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INVESTIGATION AND EVALUATION OF GEOPRESSURED—GEOTHERMAL WELLS

Prospective Test Wells in the Texas and Louisiana
Gulf Coast

March 1978
Date Published

Work Performed Under Contract No. EG-77-C-08-1528

Gruy Federal, Inc.
Houston, Texas

U. S. DEPARTMENT OF ENERGY Geothermal Energy

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INVESTIGATION AND EVALUATION OF
GEOPRESSURED GEOTHERMAL WELLS

PROSPECTIVE TEST WELLS IN THE
TEXAS AND LOUISIANA GULF COAST

GRUY FEDERAL, INC.
2500 Tanglewilde, Suite 150
Houston, Texas 77063

Date Published--March 1978

Prepared for the
U.S. Department of Energy
Division of Geothermal Energy
Under Contract No. EG-77-C-08-1528

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Package No. 2 of Wells-of-Opportunity Candidates

Contract No. EG-77-C-08-1528

This group of wells-of-opportunity (WOOs) consists of four reentry candidates located in Southern Louisiana. In addition, some preliminary information, not a part of this package but an addendum, is presented on a Galveston County well which, if dry when drilled in late summer, can be deepened to test a hot interval having unknown permeability.

The four Louisiana wells have penetrated a thick section of deep hot and geopressured Miocene or Oligocene sand. Thus the geological risk is essentially eliminated. Each of these wells has been abandoned. We have placed particular emphasis on selecting wells which are reported to have been left in such a mechanical condition that the risk of reentry operations is low. Every effort will be made to further check any well chosen for unreported conditions. Often this can be done by verbal contacts with the operator or drilling contractor.

L-6 UNION OIL OF CALIFORNIA No. 2 Pan Am Fee

L-7 J. P. OWEN ET AL No. 1 L. H. Hardee

L-8 THE SUPERIOR OIL CO. No. 1 Hazel Sawyer

L-9 SUN OIL CO. No. 2 Alice C. Plantation

3-20-78

Geopressured-Geothermal Reentry Prospect L-6North Sweet Lake Prospect

Cameron Parish, Louisiana

Introduction

This Gruy Federal Type II-A, geopressured-geothermal prospect was drilled as the Union Oil Company of California, No. 2 Pan American Fee and is located in Section 13, T12S, R8W, Cameron Parish, Louisiana. It is located approximately one half mile south of Louisiana State Route 384 and 12 miles south of the city of Lake Charles. This well was drilled and abandoned as a dry hole in 1971. The well site is shown on the USGS topographic sheet "Lake Charles Quadrangle," a section of which is reproduced on the following page.

Geology

The potential Geo² aquifer in this well is the Camerina sand series of the Upper Frio from 14,830 feet to 15,390 feet containing approximately 305 net feet of water bearing sand. No hydrocarbon saturation is evident on the resistivity log.

The well was drilled as a western extension to the North Sweet Lake field but found the potential producing horizons structurally low and water bearing. The Sweet Lake field is approximately five miles south of the subject well.

During drilling operations through these sands, the mud weight was 16.8 pounds per gallon which would indicate that the static aquifer pressure would be 12,000 psi (assuming 1000 psi overbalance). The estimated formation temperature is 306° F (152° C). A structure and a net sand isopachous maps accompany this discussion.

Mechanical Condition

The enclosed diagrammatic sketch shows the current mechanical condition of the well as reported on the plugging and abandonment report filed with the Louisiana Department of Conservation. In order to prepare this well for testing, it will be necessary to tie into the 9-5/8 inch casing at 3431 feet and run to the surface. Presently there is no tubing in the well.

The reentry prognosis and the detailed reentry cost statement is attached. The total estimated cost is summarized as follows:

Reentry operation	\$ 274,000
Testing operations	38,500
Saltwater disposal well	115,000
Plugging and clean up	<u>30,900</u>
	\$ 458,400

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CONTOUR INTERVAL 5 FEET
 DATUM IS MEAN SEA LEVEL
 DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOW WATER

ROAD CLASSIFICATION
 Heavy-duty ———— Light-duty ————
 Medium-duty ———— Unimproved dirt ————
 U. S. Route (circle with dot) State Route (circle with cross)

This area also covered by 1:24 000 scale maps of Iowa, Lake Charles, Lake Charles SW, and Lake Charles SE, 7.5 minute quadrangles, surveyed 1940 and 1955

LAKE CHARLES, LA
 N3000-W9300/15

1955

Conclusions

Gruy Federal recommends the use of The Union Oil Company of California, No. 2 Pan American Fee well as a Geo² reentry prospect for the following reasons:

1. The aquifer qualifies as a hot (306° F), geopressured (12,000 psi) candidate for testing.
2. The well is near a State highway which reduces the location preparation cost.
3. The well contains a known quantity of sand with sufficient well control to define a sizeable aquifer volume.
4. The opportunity exists to flow the aquifer at very high rates.
5. The well is on dry land.

Other than the fact that 3400 feet of 9-5/8 inch casing must be run, there are no obvious disadvantages of this well as a reentry prospect.

