and 6676.87' TVD and no sidewall sampling was undertaken because of the fish (core bit and core barrel bit sub) left in the hole.

I. LOGGING

See Table No. 2, Log Index Sheet, Appendix B.

J. DIRECTIONAL SURVEYS

See Table No. 3, Directional Surveys, Appendix B.

K. BIT RECORD

See Table No. 4, Bit Record, Appendix B.

L. WELLHEAD EQUIPMENT

The completed wellhead "Christmas tree" at the conclusion of the drilling operation consisted of a Series 1500 (5000 psi working pressure, 10,000 psi test pressure) assembly, except the 16" x 10 3/4" starting head which was a Series 900. All wellhead equipment was furnished by the Oil Center Tool Division of FMC Corporation and consisted of the following (see Figure 4, page D-4):

<u>Item</u>	<u>Description</u>
1.	Casing Head, Type C-22, 16" O.D. Slip-On & Weld W/Test Port Female Bottom x 16" 3000#WP Flanged Top W/2-2" LPO's including: <ul style="list-style-type: none">a. Casing Hanger, Type C-21, 16" x 10 3/4" O.D.b. Ring Gasket, API Metal, R-66c. (1 Set) Studs & Nuts, Udylited, 1 5/8" x 11 3/4"
2.	Spool, Casing Head, Type C-22-00, 10 3/4" O.D. 5000#WP, 16" 3000#WP Flanged Bottom x 10" 5000#WP Flanged Top W/Two 2" 5000#WP Flanged Outlets including: <ul style="list-style-type: none">a. Casing Hanger, Type C-21, 10" x 7"b. Ring Gasket, API Metal, R-54c. (1 Set) Studs & Nuts, Udylited, 1 7/8" x 13 3/4"d. Flange, Companion, 2" 5000#WPe. Ring Gaskets, API Metal, R-24f. (2 Set) Studs & Nuts, Blk., 7/8" x 6"
3.	Spool, Casing Head, Type C-22-BG, 9 5/8" O.D. Blank Bottom x 10" 5000#WP Flanged Top & BTM W/Two 2" 5000#WP Flanged Outlet (Note: Above item externally coated with Dimetecote #3) <ul style="list-style-type: none">a. Reducer Bushing, Type 4-0, 9 5/8" x 7" O.D.b. Valve, O-C-T Model 20, 2" x 2 1/16" 5000#WP Full Port. F. E.

<u>Item</u>	<u>Description</u>
c.	Flange Comp 2" 5000#WP
d.	Plug, Type V. R., 2"
e.	Bull Plug, Type B-4, 2"
f.	Bull Plug, Type "B," 2"
g.	Ring Gasket, API Metal, R-24
h.	(3 Set) Studs & Nuts, Udylited, 7/8" x 6"
4.	Tubing Head Assembly, <u>SPECIAL</u> , Type TCM-BG, 9" 5000#WP, 10" 5000#WP Flanged Bottom x 6" 5000#WP Flanged Top W/Two 3" 5000#WP Studded Side 45° Outlets & V.R. Threads W/Preparation for Style #300-4 Inner Seal Pockets in Outlets W/Test Ports in Bottom & Counterbored F/9" O.D. Bushing (Hi Temp. Packoff) including:
a.	Reducer Bushing, Type #4-0, 9" x 7" O.D. W/Viton Packing Rings
b.	Tubing Hanger Assembly, Type TC-EN, 6" x 2 7/8" O.D. EUE 8RF W/ABC, Mod. Seal & Extended Neck W/2 1/2" Type "IS" OCT BPV Groove & To Fit #83-360-684 Tubing Head & Pt. #61-943-822 Valve
c.	Flanges, Blind, 3" 5000#WP W/1" FPT Tapped Male & Counterbored F/Style #300-4 Inner Seal Sleeve W/Test Port
d.	Seal Sleeve Assemblies, O-C-T Style #300-4, 3" F/3" 5000#WP Outlets Full Stainless Steel W/Viton "O" Rings
e.	Bushing, Forged Steel, 1" Male x 1/2" Female Hex. Head
f.	Needle Valves, Type MF, 1/2"
g.	Ring Gaskets, API Stainless Steel, R-35
h.	(2 Set) Studs & Nuts, Blk., 1 1/8" x 7 1/4"
5.	Adapter, Tubing Head, <u>SPECIAL</u> , Type #A-4-EN, 6" 5000#WP Studded Bottom x 2 1/2" 5000#WP Studded Top W/Bottom Counterbored F/6" O.D. Extended Neck Tubing Hanger (#82-740-088) & Top Bored W/Style #250-4 Seal Sleeve Complete W/Two Test Ports @ 180°
a.	Ring Gasket, API Stainless Steel, R-46

<u>Item</u>	<u>Description</u>
b.	Seal Sleeve Assembly, Style #250-4, 2 1/2" F/2 1/2" 5000#WP Studded Outlet <u>STAINLESS STEEL</u> W/Viton "O" Ring
c.	Ring Gaskets, API Stainless Steel, R-27
d.	(2 Set) Studs & Nuts, Blk., 1" x 6 1/2"
6.	Valves, W-K-M Type U-5008 GM, Pow-R-Seal, Model "M" W/T-26 Trim, 2 1/2" x 2 9/16" 5000#CWP W/OPG Bonnet, F.E. Prepared F/O-C-T #250-4 Seal Pockets Per Dwg. #02-371-020 Seats to Have CTFE Inserts H/W/O
a.	Ring Gasket, API Metal, R-54
b.	(1 Set) Studs & Nuts, Udylited, 1 7/8" x 13 3/4"
c.	Casing Hanger, Type C-22, 10" x 4 1/2"
d.	Reducer Bushing, Type 4-0, 9" x 4 1/2" W/Snap Ring

III. DRILLING OPERATIONS SUPPORT SERVICES

A. DIRECTIONAL DRILLING

Oil Well Drilling Control

B. CORING

Christensen Diamond Products Company

C. DRILLING MUD

Magcobar (Oilfield Products Division of Dresser Industries, Inc.)

D. LOGGING

Schlumberger Well Services
Birdwell (Division of Seismograph Services Corporation)
Sperry-Sun Well Surveying Company

E. CASING CREWS

Parrish Oil Tools
Lamb Industries

F. CEMENTING SERVICES

Dowell (Division of Dow Chemical Company)
Halliburton Services

G. PRESSURE TESTING

Yellow Jacket Testing

H. SWABBING SERVICES

Otis Engineering Company (Division of Halliburton Company)

I. PRESSURE CONTROL

Drilling Well Control, Inc.

J. PERFORATING

Oil Well Perforators, Inc.

APPENDIX A

WELL RB-AR-2

DAILY DRILLING REPORTS

RB-AR-2
Daily Drilling Report

Note: Reported work under each date covers the time interval from 0 hours to 2400 hours. All depths reported are from ground level (GL) elevation 20' below the kelly bushing.

Site preparation work was started on 5/24/74 and completed on 6/3/74. 24" conductor casing was set and cemented at 25' GL. A 12' long x 8' wide x 9' deep cellar was excavated and cribbed with 3" boards. A welded 1/8" steel liner was then installed inside the cribbing.

Started moving in Signal Drilling Company, Inc., rig #14 and equipment on 5/27/74 and completed rigging up on 6/17/74.

- 6/17/74 Spudded hole at 1100 hours. Ran 12 1/4" bit #1 in the hole and drilled out cement from 22' to 25' and 12 1/4" hole to 166'. Lost circulation at 35' and collapsed the west side of the steel liner in the cellar. Restored circulation and continued drilling. Opened hole to 22" to 98' with bit #2. Drilled with conventional circulation using mud.
- 6/18/74 Opened 12 1/4" hole to 22" to a depth of 166'. Conditioned hole and pulled bit. Ran 6 joints (192.69') of 16" O.D., 65#, H-40, 8 round thread ST&C casing with a guide shoe on bottom and a baffle plate on top of the bottom joint. Set casing at 166' GL with a centralizer at 146'. Cemented annulus to the bottom of the cellar using Dowell with 235 sacks of RFC cement + 2% CaCl₂. Cement in place at 1315 hours. Started nipping up.
- 6/19/74 Repaired steel liner in cellar. Welded OCT casing head to the 16" O.D. casing. Installed and connected 16" Shaffer LWS double gate blowout preventer.
- 6/20/74 Tested blowout preventer to 400 psi. Ran 15" bit #3 in the hole and drilled out plug and cement from 129' and 15" hole to 363'.
- 6/21/74 Drilled 15" hole to 606'. Made trip for bit #4 at 541'.
- 6/22/74 Drilled 15" hole to 983'.
- 6/23/74 Drilled 15" hole to 1292'. Made trip for bit #5 at 1115'.
- 6/24/74 Drilled 15" hole to 1483'. Made trip for bit #6 at 1368'.
- 6/25/74 Drilled 15" hole to 1629'. Made trip for bit #7 at 1518'. Reamed 18' of out of gauge hole to bottom after trip.
- 6/26/74 Drilled 15" hole to 1847'. Made trip for bit #8 at 1672'.
- 6/27/74 Drilled 15" hole to 2118'. Made trip for bit #9 at 2108' and reamed 73' of out of gauge hole to bottom after trip.

6/28/74 Drilled 15" hole to 2187'. Conditioned hole for logging and pulled bit. Ran Schlumberger borehole geometry log to 2156'. Ran 15" bit in the hole and washed to bottom. Rigged up to run casing.

6/29/74 Ran 55 joints of 10 3/4" O.D., 45.50#, P-110 buttress thread casing and set at 2186' GL with a float shoe on bottom and a float collar at 2134' and a stage collar at 1032'. Ran 3 metal petal baskets above and below the stage collar. Used 20 centralizers throughout the string. Cemented stage #1 out bottom using Dowell with 350 sacks of Class C cement, 20% cement silica and 12% gel followed by 100 sacks of Class C cement and 35% cement silica. Cement in place 0845 hours. Set 10 3/4" slips in the casing head and removed 16" blowout preventer. Started cementing stage #2.

6/30/74 Cemented stage #2 out the stage collar with 350 sacks of Class C cement, 20% cement silica and 12% gel followed by 50 sacks of Class C cement and 35% cement silica. Cement in place at 0020 hours. Installed and connected blowout equipment stack consisting of a Cameron Type F double gate and a Hydril.