GEOPRESSURED-GEOTHERMAL WELL-OF-OPPORTUNITY CLASSIFIER

WELL NAME: UNION OIL OF CALIFORNIA No. 2 PAN AMERICAN FEE GRUY FEDERAL W.O.O. NO. L-6		UPPER SECTION		
		I. ALL TUBULAR GOODS IN PLACE WITHIN SURFACE CSG. SURFACE CSG. TO PROTECTION CSG. TO	II. PROTECTION CSG. CUT OFF WITHIN CONDUCTOR OR SUR- FACE CSG. BUT NO OH CUT WITHIN CONDUCTOR AT CUT WITHIN SURFACE CSG. AT 3431'	III. PROTECTION CST. CUT OFF BELOW SURFACE CSG. & OH EXISTS FROM: BOTTOM SURFACE CSG. AT TOP CUT OFF AT
LOWER SECTION	A. CASED THRU GEOPRESSURED ZONE OF INTEREST. ZONE OF INT. 16,830' TO 15,390' PRODN. CSG. TO PRODN. LINER 9,765' TO 15,998' PRODN. PACKER AT			
	B. PLUGGED ABOVE GEOPRESSURED ZONE, WITH OH FROM PLUG THRU GEOPRESSURED ZONE OF INT. PROTECTION CSG. AT PLUG AT TO OH ZONE OF INT. THRU ZONE OF INT.			
	C. TO ABOVE GEOPRESSURED ZONE: REQUIRED TO DRILL DEEPER. TO ZONE OF INT. TO ADDITIONAL DRILLING			

REMARKS:

UNION OIL COMPANY OF CALIFORNIA

NO. 2 PAN AM FEE

SEC. 13, T-12-S, R-8-W

SWEET LAKE AREA

CAMERON PARISH, LOUISIANA

L-6
UNION OIL COMPANY OF CALIFORNIA
No. 2 Pan Am Fee Sweet Lake Area
Cameron Parish, Louisiana

13-3/8" - 3525'
9-5/8" - 3431'/10,316'
7" - 9765'/15,998'

REENTRY PROCEDURE:

1. Prepare location.
2. Move in and rig up workover rig.
3. Dig out 13-3/8" casing, weld on casinghead (and extension, if needed).
4. Pick up 2-7/8" work string and drill cement in interval 30' to 80'.
5. Dress off top of 9-5/8" casing at 3431'.
6. Run 3431' of casing with patch, tie into 9-5/8" and hang off casing. Pressure test patch.
7. Nipple up 9-5/8" casinghead and install BOP's.
8. Continue to pick up 2-7/8" work string and drill out cement plug in interval 9650' to top of 7" liner at 9765'. Make trip to change bits and drill cement 9765' to 9850'. Mud weight to be 16.9 #/gal. before plug is completely drilled out.
9. Continue to clean out 7" casing in well to top of cement plug at 15,120'. Circulate and condition hole.
10. Pull tubing and run casing inspection and Cement Bond Logs. Test top of 7" liner and repair casing, if needed.
11. Condition hole to 15,120'. Then perforate 60' of interval within Camerina sand occurring between 14,830' and 15,120'.
12. Set packer in 7" at 14,800' and test with weight and pressure.
13. Lay down 2-7/8" work string.
14. Pick up string of 3-1/2" production tubing. Space out and set in packer at 14,800'.
15. Install back pressure valve in 3-1/2".
16. Remove BOP's, nipple up and test tree, remove back pressure valve and displace tubing with water to 14,500'. Set tubing in packer and flange up tree. Test flange.
17. Test well and release rig if everything is satisfactory.

TESTING PROCEDURE:

1. Set rental separator and skid-mounted pump. Hook up source well and salt water disposal well.
2. Place well on production using small choke size.
3. Gradually increase flow rate to approximately 5000 barrels per day while monitoring surface flowing pressure, temperature, gas-water ratio, and sand production.
4. Shut well in until static pressure is reached.
5. Run pressure gauge.
6. Place well on production at 5000 barrels per day and record flowing BHP and surface flowing pressure.
7. Sample fluid and gas.
8. After three to five days of constant production rate, shut well in to measure pressure build-up.
9. When BHP has stabilized, retrieve pressure gauge.
10. Place well back on production at successively higher rates until 10,000 barrels per day is obtained. Flow continuously at this rate for two weeks and shut-in.
11. Run pressure gauge to record final static bottom hole pressure.

SALTWATER DISPOSAL WELL:

1. Move in water well rig and rig up.
2. Drive 13-3/8" casing to refusal.
3. Drill 12-1/4" hole to approximately 1500'.
4. Set and cement 9-5/8".
5. Drill 8-3/4" hole to approximately 2500'.
6. Run electric logs.
7. Set and cement 7" casing at TD.
8. Perforate 7" as indicated by log.
9. Set packer in 7".
10. Pick up 3-1/2" tubing and set in packer.
11. Install tree, test well and release rig.