7/1/74 Ran 9 7/8" bit #10 in the hole and drilled out stage collar at 1032'. Drilled out cement from 2090' to 2165'. Ran Schlumberger cement bond log to 2172'. Ran Sperry-Sun gyroscopic multishot survey in and out of the hole on 50' stations to 2170'. Tested blowout equipment to 3000 psi.

7/2/74 Ran bit #11 in the hole and drilled out cement from 2165' to 2187' and 9 7/8" hole to 2445'.

7/3/74 Drilled 9 7/8" hole to 2788'. Made trip for bit #12 at 2611' and cleaned out 71' of fill.

7/4/74 Drilled 9 7/8" hole to 3127'.

7/5/74 Ran bit #13 in the hole and cleaned out 100' of fill. Drilled 9 7/8" hole to 3265'. Made trip for bit #14 at 3224'.

7/6/74 Drilled 9 7/8" hole to 3363'. Made trip for bit #15 at 3358'.

7/7/74 Drilled 9 7/8" hole to 3470'. Made trip for Dyna-Drill and bit #16 at 3461'.

7/8/74 Drilled 9 7/8" hole to 3690'. Made trip for bit #17 at 3631', cleaned out and reamed 12' to bottom.

7/9/74 Drilled 9 7/8" hole to 3787'. Made trip for bit #18 at 3778' and reamed out of gauge hole from 3740' to 3778'.

7/10/74 Drilled 9 7/8" hole to 3857'. Made trip for bit #19 at 3810' and laid down Dyna-Drill. Ran back in hole with conventional drilling assembly and reamed hole from 3450' to 3810'.

7/11/74 Drilled 9 7/8" hole to 4039' and pulled out of hole.

7/12/74 Ran bit #20 in the hole and drilled 9 7/8" hole to 4280'.

7/13/74 Drilled 9 7/8" hole to 4311'. Ran Sperry-Sun magnetic multishot survey on trip out of hole from 4311' to 2246'. Ran bit #21 in the hole and reamed 41' to bottom. Drilled 9 7/8" hole to 4421'.

7/14/74 Drilled 9 7/8" hole to 4502' and pulled out of hole. (Kickoff point for directionally drilled hole to middle chimney target.)

7/15/74 Ran Dyna-Drill, mule shoe sub for Sperry-Sun steering tool and bit #22 in the hole. Ran Sperry-Sun steering tool inside the drill pipe, tool would not seat in sub. Pulled out of hole and cleaned out mule shoe sub. Ran back in hole, tool would not seat, pulled out.

7/16/74 Cleaned out mule shoe sub. Ran back in hole and seated steering tool. Drilled 9 7/8" hole to 4554' and pulled out of hole.

7/17/74 Ran bit #23 in the hole and seated Sperry-Sun steering tool. Drilled 9 7/8" hole to 4632' and pulled out of hole. Changed out Dyna-Drill and ran bit #24 in the hole. Seated steering tool.

7/18/74 Drilled 9 7/8" hole to 4649'. Pulled out of hole and laid down Dyna-Drill. Ran back in hole with conventional drilling assembly and bit #25. Added 12 joints of 4 1/2" heavyweight drill pipe to string. Washed and reamed hole from 4469' to 4649'. Drilled 9 7/8" hole to 4666'.

7/19/74 Drilled 9 7/8" hole to 4778'. Ran Dyna-Drill, Sperry-Sun steering tool and bit #26 in the hole at 4730'.

7/20/74 Drilled 9 7/8" hole to 4849'. Laid down Dyna-Drill and ran bit #27 with conventional drilling assembly in the hole at 4824'.

7/21/74 Drilled 9 7/8" hole to 5009'.

7/22/74 Drilled 9 7/8" hole to 5044'. Ran Dyna-Drill, Sperry-Sun steering tool and bit #28 in the hole at 5016'.

7/23/74 Changed out Dyna-Drill and ran bit #29 in the hole. Drilled 9 7/8" hole to 5074'. Pulled out of hole and laid down Dyna-Drill.

7/24/74 Ran rerun bit #27 in the hole on conventional drilling assembly and drilled 9 7/8" hole to 5160'.

7/25/74 Drilled 9 7/8" hole to 5217'. Ran Dyna-Drill and bit #30 in the hole at 5203'.

7/26/74 Drilled 9 7/8" hole to 5263' and ran bit #31 in the hole.

7/27/74 Drilled 9 7/8" hole to 5313' and pulled out of hole. Laid down Dyna-Drill.

7/28/74 Ran 9 7/8" rerun bit #28 and junk basket in the hole with conventional drilling assembly and drilled 9 7/8" hole to 5314'. Ran 9 7/8" diamond bit #32 in the hole on a Redi-Drill drilling assembly.

7/29/74 Reamed hole to bottom and drilled 9 7/8" hole to 5385'.

7/30/74 Drilled 9 7/8" hole to 5427' and pulled out of hole. Laid down Redi-Drill and ran 9 7/8" rerun bit #27 in the hole. Reamed 100' of the hole to 5280'.

7/31/74 Reamed hole to 5428' and drilled 9 7/8" hole to 5450' and pulled out of the hole. Ran 9 7/8" rerun diamond bit #32 in the hole on Redi-Drill drilling assembly.

8/1/74 Reamed hole to bottom and drilled 9 7/8" hole to 5519'.

8/2/74 Drilled 9 7/8" hole to 5548' and pulled out of the hole. Checked out bit and Redi-Drill. Ran same back in hole and reamed 18' to bottom.

8/3/74 Drilled 9 7/8" hole to 5639'.

8/4/74 Drilled 9 7/8" hole to 5676' and pulled out of the hole and laid down Redi-Drill.

8/5/74 Ran 9 7/8" rerun bit #28 in the hole on conventional drilling assembly and reamed hole from 5435' to 5676' and drilled 9 7/8" hole to 5677'. Pulled out of hole running Sperry-Sun magnetic multishot survey from 5677' to 4331'. Started in hole.

8/6/74 Ran rerun diamond bit #32 on Redi-Drill drilling assembly and drilled 9 7/8" hole to 5698'. Pulled out of hole and changed out Redi-Drill.

8/7/74 Ran rerun bit #32 in the hole on Redi-Drill drilling assembly and drilled 9 7/8" hole to 5736'. Reamed hole after connections.

8/8/74 Drilled 9 7/8" hole to 5774'. Ran bit #33 in the hole on Dyna-Drill assembly at 5748'.

8/9/74 Drilled 9 7/8" hole to 5808' and pulled out of hole. Ran bit #34 in the hole on same assembly at 5790' and reamed 30' to bottom.

8/10/74 Ran bit #35 in the hole and drilled 9 7/8" hole to 5840'. Made trip for bit #36 at 5818'.

8/11/74 Drilled 9 7/8" hole to 5885' and pulled out of hole. Made trip for bit #37 at 5860' and reamed 20' to bottom.

8/12/74 Ran 9 7/8" rerun bit #28 in the hole on conventional drilling assembly and reamed hole from 5664' to 5884'. Pulled out of hole and ran bit #38 on Dyna-Drill assembly and started to ream, tool would not drill. Pulled out of hole.

8/13/74 Laid down Dyna-Drill and ran 9 7/8" rerun bit #28 and junk basket in the hole. Reamed to bottom and drilled on junk to 5886'. Pulled out of hole and recovered 31 roller bearings and 4 pieces of same, 13 ball bearings and 2 pieces of same. Ran bit #39 and Dyna-Drill in the hole and reamed 16' to bottom. Drilled 9 7/8" to 5910'. Started out of hole.

8/14/74 Pulled out of hole and left all bearings from one cone in the hole. Laid down Dyna-Drill. Ran 9 7/8" rerun bit #35 and junk basket in the hole on conventional drilling assembly. Reamed to top of junk and drilled 9 7/8" hole to 5912'. Pulled out of hole and ran bit #40 in the hole on Dyna-Drill assembly. Drilled 9 7/8" hole to 5924' and pulled out of hole.

8/15/74 Ran bit #41 in the hole, reamed to bottom, and drilled 9 7/8" hole to 5939'. Ran diamond bit #42 in the hole and reamed from 5884' to 5933'.

8/16/74 Reamed hole to 5939' and drilled 9 7/8" hole to 5980'. Pulled out of hole and laid down Dyna-Drill. Ran bit #42 back in the hole on Redi-Drill assembly.

8/17/74 Reamed hole to bottom and drilled 9 7/8" hole to 6003'. Pulled out of hole and laid down Dyna-Drill. Picked up Redi-Drill and ran bit #43 in the hole. Reamed to bottom.

8/18/74 Made depth correction, total depth 6011'. Drilled 9 7/8" hole to 6020'. Pulled out of hole and laid down Redi-Drill. Ran bit #43 back in the hole on conventional drilling assembly. Reamed hole from 5916' to 6020' and drilled 9 7/8" hole to 6021'.

8/19/74 Pulled out of hole and waited on drilling tools from 0130 hours to 1500 hours. Ran rerun diamond bit #42 in the hole on Redi-Drill assembly and reamed to bottom.

8/20/74 Drilled 9 7/8" hole to 6060'.

8/21/74 Drilled 9 7/8" hole to 6124'.

8/22/74 Pulled out of hole and laid down Redi-Drill. Ran rerun bit #35 in the hole, reamed and circulated hole. Pulled out of hole running surveys. Target changed from middle chimney to lower chimney.

8/23/74 Ran 4 1/2" drill pipe in the hole open ended to 6080' and plugged back hole using Halliburton with 150 sacks of Class G cement, 10% sand + 0.4% HR4. Pulled 6 stands of drill pipe and circulated excess cement out of hole. Ran 9 7/8" bit #44 in the hole and reamed hole from 5680' to 5776'.

8/24/74 Reamed hole to cement at 5822'. Drilled cement plug to 5834' and pulled out of hole to sidetrack. Ran 9 7/8" rerun diamond bit #32 in the hole on Redi-Drill assembly and sidetracked hole at 5834'. Drilled 9 7/8" hole to 5858'.

8/25/74 Drilled 9 7/8" hole to 5888' and pulled out of hole. Ran 9 7/8" rerun diamond bit #42 in the hole on Dyna-Drill assembly and reamed to bottom.

8/26/74 Drilled 9 7/8" hole to 5935'.

8/27/74 Drilled 9 7/8" hole to 5950'. Laid down Dyna-Drill and ran bit #42 back in the hole on Redi-Drill assembly at 5938'. Reamed hole from 5908' to 5938' and resumed drilling.

8/28/74 Drilled 9 7/8" hole to 5995' and started out of hole.

8/29/74 Pulled out of hole and laid down Redi-Drill. Ran bit #45 in the hole on conventional drilling assembly. Washed 90' to bottom and drilled 9 7/8" hole to 5996'. Pulled out of hole running Sperry-Sun multishot survey, instrument failed to record. Ran back in hole and washed to bottom. Ran magnetic single shot surveys. Pulled out of hole and made up 9 7/8" bit #46 on conventional drilling assembly.

8/30/74 Ran bit #46 in the hole and reamed hole to 5996'. Drilled 9 7/8" hole to 6012'.

8/31/74 Drilled 9 7/8" hole to 6088'. Ran bit #47 in the hole at 6074' and reamed 15' to bottom.

9/1/74 Drilled 9 7/8" hole to 6180' and started out of hole.

9/2/74 Pulled out of hole. Ran Dia-Log casing caliper survey inside the 10 3/4" O.D. casing. Ran bit #48 in the hole and drilled 9 7/8" hole to 6245' and pulled out of hole.

9/3/74 Ran bit #49 in the hole and drilled 9 7/8" hole to 6272'. Pulled out of hole and ran 9 7/8" diamond bit #50 in the hole on Dyna-Drill assembly.

9/4/74 Drilled 9 7/8" hole to 6335'. Pulled out of hole and laid down the Dyna-Drill.

9/5/74 Ran bit #51 in the hole on conventional drilling assembly and reamed hole from 6272' to 6335'. Drilled 9 7/8" hole to 6418'.

9/6/74 Drilled 9 7/8" hole to 6488'. Ran bit #52 in the hole at 6429' and reamed 20' to bottom.

9/7/74 Pulled out of hole and ran Sperry-Sun magnetic multishot survey from 5810' to 6481'. Ran Schlumberger caliper, compensated formation density gamma-gamma, compensated neutron-formation density, variable density, borehole compensated sonic-gamma, and dual induction-laterolog logs to 6481'.

- 9/8/74 Laid down Dyna-Drill and extra drill pipe. Ran 9 7/8" bit #52 in the hole and reamed 59' to bottom. Conditioned hole to run casing. Pulled out of hole laying down drill pipe.
- 9/9/74 Laid down drill pipe. Ran 145 joints of 7" O.D., range 3, 23#, CYS-95 buttress thread casing using the Lamb JAM system on the threads. Float shoe landed at 6476' GL. Float collar at 6426' with 2 centralizers on bottom joint, 1 centralizer on each joint of casing to the 50th joint from bottom. One centralizer on every other joint from the 50th to the 90th joint. One centralizer on every 3rd joint to the 140th joint. Stage cement collar at 3984'. 5 molded cement baskets were placed below the stage collar with the bottom basket at 6105' and the top basket at 4074'. 6 molded cement baskets were placed above the collar with the bottom basket at 3605' and the top basket at 1990'. Cemented through the shoe using Dowell with 249 barrels of 15.8 #/gallon cement slurry made up of 920 sacks of Class G cement, 35% silica sand, 10% salt, 0.7% D-13 retarder, and 0.25% D-65 antifoamant. Bumped plug at 1924 hours with 3250 psi. Good to partial returns with intermittent complete loss of returns during cementing and displacing. Displaced cement with 95 barrels of water and 159 barrels of mud. Opened stage collar at 1940 hours and circulated out contaminated mud. No pure cement slurry observed in the returns. Continued circulating with apparent full returns while waiting on cement.
- 9/10/74 Continued circulating until 1500 hours. Picked up blowout preventer, set slips and seal assembly around the 7" O.D. casing in the casing head. Reset blowout preventer. Cemented stage #2 out the collar at 3984' with 20 barrels of water ahead of 388 barrels of 15.8 #/gallon slurry made up of 1250 sacks of Class G cement, 35% silica sand, 10% sand, 0.4% D-13, and 0.25% D-65. Displaced with 158 barrels of water. Good returns at start of mixing decreasing to partial returns at the time mixing was completed. No returns after dropping plug to displace. Bumped plug and closed stage collar. Cement in place at 1805 hours.
- 9/11/74 Waited on cement until 1100 hours. Ran Oil Well Perforators temperature and sonic casing bond logs. Perforated 7" casing from 2110' to 2111' with four 1/2" shaped charges, bottom of 10 3/4" O.D. casing at 2186'. Broke circulation through the perforations with 400 psi. Squeeze #1 out the perforations using Dowell with 20 barrels of water ahead of 135 barrels of 15.8 #/gallon slurry made up of 500 sacks of Class G cement with 35% silica sand and 10% salt. Displaced cement with 80 barrels of water. Good cement returns to surface. Cement in place 1500 hours.
- 9/12/74 Waited on cement until 0230 hours. Nippled up. Pressure tested tubing head to 3800 psi.
- 9/13/74 Continued nipping up. Started pressure testing blowout preventer stack.

9/14/74 Tested blowout preventer stack, found a small leak in the API ring on a 2" flange connection. Repaired cellar and picked up 3 1/2" drill pipe. Ran 6 1/4" bit #53 in the hole and started drilling out cement from squeeze #1 at 2000'.

9/15/74 Drilled out cement to 2132'. Ran in hole and drilled out stage collar and plugs from 3980' to 3988'. Ran in hole and drilled float shoe displacement plug and cement from 6280' to 6445'.

9/16/74 Pulled out of hole. Started running Schlumberger logs.

9/17/74 Completed running Schlumberger cement bond and compensated neutron with gamma logs to 6470' and compensated formation log to 6467'. Made 2 runs with Eastman gyroscopic directional survey. Pressure tested casing to 3000 psi, lost 1000 psi and 1 barrel of mud in 5 minutes.

9/18/74 Ran Baker retrievable packer in the hole and set at various depths above and below the stage cement collar at 3984'. Pressure bled off when set above the collar and held below. Ran in hole with Baker retrievable packer on 3 1/2" drill pipe with 2 7/8" O.D. tubing below the packer to 4032' with the packer at 3590'. Pumped in 13.5 barrels of cement slurry using Dowell made up of 50 sacks of Class G cement, 35% silica sand, 10% salt, and 0.7% D-60 fluid loss additive. Pulled the bottom of the tubing to 3467' and set the packer at 3025' for squeeze #2. Squeezed with 3 barrels of water at 3300 psi and 1 barrel at 3750 psi. Released pressure and repressured to 3750 psi. Cement in place at 1830 hours. Pulled out of hole.

9/19/74 Waited on cement until 1600 hours. Estimated top of cement at 3680'. Pressured up on casing to 3000 psi, pressure bled off.

9/20/74 Made 2 runs with Schlumberger cement bond log to 3500'. The second run was made with 1000 psi of pressure held on casing. Pressure tests made with Baker retrievable packer indicated perforations at 2111' were leaking. Ran packer to 2086'.

9/21/74 Pumped in 6 barrels of Dowell mud acid with radioactive tracer. Set packer at 1713' and pumped 1/2 barrel into the perforations at 2500 psi. Established an injection rate of 2 barrels per minute at 1000 psi and pumped balance of acid into the perforations, overflushed with 2 barrels of water. Ran Schlumberger gamma ray log to 2475'. Mixed 68 barrels of slurry for squeeze #3 made up of 250 sacks of Class G cement with 35% silica sand, 10% salt, and 0.7% D-60 fluid loss additive. Pumped 56 barrels of slurry into the perforations at 2110' to 2111' at 1000 psi. Stage squeezed 6 barrels of slurry at the rate of 1/2 barrel every 30 minutes leaving 6 barrels inside the 7" O.D. casing. Final pressure 3000 psi. Pulled packer from hole. Cement in place at 1400 hours. Ran bit #53 in the hole to 1880'.

9/22/74 Waited on cement until 0800 hours. Drilled out cement from 1954' to 2116' and washed to 2253'. Pulled bit to 1954' and pressured upon casing to 3000 psi. Pressure bled off to 2800 psi in 15 minutes. Pulled out of hole.

- 9/23/74 Pressure tests ran above and below the perforations indicated they were leaking. Pulled Baker retrievable packer to 2094' and pumped in 250 gallons of Dowell mud acid. Set packer at 1716' and broke down formation with 1 barrel of acid at 3000 psi. Pumped in acid at 1 1/2 barrels per minute at 750 psi. Pressure bled to 500 psi and held. Mixed 100 sacks of Class G cement with 35% silica sand, 10% salt, and 0.75% D-60 fluid loss additive for squeeze #4. Squeezed 20 barrels into perforations leaving 7 barrels inside the casing. Final squeeze pressure 3000 psi. Cement in place at 2100 hours. Pulled out of hole.
- 9/24/74 Waited on cement to 1500 hours. Ran bit #55 in the hole and drilled cement from 1942' to 2130'. Circulated to 3638' and drilled cement from 3638' to 3912'.
- 9/25/74 Drilled out cement to 3954'. Pressure tested casing to 3000 psi. Pressure held for 15 minutes. Drilled out cement to 3992' and washed to 4087'. Pressure tested casing to 3000 psi, pressure bled to 2600 psi in 3 minutes indicating stage collar was leaking at 3984'. Ran Schlumberger cement bond log 50 4100', survey to be rerun. Ran Baker retrievable packer in the hole and set at 4068', pressured up to 3000 psi. Pressure held for 15 minutes.
- 9/26/74 Reset packer at 3876' and pressured up to 3000 psi below packer, pressure bled to 2200 psi in 15 minutes. Pressured annulus above the packer to 3000 psi, pressure held. Ran packer to 3973' and pumped in 6 barrels of Dowell mud acid. Set packer at 3134' and pumped acid into the formation at 1 barrel per minute at 3000 psi. Pressure bled to 1500 psi and held. Reset packer at 3315' and mixed 5.3 barrels of Class G cement with 2% calcium chloride followed by 13.4 barrels of Class G cement with 35% silica sand, 5% salt, and 0.75% D-60 fluid loss additive for squeeze #5. Displaced 12 barrels into stage collar at a final pressure of 3000 psi leaving 6.7 barrels inside the 7" O.D. casing. Cement in place at 0415 hours. Waited on cement until 0900 hours and pulled out of hole. Ran Schlumberger cement bond log to 3710'. Waited on cement until 2200 hours. Ran bit #55 in the hole and tagged cement at 3767', washed to hard cement at 3851' and drilled to 3928'.
- 9/27/74 Drilled cement to 3991'. Pulled bit to 3756' and pressured upon casing to 2600 psi, pressure bled off to 2100 psi in 20 minutes. Pulled out of hole. Ran Baker retrievable packer in the hole and set at 4068'. Pressure tested 7" O.D. casing below the packer to 3000 psi for 15 minutes. Pressure held. Reset packer at 3970' and tested stage collar. Pressured up to 2600 psi, pressure bled to 1800 psi in 30 minutes. Ran packer to 3974' and pumped in 250 gallons of Dowell mud acid. Set packer at 3315' and pumped the acid into the stage collar at 3984' and overflushed with 3 barrels of water. The injection rate was 2 barrels per minute at 2600 psi, the pressure bled off and held at 1600 psi after pumping stopped. Mixed 10 barrels of slurry consisting of 50 sacks of Class G cement with 2% calcium chloride followed by 13.5 barrels of slurry made up of 50 sacks of Class G cement with 35% silica sand, 5% salt, and 0.75% of