PLUGGING PROCEDURE:

1. Move in and rig up workover rig.
2. Kill well and install BOP's.
3. Pull tubing and set cement plugs as required by Department of Conservation.
4. Lay down 3-1/2" tubing.
5. Cut off 9-5/8" casing and recover as much as is feasible.
6. Cut off 13-3/8" casing and weld plate on top. Release rig.

REENTRY COST:

1.	Location preparation	\$ 50,000	
2.	Rig time - 11 days	38,300	
3.	Bits	2,500	
4.	Mud and chemicals	15,000	
5.	Casinghead	2,000	
6.	Xmas tree (40 day rental)	5,200	
7.	Casing patch	5,000	
8.	Rental tools and equipment	6,900	
9.	Inspection log	5,800	
10.	Cement Bond Log	5,300	
11.	Perforating (this can be negotiated)	12,500	
12.	2-7/8" drill pipe work string	7,800	
13.	2800' of 3-1/2" N-80 12.95# EUE 8 Rd tubing	19,000	(1)
14.	Packer	3,500	
15.	3431' of 9-5/8" N-80 40# 8 Rd casing	56,000	
16.	Supervision	3,600	
17.	Trucking	3,000	
18.	Miscellaneous	8,000	
19.	Contingencies (10%)	<u>25,000</u>	
	Total	\$ 274,000	

(1) Proposed to use approximately 12,000' of 3-1/2" tubing owned by U. S. Government and in storage in Broussard pipe yard in Intracoastal City (used on Delcambre test well).

TESTING COSTS:

1.	Separator, pump, metering equipment	\$ 14,000
2.	Air cooler	3,000
3.	Pressure measurement	8,000
4.	Labor	2,000
5.	Material	3,000
6.	Miscellaneous	3,000
7.	Sampling devices	1,500
8.	Contingencies	<u>4,000</u>
	Total	\$ 38,500

SALTWATER DISPOSAL WELL COSTS:

1. Drill to 2500' and set casing	\$ 30,000	
2. 170' of 13-3/8" casing	2,500	
3. 1500' of 9-5/8" 36# J-55 8 Rd	16,600	
4. 2500' of 7" 26# J-55 8 Rd	11,000	(1)
5. 2500' of 3-1/2" 12.95# N-80 8 Rd	3,500	(2)
6. Cement and services	14,000	
7. Logging	2,700	
8. Perforating (100 feet)	7,200	
9. Wellhead equipment	5,000	
10. Packer	3,500	
11. Supervision	2,000	
12. Miscellaneous	5,000	
13. Contingencies	<u>12,000</u>	
Total	\$ 115,000	

(1) Assuming 1500' of pipe can be recovered, 90% of which can be reused on each of six wells.

(2) Assuming 90% of tubing is reusable on each of six wells.

PLUGGING COSTS:

1. Rig time - 5 days	\$ 17,400
2. Cement and services	5,000
3. Labor	1,000
4. Supervision	1,700
5. Miscellaneous	3,000
6. Contingencies	<u>2,800</u>
Total	\$ 30,900

SUMMARY OF ESTIMATED COSTS:

Reentry and Completion Costs	\$ 274,000
Cost of Testing	38,500
Cost of Plugging	30,900
Saltwater Disposal Well	<u>115,000</u>
Total Estimated Well Cost	\$ 458,400

Geopressured-Geothermal Reentry Prospect L-7Southeast Gueydan Area

Vermillion Parish, Louisiana

Introduction

This Gruy Federal Type I-B, geopressured-geothermal prospect was drilled as the J. P. Owen et al, L. H. Hardee No. 1 and is located in Section 15, T12S, R1W, Vermillion Parish, Louisiana. It is located approximately 0.8 miles south of Louisiana State Route 14 and 3 1/2 miles southeast of the village of Gueydan. This well was drilled and abandoned as a dry hole in 1967. The well site is shown on the USGS topographic sheet "Forked Island Quadrangle," a section of which is reproduced on the following page.

Geology

The potential Geo² aquifer in this well is the Middle Frio (probably the Hackberry series) from 18,387' to 18,932' containing approximately 140 net feet of water bearing sand. No hydrocarbon saturation is evident on the resistivity log.

The well was drilled on the northeast flank of the Southeast Gueydan field but the main accumulation lay further to the west. The Gueydan field is approximately four miles north of the subject well.

During drilling operations through these sands the mud weight was 17.8 pounds per gallon which would indicate that the static aquifer pressure would be 16,200 psi (assuming 1000 psi overbalance). The estimated formation temperature is 360° F (182° C). A structure and net sand isopachous maps of the prospect accompany this discussion.

Mechanical Condition

The enclosed diagrammatic sketch shows the current mechanical condition of the well as reported on the plugging and abandonment record filed with the Louisiana Department of Conservation. In order to test this well it will be necessary to tie into the 7-5/8 inch liner at approximately 13,250 feet and run to surface. Also, 2100 feet of 5-1/2 inch liner must be run and cemented. Presently there is no tubing in the well.