D-60 fluid loss additive for a total of 23.5 barrels of 16 #/gallon slurry for squeeze #6. Squeezed 17.3 barrels into the stage collar leaving 6.2 barrels in the 7" O.D. casing. Final squeeze pressure was 3400 psi. Released packer and reversed out 25 barrels of water. Reset packer at 3315' and held pressure to 2600 psi for 4 hours. Reset packer at 1980' and held pressure at 2600 psi for 15 minutes. Pulled out of hole. Perforated casing using Oil Well Perforators at 2920' with 4 holes.

- 9/28/74 Perforated 7" O.D. casing at 2290' with 4 holes. Ran Baker retrievable packer in the hole and set at 2840'. Pressured up to 1000 psi below the packer, pressure held for 10 minutes. Pressured up to 1000 psi above the packer, pressure bled off to 600 psi. Broke down the perforations above and below the packer with 1500 psi at a rate of 1/2 barrel per minute. Circulation was not established between the perforations pumping in either direction. Pulled out of hole. Set a Baker Model K wire line cement retainer at 2741'. Ran the cement retainer stinger in the hole on 3 1/2" drill pipe and stabbed into retainer. Squeeze #7 into the perforations at 2920' using Dowell. Mixed 10 barrels of slurry consisting of 50 sacks of Class G cement with 2% calcium chloride and a radioactive tracer followed by 57 barrels of slurry made up of 200 sacks of Class G cement with 35% silica sand, 5% salt, and 0.75% of D-60 fluid loss additive. Squeezed 61.5 barrels of slurry through the perforations leaving 5.5 barrels inside the 7" O.D. casing. Cement in place at 1200 hours. Pulled out of hole. Ran Oil Well Perforators gamma log, no cement indicated above the retainer.
- 9/29/74 Waited on cement until 0600 hours. Ran Oil Well Perforators temperature and casing bond log. Perforated 7" O.D. casing using Oil Well Perforators with 4 holes at 2626'. Set a Baker Model K cement retainer at 2461'. Ran stinger for retainer on 3 1/2" drill pipe and stabbed into retainer. Established an injection rate of 2 barrels per minute, no fluid circulated out of upper perforations at 2290'. Squeeze #8 out perforations at 2626' using Dowell. Mixed 10 barrels of slurry consisting of 50 sacks of Class G cement with 2% calcium chloride and a radioactive tracer followed by 57 barrels of slurry made up of 200 sacks of Class G cement with 35% silica sand, 5% salt, and 0.75% D-60 fluid loss additive. Displaced all the slurry out the perforations and cleared with 10 barrels of water at 1330 hours. Maximum pumping pressure 1200 psi. Waited on cement until 2030 hours. Squeeze #9 out same perforations as squeeze #8. Established an injection rate of 3 barrels per minute at 1500 psi. Mixed 10 barrels of slurry consisting of 50 sacks of Class G cement with 2% calcium chloride and a radioactive tracer followed by 42.7 barrels of slurry made up of 150 sacks of Class G cement with 35% silica sand, 5% salt, and 0.75% D-60. Squeezed 46.7 barrels into the perforations leaving 6 barrels inside the casing. Final squeeze pressure 3000 psi. Cement in place at 2315 hours. Pulled out of hole.
- 9/30/74 Ran Oil Well Perforators gamma log. No cement indicated above the retainer at 2461'. Waited on cement until 1100 hours. Ran Oil Well

Perforators temperature log. Ran Baker retrievable packer in the hole and set at 2157'. Established an injection rate below the packer through the perforations at 2290' of 4 barrels per minute at 1400 psi. Squeezed perforations using Dowell for squeeze #10 using 20.3 barrels of slurry consisting of 100 sacks of Class G cement with 2% calcium chloride followed by 42.7 barrels of slurry made up of 150 sacks of Class G cement, 35% silica sand, and 5% salt. Displaced 58.7 barrels through the perforations leaving 4.3 barrels inside the 7" O.D. casing. Final squeeze pressure 3200 psi. Cement in place at 1600 hours. Pulled out of hole.

10/1/74 Waited on cement until 1000 hours. Ran 6 1/4" bit #57 in the hole, tagged cement at 2168'. Drilled cement from 2168' to 2297' and washed to cement retainer at 2461'. Drilled out retainer and drilled cement from 2474' to 2580'. Pressured up to 2600 psi, pressure held for 15 minutes. Drilled cement from 2580' to 2625'.

10/2/74 Drilled cement stringers to 2640'. Washed to cement retainer at 2741'. Pressured up to 2600 psi, pressure bled off to 1800 psi in 15 minutes indicating perforations at 2626' were leaking. Pulled out of hole. Ran Baker retrievable packer in the hole and set at 2569'. Pressured up to 2600 psi, pressure held for 15 minutes indicating perforations at 2626' were not leaking. Reset packer at 2093'. Pressured up to 2600 psi to test perforations at 2110' and 2290', pressure bled to 2500 psi in 15 minutes. Pressured casing above packer to 2700 psi, pressure held for 15 minutes. Repressured below packer to 2600 psi twice, last pressure bled to 2200 psi in 30 minutes. Reset packer at 2270' to test perforations at 2290'. Pressured up to 2600 psi, pressure held for 15 minutes. Pressured up to 2600 psi above the packer, pressure bled to 2500 psi in 15 minutes. Repressured below the packer to 3000 psi, pressure held for 15 minutes. Repressured above the packer to 3000 psi, pressure bled to 2200 psi in 45 minutes. Released packer and pulled up to 2115', pumped 250 gallons of Dowell mud acid in the hole. Set packer at 1905' and pressured up to 3000 psi, pressure bled to 2300 psi in 50 minutes, unable to pump acid into perforations at 2110'. Released packer and ran to 2115' and reversed acid out of the hole. Set packer at 2125' and pressured up to 2950 psi below the packer, pressure bled to 2850 psi in 14 minutes. Pressured to 3000 psi above and below the packer, pressure bled to 2900 psi below the packer and to 2800 psi above the packer in 12 minutes. Reset packer at 2270' and pressured up to 3000 psi, pressure bled to 2800 psi in 22 minutes. Reset packer at 2364' and pressured up to 3000 psi, pressure bled to 2800 psi in 10 minutes.

10/3/74 Pulled out of hole. Ran bit #58 in the hole and drilled out cement retainer at 2741' and cement to 2949'. Pulled out of hole and ran bit #59 in the hole. Drilled cement from 3819' to 3984' and washed to 4040'. Pulled out of hole.

10/4/74 Ran Baker Model C-3 casing scraper inside the 7" O.D. casing to 4080'. Pulled out of hole. Ran Baker Model C retrievable bridge plug below a Model R packer in the hole for straddle testing inside

the 7" O.D. casing. Ran pressure tests on the stage collar at 3984', perforations at 2920', 2626', and 2290' to 3000 psi for 15 minutes, all pressures held. Started pressure testing the perforations from 2110' to 2111'.

- 10/5/74 Final test on perforations with the bridge plug at 2117' and the packer at 2090' indicated pressure bled off from 3000 psi to 2500 psi in 5 minutes. Pulled out of hole. Ran Schlumberger cement bond log. Ran Baker Model R packer in the hole to 2125' and pumped in 250 gallons of Dowell mud acid. Pulled up and set packer at 1905'. Pumped acid out the perforations at 2110' with 2250 psi at 3 barrels per minute. Squeezed perforations for squeeze #11 using Dowell using 20.3 barrels of slurry consisting of 100 sacks of Class G cement with 2% calcium chloride followed by 38.7 barrels of slurry made up of 136 sacks of Class G cement, 35% silica sand, and 3% salt. Displaced 54.7 barrels into the perforations leaving 4.3 barrels inside the 7" O.D. casing. Final squeeze pressure 3300 psi. Unseated packer and left 3000 psi on the casing. Cement in place at 1600 hours.
- 10/6/74 Released pressure at 1600 hours and pulled out of hole. Ran bit #59 back in hole and drilled cement from 2025' to 2144'.
- 10/7/74 Drilled out cement from 2144' to 2158' and ran bit to 2229'. Ran Baker packer in the hole to 2150' and pressured up on casing above the packer to 3000 psi, pressure held for 20 minutes. Pressured up below the packer to 3000 psi, pressure held for 15 minutes. Pulled out of hole. Standby at 0800 hours.
- 10/8/74 Standby to 0900 hours. Pressure tested blowout preventer stack, lines and sidewall sampling lubricator to 3000 psi. Standby at 1915 hours.
- 10/9/74 Straightened kelly and pressure tested kelly cock and kelly. Ran 6 1/4" bit #60 in the hole to cement at 6310'. Drilled out cement from 6310', float collar at 6426', float shoe at 6476' and new 6 1/4" hole from 6488' to 6491'.
- 10/10/74 Drilled 6 1/4" hole to 6528'. Ran bit #61 in the hole and reamed to bottom.
- 10/11/74 Drilled 6 1/4" hole to 6590'. Ran bit #62 in the hole, washed and reamed from 6490' to 6497'.
- 10/12/74 Reamed from 6497' to 6590' and drilled 6 1/4" hole to 6640'. Pulled out of hole.
- 10/13/74 Ran bit #63 in the hole, washed 20' to bottom, and drilled 6 1/4" hole to 6658'. Trip for bit #64 and drilled to 6663'.
- 10/14/74 Drilled 6 1/4" hole to 6707'. Ran bit #65 in the hole at 6705'.

10/15/74 Drilled 6 1/4" hole to 6723'. LLL started directing operations at 0230 hours. Ran 6 1/4" diamond core bit #66 in the hole and cut core #1 from 6723' to 6750'.

10/16/74 Pulled out of hole, recovered 21'. Ran bit #67 in the hole, reamed core hole and drilled 6 1/4" hole to 6772'. Pulled out of hole.

10/17/74 Ran bit #68 in the hole, reamed 8' to bottom and drilled 6 1/4" hole to 6816'. Ran bit #69 in the hole at 6805' and reamed 47' to bottom.

10/18/74 Drilled 6 1/4" hole to 6866'. Pulled out of hole. Ran bit #69 back in the hole and washed to bottom. Pulled out of hole running Sperry-Sun magnetic multishot survey from 6847' to 6488'.

10/19/74 Ran bit #70 in hole and drilled to 6911'. Conditioned hole for coring.

10/20/74 Pulled out of hole. Ran 6 1/4" diamond core bit #66 back in the hole and washed 30' to bottom. Cut core #2 from 6911' to 6925.5'. Pulled out of hole and recovered 13 1/2'. Ran bit #71 in the hole and reamed 20' to bottom. Drilled 6 1/4" hole from 6925.5' to 6937'.

10/21/74 Drilled 6 1/4" hole to 7045'. Pulled out 6 stands of drill pipe and mixed mud. Started losing circulation at 6975' with a complete loss at 6977' at 0700 hours.

10/22/74 Pulled out of hole while intermittently pumping mud in the annulus using a Halliburton pump truck. Ran 6 1/4" diamond core bit #66 back in the hole and cut core #3 from 7045' to 7057' and stuck bit. Worked core assembly loose and pulled out of hole, no core recovery. Left 6 1/4" diamond core bit, the bottom outer core barrel stabilizer approximately 2' long, 2-piece inner tube shoe and core catcher and a piece off of the bottom of the inner barrel in the hole. Started in hole with a rerun 6 1/4" bit.

10/23/74 Completed trip in hole, washed to top of fish at 7055'. Ran single shot survey and pulled out of hole. Rigged to run liner. Ran 5" liner in the hole to 7051' and could not release liner running tool. Pulled out of hole.

10/24/74 Pulled liner to rotary table. Modified Brown liner hanger and ran 676.83' of 5" O.D. flush joint liner back in the hole on 3 1/2" drill pipe as follows: Brown Oil Tool float shoe and collar, 5 joints (153.80') of 15.50#, J-55, FJ Hydril thread casing, crossover sub, 12 joints (504.76') of 14.78#, J-55, Atlas Bradford thread casing, crossover sub, Brown Oil Tool liner hanger swivel, and a Brown Oil Tool Hyflo liner hanger with hold-down slips. Tagged fill at 7051' and set liner at 7049' with the top at 6372' inside the 7" O.D. casing. Released liner running tool and spudded with drill pipe to compress the packoff seal. Pulled out of hole. LLL returned operations to CONOCO at 1700 hours. Ran Schlumberger temperature log.

- 10/25/74 Ran Schlumberger compensated formation density log. Ran Halliburton retrievable bridge plug in the hole and set at 6190' inside the 7" O.D. casing. Filled casing with water and pulled out of hole. Removed blowout preventer stack.
- 10/26/74 Installed 4 1/2" casing spool and reset blowout preventer stack on top of the spool. Ran drill pipe in the hole and retrieved bridge plug at 6190'. Started laying down 3 1/2" drill pipe.
- 10/27/74 Laid down drill pipe and prepared to run 4 1/2" O.D. casing. Ran in hole with Baker Model FA retainer production packer on a wire line and set at 6150' inside the 7" O.D. casing. Fluid level indicated at 2620'. Ran 144 joints of 4 1/2" O.D., 13.50#, N-80 buttress thread casing with a latch-in type stinger on bottom and Baker Model J stage cementing collar 1' off bottom. Ran stinger into the retainer at 6150' to anchor the casing with the stage collar at 6149'. Cemented annulus out the collar using Dowell with 500 sacks of Class G cement with 35% silica sand, 10% salt, and 0.5% D-13. Circulated out an estimated 7 barrels of cement slurry at the surface. Final pump pressure 4400 psi. Bumped plug in the stage collar at 5500 psi. Lifted the blowout preventer stack.
- 10/28/74 Set slips on the 4 1/2" O.D. casing with 175,000# tension on the casing and cutoff casing. Changed tubing head bushings to 4 1/2" and pressure tested to 3000 psi. Reinstalled blowout preventer stack. Started running 3 5/8" bit #72 in the hole on 2 3/8" O.D., J-55 tubing for drill pipe.
- 10/29/74 Ran 3 5/8" bit in the hole and drilled out cement from 6037' to the stage collar at 6149' circulating with water. Drilled out stage collar and plug and washed to the top of the float collar inside the 5" liner at 7047'. Pulled out of hole.
- 10/30/74 Completed trip out of hole. Laid down drill collars and bit. Ran 2 3/8" O.D., 4.70#, EUE, J-55 tubing with an open mule shoe on bottom at 6494' and an Otis S nipple 2 joints from bottom.
- 10/31/74 Removed blowout preventer stack. Installed production wellhead and pressure tested to 3000 psi. Ran Birdwell high-intensity gamma log. Rig up Oil Well Perforators and perforated 5" O.D. liner using 1 11/16", 13-gram, aluminum jet shots from 6937' to 7037' with 1 shot per foot. The wire line run indicated fluid level was 2700' from the surface. After perforating, the tubing pressure was 100 psi and the casing pressure was 300 psi at 2200 hours. Shut in for pressure buildup.
- 11/1/74 Shut in for pressure buildup until 1300 hours. Attempted to flow well, well would not flow. Connected the Fawn Creek gas well to the annulus of RB-AR-02 and pressured to 1350 psi, well did not flow. Connected to the tubing and pressured to 1000 psi, well did not flow. Shut in at 1730 hours.

11/2/74 At 0600 hours, tubing pressure was 750 psi, casing pressure was 1450 psi. Bled pressure from tubing. Injected 25,000 standard cubic feet of nitrogen in the annulus at a maximum pressure of 1625 psi. Well started flowing at 1000 hours at a rate of 860 mcf per day. The flow rate was increased to 1700 mcf per day for a 2-hour period. Final casing pressure was 1520 psi. Flowing tubing pressure varied from 800 to 1100 psi. Produced 30 barrels of fluid during test. Released rig at 1600 hours to demobilize. Hole completed 11/2/74.

APPENDIX B

WELL RB-AR-2

TABLES

TABLE NO. 1
RB-AR-2
SUMMARY OF REMEDIAL CEMENTING

Depth (GL)	Job No.	Sacks	Cu. Ft.	Type of Slurry
2110'- 2111' (Perf.)	1	500	729	Class G + 35% silica sand + 10% salt
	3	250	348	Class G + 35% silica sand + 10% salt + 0.7% D-60
	4	100	112	Class G + 35% silica sand + 10% salt + 0.75% D-60
	11	100	114	Class G + 2% calcium chloride
		<u>136</u>	<u>193</u>	Class G + 35% silica sand + 3% salt
TOTAL		1,086	1,496	
2290' (Perf.)	10	100	114	Class G + 2% calcium chloride
		<u>150</u>	<u>216</u>	Class G + 35% silica sand + 5% salt
TOTAL		250	330	
2626' (Perf.)	8	50	56	Class G + 2% calcium chloride
		200	320	Class G + 35% silica sand + 5% salt + 0.75% D-60
	9	50	56	Class G + 2% calcium chloride
		<u>150</u>	<u>206</u>	Class G + 35% silica sand + 5% salt + 0.75% D-60
TOTAL		450	638	
2920' (Perf.)	7	50	56	Class G + 2% calcium chloride
		<u>200</u>	<u>289</u>	Class G + 35% silica sand + 5% salt + 0.75% D-60
TOTAL		250	345	
3984' (Collar)	2	50	59	Class G + 35% silica sand + 10% salt + 0.7% D-60
	5	25	30	Class G + 2% calcium chloride
		50	38	Class G + 35% silica sand + 5% salt + 0.75% D-60
	6	50	56	Class G + 2% calcium chloride
		<u>50</u>	<u>41</u>	Class G + 35% silica sand + 5% salt + 0.75% D-60
TOTAL		225	224	
GRAND TOTAL		2,261	3,033	NOTE: All depths are from ground level.

Sacks are total sacks used to make up the slurry.

Cu. Ft. is the amount of slurry displaced in the annulus.