The reentry prognosis and the detailed reentry cost statement are attached. The total estimated cost is summarized as follows:

Reentry operations	\$ 549,550
Testing operations	38,500
Saltwater disposal well	115,000
Plugging and clean up	<u>37,700</u>
	\$ 740,750

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7544 III
(CROWLEY

Conclusions

Gruy Federal recommends the use of the J. P. Owen et al, L. W. Hardee No. 1 well as a Geo² reentry prospect for the following reasons:

1. The aquifer qualifies as a hot (360° F), geopressured (16,200 psi) candidate for testing.
2. The well is located near a State highway which reduces the location preparation cost.
3. The well contains a known quantity of sand with sufficient control in the vicinity to indicate a sizeable aquifer volume.
4. The opportunity exists to flow the well at very high rates.
5. The well is on dry land.

The disadvantage of this well as a reentry prospect is the relatively high cost of the tubular goods required to test the well.

GEOPRESSURED-GEOTHERMAL WELL-OF-OPPORTUNITY CLASSIFIER

WELL NAME: J. P. OWEN ET AL L. H. HARDEE No. 1 GRUY FEDERAL W.O.O. NO. L-7		UPPER SECTION		
		I. ALL TUBULAR GOODS IN PLACE WITHIN SURFACE CSG. SURFACE CSG. TO 5,500' PROTECTION CSG. TO 11,310'	II. PROTECTION CSG. CUT OFF WITHIN CONDUCTOR OR SURFACE CSG. BUT NO OH CUT WITHIN CONDUCTOR AT CUT WITHIN SURFACE CSG. AT	III. PROTECTION CST. CUT OFF BELOW SURFACE CSG. & OH EXISTS FROM: BOTTOM SURFACE CSG. AT TOP CUT OFF AT > OH
16 LOWER SECTION	A. CASED THRU GEOPRESSURED ZONE OF INTEREST. ZONE OF INT. TO PRODN. CSG. TO PRODN. LINER TO PRODN. PACKER AT			
	B. PLUGGED ABOVE GEOPRESSURED ZONE, WITH OH FROM PLUG THRU GEOPRESSURED ZONE OF INT. PROTECTION CSG. AT 11,310' PLUG AT 16,965' ZONE OF INT. 18,387' TO 18,932' > 1967' OH THRU ZONE OF INT.			
	C. TO ABOVE GEOPRESSURED ZONE: REQUIRED TO DRILL DEEPER. TD TO > ADDITIONAL DRILLING			

REMARKS: Well also has 9-5/8" liner 11,136' to 13,455' and 7-5/8" liner bottomed at 16,965'.

GRUY FEDERAL, INC.
Houston, Texas
SOUTHEAST GUEYDAN AREA
Vermilion Parish, Louisiana
Gueydan Deep Structure
STRUCTURE: TOP OF POROSITY
Mid Frio (Probably Hackberry) Sand

J. P. OWEN EA AL
 L. H. HARDEE NO. 1
 SEC. 15 T-12-S R-1-W
 SOUTHEAST GUEYDAN AREA
 VERMILION PARISH, LOUISIANA

GROUND SURFACE

CEMENT PLUG 0-30'

18" CONDUCTOR @ 180'

CEMENT PLUG 3,180' - 3,380'

CEMENT PLUG 5,450' - 5,550'

16" CSA 5,500'

9-5/8" LINER HUNG AT 11,136'

11-3/4" CSA 11,310'

TOP 7-5/8" LINER

9-5/8" CSA 13,455'

SQUEEZE CEMENT AT 16,088'

CEMENT PLUG 16,700' - 17,300'

7-5/8" LINER @ 16,965'

6-1/2" OPEN HOLE TO 18,932'

TOP MID FRIO (PROB. HACKBERRY) 18,387'

104' + GEO² SAND

IN MID FRIO (PROBABLY HACKBERRY) 18,932'

CURRENT STATUS

T.D.
18,932'

18

L7

L-7
J. P. OWEN ET AL
L. H. Hardee No. 1
Southwest Gueydan Area
Vermilion Parish, Louisiana

16" - 5500'
11-3/4" - 11,310'
9-5/8" - 13,255'/13,455'
7-5/8" - 13,255'/16,965'
Open hole 16,965'/18,932'

GEO² TESTING PROGNOSIS

REENTRY PROCEDURE:

1. Prepare location.
2. Move in and rig up workover rig.
3. Dig out 11-3/4" casing, weld on casinghead and extension, if needed.
4. Pick up 2-7/8" work string and drill cement in interval 0-30'.
5. Nipple up 11-3/4" casinghead and install BOP's.
6. Continue to pick up 2-7/8" work string and drill out cement plug in 3180' - 3380' interval and 5450' - 5550'. Mud weight to be 17.6#/gal. before plug is completely drilled out.
7. Continue to clean out well to top of 9-5/8" liner at 11,136'. Circulate and condition hole.
8. Dress off tie back sleeve on top of 7-5/8" liner at approximately 13,250' and run tie back string of 7-5/8" casing to surface.
9. Nipple up 7-5/8" casing and install BOP's and test casing.
10. Continue to run 2-7/8" work string and drill out cement plugs at 16,088' and from 16,700' to 17,300'.
11. Wash and ream old 6-1/2" hole to original total depth of 18,932' and condition well.
12. Pick up core barrel assembly and cut core from 18,932' to base of sand or 50'.
13. Condition hole and run electric logs in open hole.
14. Set 5-1/2" 23# P-110, SFJ liner at total depth with top at 16,800'. Cement liner full length.
15. Clean out 5-1/2" to float collar.

REENTRY PROCEDURE Continued

16. Circulate and condition hole, pull tubing, and run Cement Bond Log. Squeeze cement, if necessary. Perforate approximately 40', 4 shots/ft. at 18,400'±.
17. Set packer in 5-1/2" at 15,900' and test with weight and pressure.
18. Lay down 2-7/8" work string.
19. Pick up combination string of 2-7/8" 8.7# P-105 8 Rd and 3-1/2" 12.95# N-80 8 Rd tubing. Space out and set in packer at 18,200'±.
20. Install back pressure valve in 3-1/2".
21. Remove BOP's, nipple up and test tree, remove back pressure valve and displace tubing with water to 15,900'. Set tubing in packer and flange up tree. Test flange.
22. Test well and release rig if everything is satisfactory.

TESTING PROCEDURE:

1. Set rental separator and skid-mounted pump. Hook up source well and salt water disposal well.
2. Place well on production using small choke size.
3. Gradually increase flow rate to approximately 5000 barrels per day while monitoring surface flowing pressure, temperature, gas-water ratio, and sand production.
4. Shut well in until static pressure is reached.
5. Run pressure gauge.
6. Place well on production at 5000 barrels per day and record flowing BHP and surface flowing pressure.
7. Sample fluid and gas.
8. After three to five days of constant production rate, shut well in to measure pressure build-up.
9. When BHP has stabilized retrieve pressure gauge.
10. Place well back on production at successively higher rates until 10,000 barrels per day is obtained. Flow continuously at this rate for two weeks and shut-in.
11. Run pressure gauge to record final static bottom hole pressure.

SALTWATER DISPOSAL WELL

1. Move in water well rig and rig up.
2. Drive 13-3/8" casing to refusal.
3. Drill 12-1/4" to approximately 1500'.
4. Set and cement 9-5/8".
5. Drill 8-3/4" hole to approximately 2500'.
6. Run electric logs.
7. Set and cement 7" casing at TD.
8. Perforate 7" as indicated by log.
9. Set packer in 7".
10. Pick up 3-1/2" tubing and set in packer.
11. Install tree, test well and release rig.

PLUGGING PROCEDURE:

1. Move in and rig up workover rig.
2. Kill well and install BOP's.
3. Pull tubing and set cement plugs as required by Department of Conservation.
4. Lay down 3-1/2" tubing.
5. Cut off 7-5/8" casing and recover as much as is feasible.
6. Cut off 11-3/4" casing and weld plate on top. Release rig.

REENTRY COST:

1. Lease and permit costs	\$ 25,000	
2. Location preparation	15,000	
3. Rig time - 17 days	59,200	
4. Bits	2,400	
5. Mud and chemicals	35,000	
6. Casinghead	1,000	
7. Xmas tree	5,200	
8. Casing patch	6,000	
9. Rental tools and equipment	16,000	
10. Trucking	10,000	
11. Inspection log	7,000	
12. Liner setting tools, etc.	4,500	
13. Cement and services	7,000	
14. Cement Bond Log	5,500	
15. Perforating	10,300	
16. 2-7/8" drill pipe work string	15,000	
17. 2700' of 3-1/2" N-80 12.95# EUE 8 Rd tubing	18,000	(1)
18. Packer	3,500	
19. 13,300' of 7-5/8" S-95 10# 8 Rd casing @ 14.50	192,850	(2)
20. 4206' of 5-1/2" P 110 SFJ casing @ 13.00	54,600	
21. Supervision	5,500	
22. Miscellaneous	6,000	
23. Contingencies	<u>45,000</u>	
Total	\$549,550	

(1) Propcsed to use approximately 12,000' of 3-1/2" tubing owned by U. S. Government and in storage in Broussard pipe yard in Intracoastal City (used on Delcambre test well).

(2) This may be salvable if it is not necessary to cement to repair casing patch.

TESTING COSTS:

1. Separator, pump, metering equipment	\$ 14,000
2. Air cooler	3,000
3. Pressure measurement	8,000
4. Labor	2,000
5. Material	3,000
6. Miscellaneous	3,000
7. Sampling devices	1,500
8. Contingencies	<u>4,000</u>
Total	\$ 38,500

SALTWATER DISPOSAL WELL COSTS:

1. Drill to 2500' and set casing	\$ 30,000	
2. 170' of 13-3/8" casing	2,500	
3. 1500' of 9-5/8" 36# J-55 8 Rd	16,600	
4. 2500' of 7" 26# J-55 8 Rd	11,000	(1)
5. 2500' of 3-1/2" 12.95# N-80 8 Rd	3,500	(2)
6. Cement and services	14,000	
7. Logging	2,700	
8. Perforating (100 feet)	7,200	
9. Wellhead equipment	5,000	
10. Packer	3,500	
11. Supervision	2,000	
12. Miscellaneous	5,000	
13. Contingencies	<u>12,000</u>	
Total	\$ 115,000	

(1) Assuming 1500' of pipe can be recovered, 90% of which can be reused on each of six wells.