TABLE NO. 2
RB-AR-2
LOG INDEX SHEET

<u>Date</u>	<u>Type Log</u>	<u>Run No.</u>	<u>Interval Logged (GL)</u>
(Schlumberger Logs)			
6/28/74	Borehole Geometry	1	165'-2154'
7/1/74	Cement Bond	1	30'-2160'
9/7/74	Caliper	1	2186'-5200'
9/7/74	Compensated Formation Density Gamma Gamma	1	5200'-6480'
9/7/74	Compensated Neutron-Formation Density	1	5200'-6480'
9/7/74	Compensated Sonic-Gamma	1	5200'-6480'
9/7/74	Dual Induction-Laterolog	1	5194'-6475'
9/7/74	Variable Density	1	5200'-6480'
9/17/74	Compensated Formation Density	1	30'-6466'
9/17/74	Compensated Neutron	1	5170'-6468'
9/17/74	Cement Bond	1-2	0'-6458'
9/19/74	Cement Bond	3	70'-3500'
9/19/74	Cement Bond	4	300'-3500'
9/21/74	Gamma	1	550'-2475'
9/26/74	Cement Bond	5	1700'-3692'
10/4/74	Cement Bond	6	1500'-3700'
10/24/74	Temperature	1	6700'-7069'
10/25/74	Compensated Neutron-Formation Density	2	6200'-7067'
	Saraband Sandstone Analysis		
(Birdwell Logs)			
10/31/74	High-Intensity Gamma	1	6960'-7068'
(Oil Well Perforator Logs--No copies available)			
9/11/74	Acoustical Bond		
9/11/74	Temperature		
9/29/74	Cement Bond		
9/29/74	Temperature		
9/30/74	Cement Bond		
9/30/74	Gamma		
9/30/74	Temperature		

TABLE NO. 3
RB-AR-2
DIRECTIONAL SURVEYS

<u>Date Run</u>	<u>Measured Depth</u>	<u>Company</u>	<u>Type Survey</u>	<u>Job No.</u>
7/1/74	0'-2170'	Sperry-Sun	Gyroscopic Multishot	SU3-11123
7/1/74	0'-2170'	Sperry-Sun	Gyroscopic Multishot	SU3-11124
7/13/74	2170'-4331'	Sperry-Sun	Magnetic Multishot	MS-11132
8/5/74	4331'-5677'	Sperry-Sun	Magnetic Multishot	MS-11147
8/18/74	5677'-6018'	Sperry-Sun	Magnetic Multishot	MS-11148
9/7/74	5810'-6481'	Sperry-Sun	Magnetic Multishot	MS-11157
10/18/74	6481'-6867'	Sperry-Sun	Magnetic Multishot	MS-11189
		Sperry-Sun	Recomputed Surveys	SU3-11123 & SU3-11124 & MS-11132
9/17/74	300'-6425'	Eastman	Tangential Computation. Radius of Curvature Computation.	RM-13774-G41

TABLE NO. 4
RB-AR-2
BIT RECORD

Bit No.	Size	Make	Type	Depth Out (KB)	Feet Drilled	Rotating Hours
1	12 1/4"	Security	S4T-J	186'	144'	5 1/4
2	22"		Hole Opener	186'	144'	5
3	15"	Hughes	OCS3A	561'	375'	28 1/2
4	15"	Reed	YT3A	1135'	574'	33 3/4
5	15"	Reed	YT3A	1388'	253'	22
6	15"	Reed	YT3A	1538'	150'	17 1/2
7	15"	Hughes	OSC3A	1692'	154'	20 1/2
8	15"	Reed	Y11J	2108'	416'	25 3/4
9	15"	Hughes	OSC3A	2207'	99'	6
10	9 7/8"	Hughes	OWVJ	Drilled cement.		
11	9 7/8"	Reed	YS1J	2631'	424'	29
12	9 7/8"	Reed	YS1J	3147'	516'	31 1/2
13	9 7/8"	Hughes	OWVJ	3244'	97'	6 1/4
14	9 7/8"	Reed	Y12J	3378'	134'	18 1/4
15	9 7/8"	Reed	Y12J	3481'	103'	16 1/4
16	9 7/8"	Hughes	OSC1G	3651'	170'	15 1/2
17	9 7/8"	Reed	S21J	3798'	147'	16
18	9 7/8"	Security	M4NJ	3830'	32'	8 1/4
19	9 7/8"	Reed	Y12J	4059'	229'	24 1/4
20	9 7/8"	Reed	Y12J	4331'	272'	23 3/4
21	9 7/8"	Reed	Y12J	4522'	191'	23 1/2
22	9 7/8"	Hughes	OSC1G	4574'	52'	11
23	9 7/8"	Hughes	OWVJ	4652'	78'	11 1/4
24	9 7/8"	Hughes	OWVJ	4669'	17'	5 1/4
25	9 7/8"	Hughes	OSC1G	4750'	81'	12
26	9 7/8"	Hughes	OWVJ	4844'	94'	11 1/2
27	9 7/8"	Security	S84	5036'	192'	25 1/2
28	9 7/8"	Reed	S21J	5064'	28'	4 3/4
29	9 7/8"	Hughes	OWVJ	5094'	30'	11 3/4
27 Rerun	9 7/8"	Security	S84	5223'	129'	23
30	9 7/8"	Hughes	OWVJ	5283'	60'	14 1/2
31	9 7/8"	Hughes	SDVJ	5333'	50'	15
28 Rerun	9 7/8"	Reed	S21J	5334'	1'	2
32	9 7/8"	Varel	Diamond	5447'	113'	27 1/2
27 Rerun	9 7/8"	Security	S84	5470'	23'	7 3/4
32 Rerun	9 7/8"	Varel	Diamond	5696'	226'	61 1/2
28 Rerun	9 7/8"	Reed	S21J	5697'	1'	1/2
32 Rerun	9 7/8"	Varel	Diamond	5768'	71'	23 3/4
33	9 7/8"	Hughes	OWVJ	5810'	42'	10
34	9 7/8"	Hughes	OWVJ	5828'	18'	4 3/4
35	9 7/8"	Security	S84	5838'	10'	4
36	9 7/8"	Hughes	OWVJ	5880'	42'	9 1/2
37	9 7/8"	Reed	YS1J	5905'	25'	3 3/4
28 Rerun	9 7/8"	Reed	S21J	Ream		
38	9 7/8"	Security	M4NJ	Ream		
28 Rerun	9 7/8"	Reed	S21J	5906'	1'	1 3/4
39	9 7/8"	Security	M4NJ	5930'	24'	4 1/4
35 Rerun	9 7/8"	Security	S84	5932'	2'	1
40	9 7/8"	Reed	F52	5944'	12'	3 3/4
41	9 7/8"	Reed	S1GJ	5959'	15'	2 3/4

<u>Bit No.</u>	<u>Size</u>	<u>Make</u>	<u>Type</u>	<u>Depth Out (KB)</u>	<u>Feet Drilled</u>	<u>Rotating Hours</u>
42	9 7/8"	Varel	Diamond	6023'	64'	15
43	9 7/8"	Hughes	OWV	6041'	18'	3 1/2
42 Rerun	9 7/8"	Varel	Diamond	6144'	103'	35
35 Rerun	9 7/8"	Security	S84	Ream		
44	9 7/8"	Reed	YS1J	5854'	12' (cement)	
32 Rerun	9 7/8"	Varel	Diamond	5908'	54'	18 3/4
42 Rerun	9 7/8"	Varel	Diamond	6015'	107'	46 1/2
45	9 7/8"	Security	HG	6016'	1'	1/2
46	9 7/8"	Hughes	OWVJ	6094'	78'	12 1/2
47	9 7/8"	Security	M4NJ	6200'	106'	18 1/2
48	9 7/8"	Hughes	OWVJ	6265'	65'	8 3/4
49	9 7/8"	Security	M4NJ	6292'	27'	3 3/4
50	9 7/8"	Varel	Diamond	6355'	63'	12
51	9 7/8"	Security	M4NJ	6449'	94'	13 3/4
52	9 7/8"	Security	M4NJ	6508'	59'	6 1/2
53	6 1/4"	Reed	YS1J	Drilled cement.		
54	6 1/4"	Security	M4NJ	Drilled cement.		
55	6 1/4"	Reed	Y21	Drilled cement.		
56	6 1/4"	Reed	Y21R	Drilled cement.		
57	6 1/4"	Reed	Y21R	Drilled cement.		
58	6 1/4"	Security	M4NJ	Drilled cement.		
59	6 1/4"	Smith	DO	Drilled cement.		
60	6 1/4"	Smith	VS	6548'	40'	14
61	6 1/4"	Security	M4NJ	6610'	62'	15 1/2
62	6 1/4"	Reed	Y21R	6660'	50'	18
63	6 1/4"	Hughes	J33	6678'	18'	12 1/4
64	6 1/4"	Hughes	1GJ	6725'	47'	18 1/2
65	6 1/4"	Reed	Y21R	6743'	18'	3 1/2
66	6 1/4"	Christensen	Core	6770'	27'	7
67	6 1/4"	Hughes	OWVJ	6792'	22'	10 3/4
68	6 1/4"	Hughes	OSC1G	6825'	33'	7
69	6 1/4"	Hughes	OSC1G	6886'	61'	17 1/2
70	6 1/4"	Hughes	OSC1G	6931'	45'	11
66 Rerun	6 1/4"	Christensen	Core	6945.5'	14.5'	4
71	6 1/4"	Hughes	OSC1G	7065'	119.5'	15
66 Rerun	6 1/4"	Christensen	Core	7077'	12'	3/4
72	3 5/8"	Smith	T2	Drilled cement.		