(2) Assuming 90% of tubing is reusable on each of six wells.

PLUGGING COSTS:

1. Rig time - 6 days	\$ 20,800
2. Cement and services	7,500
3. Labor	1,000
4. Supervision	2,000
5. Miscellaneous	3,000
6. Contingencies	<u>3,400</u>
Total	\$ 37,700

SUMMARY OF ESTIMATED COSTS:

Reentry and Completion Costs	\$ 549,550
Cost of Testing (30 days)	38,500
Cost of Plugging	37,700
Cost of Saltwater Disposal Well	<u>115,000</u>
Total Estimated Well Cost	\$ 740,750

Geopressured-Geothermal Reentry Prospect L-8South Gueydan Area

Vermilion Parish, Louisiana

Introduction

This Gruy Federal Type II-A, geopressured-geothermal prospect was drilled as The Superior Oil Company No. 1 Hazel Sawyer, and is located in Section 35, T11S, Range 1-W, Vermilion Parish, Louisiana. It is located off the southeast flank of the Gueydan field and is accessible by lease and section roads. The well was drilled and abandoned as a dry hole in late 1971. The location is shown more accurately on the USGS topographic sheet "Crowley, Louisiana Quadrangle," a section of which is reproduced on the following page.

Geology

The potential Geo² aquifer in this well is the Camerina sand series of Frio-Oligocene age in the interval from 16,385' to 16,840' containing 120' of water bearing sand with no hydrocarbon saturation being evident on the resistivity logs.

The well was drilled as a deep outpost test on the southeast flank of the recognized Gueydan salt dome structure. Geological data from this and other deep tests in the area indicate that the shallow Gueydan structure shifts to the south with depth and tends to associate a large deep-seated anticlinal area that tends to connect the Gueydan, Southeast Gueydan fields on the deeper structure. The proposed well is on the north flank of the deep structure and should offer a large drainage area for testing.

During drilling operations through these sands, the mud weight was 17.9 pounds per gallon which would indicate that the static aquifer pressure would be 14,450 psi (assuming 1000 psi overbalance from the hydrostatic head of the mud column). The estimated formation temperature is 328°F (164°C). The structure and net isopachous maps of this prospect accompany this discussion.

Mechanical Condition

The enclosed diagrammatic sketch shows the current mechanical condition of the well as reported on the plugging and abandonment record filed with the Louisiana Department of Conservation. In order to safely test this well it will be necessary to drill out cement plugs and tie into the intermediate casing string with 2958' of 11-3/4" O.D. casing and into the 7" liner tie-back sleeve located at 11,992'. It is noted that the Geo² sands are cased off at this time.

The reentry prognosis and the detailed cost for reentry is attached. The total estimated cost is summarized as follows:

Reentry operations	\$ 499,300
Testing operations	38,500
Saltwater disposal well	115,000
Plugging and clean up	<u>30,900</u>
	\$ 683,700

Geological Survey

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11 photographs
1955

tum
system,

1 ticks,

UTH GRID AND 1955 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

SCALE 1:62500

CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

THIS MAP COMPIES WITH NATIONAL MAP ACCURACY STANDARDS

ROAD CLASSIFICATION

CROWLEY, LA.
N3000—W9215/15
1955

Conclusions

Gruy Federal recommends the use of the No. Hazel Sawyer as a Geo² reentry prospect for the following reasons:

1. The aquifer qualifies as a hot (328° F), geopressured (14,450 psi) candidate for testing.
2. The well location is easily reached on land and will require minimum location costs.
3. The areal extent of the aquifer appears to be broad and should yield high rates of flow throughout the test period.
4. Geological risk is at a minimum.
5. Tubular goods requirements are relatively high, but salvage value is also high.

GEOPRESSURED-GEOTHERMAL WELL-OF-OPPORTUNITY CLASSIFIER					
WELL NAME: THE SUPERIOR OIL COMPANY No. 1 HAZEL SAWYER GRUY FEDERAL W.O.O. NO. L-8	UPPER SECTION				
	I. ALL TUBULAR GOODS IN PLACE WITHIN SURFACE CSG. SURFACE CSG. TO PROTECTION CSG. TO	II. PROTECTION CSG. CUT OFF WITHIN CONDUCTOR OR SUR- FACE CSG. BUT NO OH CUT WITHIN CONDUCTOR AT CUT WITHIN SURFACE CSG. AT 3035'	III. PROTECTION CST. CUT OFF BELOW SURFACE CSG. & OH EXISTS FROM: BOTTOM SURFACE CSG. AT TOP CUT OFF AT		
28 NOTION LOWER SECTION	A. CASED THRU GEOPRESSURED ZONE OF INTEREST. ZONE OF INT. 16,385' TO 16,840' PRODN. CSG. 0 TO 11,992' PRODN. LINER 11,992' TO 17,200' PRODN. PACKER AT 11,992'				
	B. PLUGGED ABOVE GEOPRESSURED ZONE, WITH OH FROM PLUG THRU GEOPRESSURED ZONE OF INT. PROTECTION CSG. AT PLUG AT ZONE OF INT. TO				> OH THRU ZONE OF INT.
	C. TO ABOVE GEOPRESSURED ZONE: REQUIRED TO DRILL DEEPER. TO ZONE OF INT. TO				> ADDITIONAL DRILLING

REMARKS: Well also has an intermediate string cut off at 10,570' and a protection string cut off at 12,947'.

NET SAND ISOPACHOUS MAP
CAMERINA (FRIO) SAND

L8

⊗ Control Wells.
* ✦ Wells not penetrative horizon of interest.
SCALE: 1" = 4,000'

GRUY FEDERAL, INC.
Houston, Texas
SOUTHEAST GUYDAN AREA
Vermilion Parish, Louisiana
Guydan Deep Structure
STRUCTURE: TOP OF POROSITY
Camerina (Frio) Sand

L8

THE SUPERIOR OIL COMPANY
 HAZEL SAWYER NO. 1
 SOUTHEAST GUEYDAN AREA
 SEC. 35 T-11-S R-1-W
 VERMILION PARISH, LOUISIANA

L-8
SUPERIOR OIL COMPANY
Hazel Sawyer No. 1
Vermilion Parish, Louisiana

16" - 3035'
11-3/4" - 2958'/10,570'
9-5/8" - 7569'/12,947'
7" liner - 17,200'
Open hole - 19,808'

GEO² TESTING PROGNOSIS

REENTRY PROCEDURE:

1. Prepare location.
2. Move in and rig up workover rig.
3. Dig out 16" OD casing, weld on casinghead and extension, if needed.
4. Pick up 3-1/2" work string and drill cement plugs in interval 0 - 100' and 2789' - 3068'.
5. Dress off top of 11-3/4" OD casing at 2958'.
6. Run 11-3/4" casing with patch, tie into 11-3/4" and hang casing. Pressure test patch.
7. Nipple up 11-3/4" casinghead and install BOP's.
8. Continue to pick up 3-1/2" work string and wash to top of plug at 7374'.
9. Drill cement plug at 7374' to 7688'.
10. If completion record on well indicates that the 7" liner hanger is equipped with a tie back sleeve, drill plug at 11,992' - 12,068'.
11. Clean out and condition hole to top of cement plug at 16,747'.
12. Run casing inspection log and Cement Bond Log. Repair casing and squeeze cement, if necessary. Pressure test casing.
13. Run 7" casing, tie into liner, cement and hang casing. Drill out cement.
14. Perforate 85' with 4 shots/ft. over gross sand interval 16,385' - 16,650'.
15. Set packer in 7" at 16,100' and test with weight and pressure.
16. Lay down 3-1/2" work string.
17. Pick up 3-1/2", 12.95#/Ft., N-80, 8 Rd tubing. Set in packer at 16,500'.

REENTRY PROCEDURE Continued

18. Install back pressure valve in 3-1/2".
19. Remove BOP's, nipple up and test tree, remove back pressure valve and displace tubing with water to 16,100'. Set tubing in packer and flange up tree. Test flange.
20. Release rig.

TESTING PROCEDURE:

1. Set rental separator and skid-mounted pump. Hook up source well and salt water disposal well.
2. Place well on production using small choke size.
3. Gradually increase flow rate to approximately 5000 barrels per day while monitoring surface flowing pressure, temperature, gas-water ratio, and sand production.
4. Shut well in until static pressure is reached.
5. Run pressure gauge.
6. Place well on production at 5000 barrels per day and record flowing BHP and surface flowing pressure.
7. Sample fluid and gas.
8. After three to five days of constant production rate, shut well in to measure pressure build-up.
9. When BHP has stabilized, retrieve pressure gauge.
10. Place well back on production at successively higher rates until 10,000 barrels per day is obtained. Flow continuously at this rate for two weeks and shut-in.
11. Run pressure gauge to record final static bottom hole pressure.

SALTWATER DISPOSAL WELL

1. Move in water well rig and rig up.
2. Drive 13-3/8" casing to refusal.
3. Drill 12-1/4" to approximately 1500'.
4. Set and cement 9-5/8".
5. Drill 8-3/4" hole to approximately 2500'.
6. Run electric logs.
7. Set and cement 7" casing at TD.
8. Perforate 7" as indicated by log.
9. Set packer in 7".
10. Pick up 3-1/2" tubing and set in packer.
11. Install tree, test well and release rig.

PLUGGING PROCEDURE:

1. Move in and rig up workover rig.
2. Kill well and install BOP's.
3. Pull tubing and set cement plugs as required by Department of Conservation.
4. Lay down 3-1/2" tubing.
5. Cut off 7" casing and recover as much as is feasible.
6. Cut off 11-3/4" casing and weld plate on top. Release rig.