APPENDIX C

WELL RB-AR-2

DIRECTIONAL SURVEY SUMMARY

RIO BLANCO REENTRY WELL RB-AR-02

ALL MEASURED DEPTHS FROM KB

DIRECTIONAL SURVEY DATA REDUCTION SUMMARY FROM PROGRAM GORE

Station Number	Measured Depth (Feet)	+ North - South (Feet)	+ East - West (Feet)	Vertical Depth (Feet)	Inclina- tion (Deg)	Bearing (Deg)	Dogleg (Deg/ 100')
1	-.0	.0	.0	.0	-.0	.00	.0
2	-.0	.00	.00	.00	-.0	.00	R
3	-.0	.00	.00	.00	-.0	.00	R
4	-.0	.00	.00	.00	-.0	.00	R
5	-.0	.00	.00	.00	-.0	.00	R
6	-.0	.00	.00	.00	-.0	.00	R
7	-.0	.00	.00	.00	-.0	.00	R
8	-.0	.00	.00	.00	-.0	.00	R
9	19.50	.00	.00	19.50	.0	360.00	.00
10	69.50	.01	-.03	69.50	.08	291.52	.17
11	119.50	.04	-.06	119.50	.03	42.50	.20
12	169.50	.08	-.04	169.50	.08	5.08	.12
13	219.50	.12	-.06	219.50	.05	259.08	.22
14	269.50	.06	-.13	269.50	.17	220.35	.26
15	319.50	-.08	-.25	319.50	.25	223.40	.17
16	369.50	-.26	-.39	369.50	.28	210.02	.14
17	419.50	-.54	-.52	419.50	.42	203.50	.28
18	469.50	-.96	-.68	469.50	.62	196.87	.42
19	519.50	-1.55	-.83	519.49	.78	193.27	.34
20	569.50	-2.17	-.89	569.49	.67	175.67	.50
21	619.50	-2.64	-.90	619.49	.42	192.13	.58
22	669.50	-2.88	-.81	669.49	.33	116.32	.93
23	719.50	-2.92	-.75	719.48	.17	293.82	1.00
24	769.50	-3.30	-.56	769.48	1.10	147.83	2.48
25	819.50	-3.90	.40	819.47	1.67	105.93	2.24
26	869.50	-4.34	1.69	869.45	1.47	111.58	.50
27	919.50	-4.65	3.08	919.43	1.83	95.53	1.17
28	969.50	-5.13	4.81	969.40	2.33	113.37	1.63
29	1019.50	-6.01	6.56	1019.36	2.17	120.25	.63
30	1069.50	-7.07	8.12	1069.32	2.17	128.23	.60
31	1119.50	-8.27	9.54	1119.29	2.08	132.23	.34
32	1169.50	-9.34	10.68	1169.26	1.50	134.42	1.17
33	1219.50	-10.16	11.30	1219.25	.92	156.37	1.47
34	1269.50	-10.81	11.42	1269.25	.67	189.17	1.01
35	1319.50	-11.44	11.23	1319.24	.83	203.30	.50
36	1369.50	-12.07	10.88	1369.24	.83	214.08	.31
37	1419.50	-12.62	10.47	1419.23	.75	220.32	.24
38	1469.50	-13.13	10.00	1469.23	.83	225.15	.21
39	1519.50	-13.50	9.43	1519.22	.75	249.27	.68
40	1569.50	-13.76	8.81	1569.22	.80	246.02	.13
41	1619.50	-13.98	8.06	1619.21	1.00	259.77	.59
42	1669.50	-14.28	7.21	1669.21	1.08	241.18	.69

Station Number	Measured Depth (Feet)	+ North - South (Feet)	+ East - West (Feet)	Vertical Depth (Feet)	Inclina- tion (Deg)	Bearing (Deg)	Dogleg (Deg/ 100')
43	1719.50	-15.01	6.51	1719.19	1.33	210.25	1.38
44	1769.50	-16.18	5.82	1769.18	1.78	210.88	.90
45	1819.50	-17.64	4.90	1819.15	2.17	213.45	.79
46	1869.50	-19.42	3.70	1869.10	2.75	214.37	1.17
47	1919.50	-21.37	2.13	1919.04	3.00	222.75	.98
48	1969.50	-22.97	.31	1968.98	2.60	235.63	1.49
49	2019.50	-24.13	-1.55	2018.93	2.42	240.48	.56
50	2069.50	-25.10	-3.46	2068.88	2.50	245.55	.47
51	2119.50	-26.04	-5.46	2118.84	2.58	244.05	.21
52	2169.50	-27.02	-7.53	2168.78	2.67	245.58	.22
53	2189.50	-27.39	-8.39	2188.76	2.67	247.57	.46
54	2266.00	-28.81	-11.77	2265.17	2.83	247.00	.22
55	2329.00	-29.91	-14.83	2328.09	3.08	253.00	.63
56	2393.00	-30.93	-18.16	2391.99	3.17	253.00	.13
57	2457.00	-32.09	-21.45	2455.90	3.08	248.00	.45
58	2520.00	-33.32	-24.56	2518.81	3.00	249.00	.16
59	2583.00	-34.47	-27.65	2581.72	3.00	250.00	.08
60	2646.00	-35.74	-30.79	2644.63	3.17	246.00	.43
61	2709.00	-37.18	-34.10	2707.53	3.42	247.00	.41
62	2773.00	-38.69	-37.73	2771.41	3.62	248.00	.33
63	2836.00	-40.20	-41.39	2834.28	3.58	247.00	.11
64	2900.00	-41.63	-45.02	2898.16	3.42	250.00	.39
65	2964.00	-43.02	-48.62	2962.05	3.50	248.00	.23
66	3028.00	-44.62	-52.39	3025.92	3.83	246.00	.56
67	3091.00	-46.39	-56.26	3088.77	3.92	245.00	.17
68	3155.00	-48.29	-60.17	3152.63	3.87	243.00	.23
69	3218.00	-50.16	-63.91	3215.49	3.75	244.00	.21
70	3282.00	-51.99	-67.67	3279.35	3.75	244.00	.00
71	3345.00	-53.85	-71.40	3342.21	3.83	243.00	.17
72	3408.00	-55.70	-74.82	3405.09	3.25	240.00	.97
73	3471.00	-57.35	-77.73	3468.00	2.83	241.00	.67
74	3533.00	-58.70	-80.33	3529.93	2.58	244.00	.46
75	3597.00	-59.97	-82.82	3593.87	2.42	242.00	.29
76	3661.00	-61.27	-85.12	3657.82	2.33	239.00	.23
77	3724.00	-62.65	-87.05	3720.77	2.00	229.00	.80
78	3787.00	-63.59	-88.73	3783.74	1.58	256.00	1.48
79	3850.00	-64.06	-90.45	3846.72	1.67	253.00	.19
80	3913.00	-64.86	-92.05	3909.69	1.63	234.00	.87
81	3977.00	-65.86	-93.43	3973.67	1.42	234.00	.34
82	4040.00	-66.70	-95.16	4036.64	2.12	251.00	1.38
83	4104.00	-67.41	-97.41	4100.59	2.12	254.00	.17
84	4167.00	-67.95	-99.56	4163.56	1.92	258.00	.39
85	4226.00	-68.38	-101.58	4222.52	2.08	258.00	.28
86	4290.00	-68.80	-103.77	4286.48	1.92	260.00	.28
87	4308.00	-68.98	-104.43	4304.47	2.50	251.00	3.76
88	4331.00	-69.32	-105.25	4327.45	1.92	243.00	2.86
89	4337.00	-69.40	-105.47	4333.45	2.50	254.00	11.98

Station Number	Measured Depth (Feet)	+ North - South (Feet)	+ East - West (Feet)	Vertical Depth (Feet)	Inclina- tion (Deg)	Bearing (Deg)	Dogleg (Deg/ 100')
90	4369.00	-69.81	-106.80	4365.42	2.50	252.00	.27
91	4375.00	-69.89	-107.01	4371.41	1.75	248.00	12.73
92	4400.00	-70.24	-107.87	4396.39	2.50	247.00	3.00
93	4432.00	-70.75	-109.16	4428.36	2.50	250.00	.41
94	4438.00	-70.84	-109.37	4434.36	1.75	245.00	12.86
95	4464.00	-71.22	-110.26	4460.34	2.50	248.00	2.92
96	4496.00	-71.76	-111.54	4492.31	2.50	246.00	.27
97	4502.00	-71.84	-111.75	4498.31	1.75	257.00	14.17
98	4527.00	-72.14	-112.62	4523.29	2.50	247.00	3.34
99	4559.00	-72.44	-113.82	4555.26	2.00	267.00	2.89
100	4582.00	-72.21	-114.47	4578.25	1.75	316.00	6.83
101	4591.00	-72.06	-114.67	4587.25	1.50	294.00	7.41
102	4604.00	-71.86	-114.88	4600.25	1.25	338.00	8.12
103	4623.00	-71.42	-114.93	4619.24	1.50	7.00	3.84
104	4655.00	-70.20	-114.63	4651.22	3.00	17.00	4.83
105	4665.00	-69.61	-114.42	4661.20	4.25	22.00	12.88
106	4686.00	-68.15	-113.87	4682.14	4.25	19.00	1.06
107	4697.00	-67.38	-113.62	4693.11	4.25	17.00	1.35
108	4718.00	-65.78	-113.06	4714.04	5.00	21.00	3.89
109	4752.00	-62.64	-112.26	4747.88	6.00	9.00	4.47
110	4782.00	-59.44	-111.63	4777.71	6.50	13.00	2.21
111	4819.00	-54.63	-110.62	4814.38	8.75	11.00	6.12
112	4845.00	-50.63	-109.88	4840.06	9.25	10.00	2.01
113	4883.00	-44.07	-108.66	4877.46	11.00	11.00	4.63
114	4909.00	-39.13	-107.74	4902.97	11.25	10.00	1.21
115	4945.00	-32.25	-106.34	4938.28	11.25	13.00	1.63
116	4972.00	-27.09	-105.34	4964.76	11.25	9.00	2.89
117	5009.00	-19.90	-104.07	5001.04	11.50	11.00	1.26
118	5036.00	-14.60	-103.14	5027.50	11.50	9.00	1.48
119	5100.00	-1.28	-99.99	5090.01	13.25	17.00	3.82
120	5109.00	.67	-99.32	5098.77	13.25	21.00	10.18
121	5140.00	7.52	-96.62	5128.88	14.25	22.00	3.32
122	5146.00	8.89	-96.08	5134.70	14.25	21.00	4.10
123	5163.00	12.85	-94.60	5151.17	14.50	20.00	2.07
124	5203.00	22.35	-90.95	5189.85	15.00	22.00	1.78
125	5209.00	23.82	-90.37	5195.64	15.50	21.00	9.42
126	5226.00	28.00	-88.77	5212.04	15.00	21.00	2.94
127	5273.00	40.46	-83.99	5257.10	18.00	21.00	6.38
128	5290.00	45.46	-82.06	5273.23	18.75	21.00	4.41
129	5305.00	50.13	-80.17	5287.36	20.50	23.00	12.49
130	5336.00	60.07	-76.15	5316.44	20.00	21.00	2.75
131	5344.00	62.75	-75.04	5323.90	22.50	24.00	34.07
132	5354.00	66.22	-73.53	5333.15	22.00	23.00	6.27
133	5377.00	74.38	-69.98	5354.36	23.50	24.00	6.73
134	5399.00	82.32	-66.69	5374.62	22.50	21.00	7.00
135	5417.00	88.92	-64.08	5391.15	24.00	22.00	8.62
136	5447.00	100.35	-59.47	5418.51	24.50	22.00	1.67

Station Number	Measured Depth (Feet)	+ North - South (Feet)	+ East - West (Feet)	Vertical Depth [*] (Feet)	Inclina- tion (Deg)	Bearing (Deg)	Dogleg (Deg/ 100')
137	5463.00	106.60	-57.07	5433.04	25.00	20.00	6.09
138	5480.00	113.33	-54.55	5448.44	25.00	21.00	2.49
139	5525.00	131.62	-47.90	5489.02	26.25	19.00	3.38
140	5543.00	139.31	-45.26	5505.07	27.50	19.00	6.94
141	5587.00	158.88	-38.13	5543.83	29.00	21.00	4.03
142	5605.00	167.24	-35.00	5559.46	30.50	20.00	8.78
143	5648.00	188.12	-27.61	5596.32	31.50	19.00	2.62
144	5677.00	202.46	-22.39	5620.98	32.00	21.00	4.02
145	5705.00	216.33	-17.61	5644.82	31.25	17.00	7.95
146	5712.00	219.90	-16.55	5650.75	33.00	16.00	26.13
147	5712.00	219.90	-16.55	5650.75	31.50	17.00	R
148	5737.00	232.69	-12.76	5671.89	33.00	16.00	6.37
149	5744.00	236.34	-11.65	5677.76	33.00	18.00	15.56
150	5769.00	249.71	-7.44	5698.46	35.25	17.00	9.28
151	5776.00	253.56	-6.26	5704.18	35.00	17.00	3.57
152	5776.00	253.56	-6.26	5704.18	34.75	17.00	R
153	5800.00	267.01	-2.15	5723.63	37.00	17.00	9.38
154	5807.00	271.03	-.88	5729.22	37.00	18.00	8.60
155	5810.00	272.76	-.32	5731.60	37.75	18.00	25.00
156	5823.00	280.35	2.15	5741.87	38.00	18.00	1.92
157	5832.00	285.67	3.88	5748.92	38.75	18.00	8.33
158	5839.00	289.84	5.27	5754.36	39.25	19.00	11.48
159	5846.00	293.99	6.70	5759.82	38.25	19.00	14.29
160	5854.00	298.74	8.38	5766.03	39.83	19.94	21.12
161	5854.30	298.92	8.44	5766.26	39.75	18.70	265.56*
162	5878.00	313.03	13.40	5684.65	38.50	20.00	6.31
163	5887.00	318.27	15.41	5791.68	38.75	22.00	14.15
164	5910.00	331.59	20.66	5809.68	38.25	21.00	3.47
165	5917.00	335.65	22.30	5815.14	39.25	23.00	22.89
166	5926.00	340.93	24.49	5822.10	39.50	22.00	7.58
167	5943.00	350.84	28.20	5835.40	37.50	19.00	16.09
168	5962.00	361.77	32.07	5850.45	37.75	20.00	3.47
169	5974.00	368.77	34.55	5859.88	38.75	19.00	9.80
170	5995.00	381.23	38.96	5876.20	39.25	20.00	3.83
171	6006.00	387.81	41.29	5884.70	39.50	19.00	6.20
172	6038.00	407.16	47.95	5909.30	40.00	19.00	1.56
173	6056.00	418.06	51.81	5923.09	40.00	20.00	3.57
174	6069.00	426.02	54.63	5932.98	41.00	19.00	9.17
175	6086.00	436.51	58.34	5945.83	40.75	20.00	4.12
176	6101.00	445.83	61.64	5957.11	41.75	19.00	7.99
177	6135.00	467.18	69.00	5982.52	41.50	19.00	.74
178	6151.00	477.15	72.62	5994.51	41.50	21.00	8.28
179	6165.00	485.88	75.89	6004.95	42.00	20.00	5.95
180	6176.00	492.77	78.46	6013.13	42.00	21.00	6.08
181	6196.00	505.44	83.07	6027.90	42.75	19.00	7.71
182	6228.00	526.17	90.21	6051.21	43.75	19.00	3.13
183	6236.00	531.41	91.97	6056.99	43.75	18.00	8.64

*The merging of seven multishot surveys with single-shot surveys resulted in small course lengths which in turn distorted the doglegs in degrees per 100 ft.

Station Number	Measured Depth (Feet)	+ North - South (Feet)	+ East - West (Feet)	Vertical Depth (Feet)	Inclina- tion (Deg)	Bearing (Deg)	Dogleg (Deg/ 100')
184	6260.00	547.26	97.27	6074.22	44.50	19.00	4.26
185	6264.00	549.93	98.14	6077.06	44.83	17.00	36.12
186	6291.00	567.79	104.28	6096.35	44.00	21.00	10.82
187	6299.00	573.03	106.24	6102.07	44.75	20.00	12.82
188	6308.00	578.91	108.50	6108.50	44.00	22.00	17.63
189	6323.00	588.38	112.61	6119.38	43.00	25.00	15.29
190	6328.00	591.52	113.97	6123.03	43.50	22.00	42.31
191	6355.00	608.49	121.53	6142.62	43.50	26.00	10.20
192	6359.00	610.98	122.72	6145.52	43.50	25.00	17.21
193	6386.00	627.76	130.90	6165.02	44.00	27.00	5.45
194	6391.00	630.87	132.45	6168.61	44.25	26.00	14.79
195	6417.00	647.21	140.43	6187.19	44.50	26.00	.96
196	6418.00	647.84	140.74	6187.91	44.50	27.00	70.09
197	6425.00	652.22	142.97	6192.90	44.62	27.00	1.67
198	6450.00	667.91	150.97	6210.63	45.00	27.00	1.53
199	6480.00	686.94	160.45	6231.80	45.25	26.00	2.50
200	6481.00	687.57	160.78	6232.50	45.50	28.00	144.52*
201	6508.00	704.66	169.57	6251.47	45.25	26.50	4.06
202	6526.00	716.05	175.25	6264.20	44.75	26.50	2.78
203	6538.00	723.61	179.06	6272.70	45.00	27.00	3.60
204	6568.00	742.26	188.57	6294.19	43.50	27.00	5.00
205	6600.00	761.66	198.67	6317.55	42.75	28.00	3.17
206	6631.00	780.07	208.45	6340.49	41.75	28.00	3.23
207	6635.00	782.43	209.68	6343.47	42.00	27.00	17.82
208	6663.00	799.01	218.13	6364.40	41.25	27.00	2.68
209	6670.00	803.07	220.20	6369.71	40.00	27.00	17.86
210	6694.00	816.69	227.44	6388.10	40.00	29.00	5.36
211	6726.00	834.44	237.28	6412.83	38.75	29.00	3.91
212	6757.00	851.27	246.61	6437.14	38.00	29.00	2.42
213	6762.00	853.98	248.08	6441.08	38.00	28.00	12.31
214	6788.00	867.97	255.67	6461.64	37.50	29.00	3.04
215	6793.00	870.62	257.18	6465.60	37.75	30.00	13.19
216	6819.00	884.44	264.99	6486.19	37.50	29.00	2.54
217	6851.00	901.38	274.38	6511.66	37.00	29.00	1.56
218	6867.00	909.80	279.05	6524.44	37.00	29.00	.00
219	6978.00	966.17	310.30	6614.80	34.00	29.00	2.70
220	7010.00	981.82	318.97	6641.32	34.00	29.00	.00
221	7058.00	1005.30	331.99	6681.12	34.00	29.00	.00
222	7077.00	1014.59	337.14	6696.87	34.00	29.00	.00

222 STATIONS FOR ZGS028 TYPE 1

Horizontal Displacement: 1069.14' at N 18° 22' 52" E

True Vertical Depth: 6696.87' KB, 6677.37' GL

Measured Depth: 7077' KB, 7057.5 GL

*The merging of seven multishot surveys with single-shot surveys resulted in small course lengths which in turn distorted the doglegs in degrees per 100 ft.

APPENDIX D

WELL RB-AR-2

ILLUSTRATIONS

RIO BLANCO, COUNTY
NW 1/4, SEC. 14, T3S, R98W, 6th P.M.

SITE LOCATION SURVEY

FIGURE 1

RB-AR-2 DOWNHOLE STATUS

NOTE:
ALL DEPTHS ARE GROUND LEVEL
MEASUREMENTS 19.5' (20') BELOW
KELLY BUSHING ELEVATION.

FIGURE 2

FIGURE 3. RB-AR-2 DRILLING CURVE

FIGURE 4. RB-AR-2 WELLHEAD STATUS

FIGURE 5. RB-AR-2 BOTTOM HOLE LOCATION FROM SURFACE

Distribution:

Brig. Gen. J. Bratton, DMA, HQ
T. F. Cornwell, DMA, HQ
J. L. Hodges, DMA, HQ
J. Ham, P&NG/FE, HQ
J. W. Watkins, Div. of OG&ST, HQ
D. C. Ward, Div. of OG&ST, HQ
C. Appledorn, CER, Las Vegas, NV
R. S. Brundage, CER, Las Vegas, NV
G. R. Luetkehans, CER, Las Vegas, NV
W. C. Blackburn, Conoco, Casper, WY
D. W. Mitchell, Conoco, Casper, WY
F. E. Ellis, Conoco, Houston, TX
R. L. Mann, Conoco, Houston, TX
E. L. Moffatt, Conoco, New Orleans, LA
L. B. Ballou, LLL, Livermore, CA
L. L. Schwartz, LLL, Livermore, CA
C. J. Sisemore, LLL, Livermore, CA
W. R. Woodruff, LLL, Livermore, CA
H. C. Gleason, LLL, Mercury, NV
R. G. Miller, LLL, Mercury, NV
M. Dolenc, EPNG, El Paso, TX
P. L. Randolph, EPNG, El Paso, TX
C. H. Atkinson, BERC, Bartlesville, OK
F. W. Stead, USGS, Denver, CO
A. E. Doles, EIC, Santa Fe, NM
C. Gustufson, EIC, Santa Fe, NM
P. M. Dougan, EOC, Salt Lake City, UT
M. E. Gates, Manager, NV
C. E. Williams, Deputy Mgr., NV
R. W. Taft, AM/PE&B, NV
J. B. Cotter, IAD, NV
W. E. Gries, IAD, NV
R. T. Stearns, IAD, NV
J. N. Fiore, E&CM Div., NV
R. R. Loux, OPA, NV (20)
B. W. Church, RB, NV
L. J. O'Neill, RB, NV
B. G. DiBona, IAD, NV
NV Library (2)
TIC, Oak Ridge (27)
F&S, LV (5)
F&S, Tulsa (2)