REENTRY COST:

1.	Location preparation	\$ 50,000	
2.	Rig time - 14 days	48,800	
3.	Bits	3,000	
4.	Mud and chemicals	18,000	
5.	Casinghead	2,000	
6.	Xmas tree (40 day rental)	5,200	
7.	Casing patch	6,000	
8.	Rental tools and equipment	8,800	
9.	Inspection logs	4,800	
10.	Cement and services	5,000	
11.	Cement Bond Log	5,600	
12.	Perforating (this can be negotiated)	20,000	
13.	3-1/2" drill pipe work string	14,000	
14.	2958' of 11-3/4" S-80 47# 8 Rd casing	52,400	
15.	4100' of 3-1/2" N-80 12.95# EUE 8 Rd tubing	27,400	(1)
16.	Packer	3,500	
17.	12,800' of 7" S-95 29# 8 Rd casing	162,400	
18.	Supervision	4,600	
19.	Trucking	4,000	
20.	Miscellaneous	8,800	
21.	Contingencies (10%)	<u>45,000</u>	
	Total	\$ 499,300	

- (1) Proposed to use approximately 12,000' of 3-1/2" tubing owned by U. S. Government and in storage in Broussard pipe yard in Intracoastal City (used on Delcambre test well).

TESTING COSTS:

1.	Separator, pump, metering equipment	\$ 14,000	
2.	Air cooler	3,000	
3.	Pressure measurement	8,000	
4.	Labor	2,000	
5.	Material	3,000	
6.	Miscellaneous	3,000	
7.	Sampling devices	1,500	
8.	Contingencies	<u>4,000</u>	
	Total	\$ 38,500	

SALTWATER DISPOSAL WELL COSTS:

1. Drill to 2500' and set casing	\$ 30,000	
2. 170' of 13-3/8" casing	2,500	
3. 1500' of 9-5/8" 36# J-55 8 Rd	16,600	
4. 2500' of 7" 26# J-55 8 Rd	11,000	(1)
5. 2500' of 3-1/2" 12.95# N-80 8 Rd	3,500	(2)
6. Cement and services	14,000	
7. Logging	2,700	
8. Perforating (100 feet)	7,200	
9. Wellhead equipment	5,000	
10. Packer	3,500	
11. Supervision	2,000	
12. Miscellaneous	5,000	
13. Contingencies	<u>12,000</u>	
Total	\$ 115,000	

(1) Assuming 1500' of pipe can be recovered, 90% of which can be reused on each of six wells.

(2) Assuming 90% of tubing is reusable on each of six wells.

PLUGGING COSTS:

1. Rig time - 5 days	\$ 17,000
2. Cement and services	5,000
3. Labor	1,000
4. Supervision	1,700
5. Miscellaneous	3,000
6. Contingencies	<u>2,800</u>
Total	\$ 30,900

SUMMARY OF ESTIMATED COSTS:

Reentry and Completion Costs	\$ 499,300
Cost of Testing	38,500
Cost of Plugging	30,900
Saltwater Disposal Well	<u>115,000</u>
Total Estimated Well Cost	\$ 683,700

Geopressured-Geothermal Reentry Prospect L-9South Garden City Area

St. Mary Parish, Louisiana

Introduction

This Gruy Federal Type II-B, geopressured-geothermal prospect was drilled as the Sun Oil Company, No. 2 Alice C. Plantation, and is located in Section 2, T16S R10E, St. Mary Parish, Louisiana. It is located approximately one half mile west of Louisiana Route 317 and approximately one half mile north of the village of North Bend. This well was drilled and abandoned as a dry hole in 1963. The location is shown on the USGS topographic sheet "North Bend Quadrangle," a section of which is reproduced on the following page.

Geology

The potential Geo² aquifer in this well is the Lower Marginulina ascensionensis sand series of lower Miocene age from 16,810' to 17,900' containing approximately 315 net feet of water bearing sand. No hydrocarbon saturation is evident on the resistivity log.

The well was drilled as an extension on the extreme southern flank of the Garden City field; but instead, penetrated a large down-to-the-coast fault which isolated it from the northern accumulation. Bayou Sale field is located approximately five miles southwest of the subject well.

During drilling operations through these sands the mud weight was 17.2 pounds per gallon which would indicate that the static aquifer pressure would be 14,500 psi (assuming 1000 psi overbalance). The estimated formation temperature is 320° F (160° C). A structure and net sand isopachous maps of the prospect accompany this discussion.

Mechanical Condition

The enclosed diagrammatic sketch shows the current mechanical condition of the well as reported on the plugging and abandonment record filed with the Louisiana Department of Conservation. In order to test this well it will be necessary to tie into the 9-5/8 inch protection string at 3425 feet and run approximately 2000 feet of 7 inch liner. Presently there is no tubing in the well.

The reentry prognosis and the detailed reentry cost statement is attached. The total estimated costs are summarized as follows:

Reentry operations	\$ 447,720
Testing operations	38,500
Saltwater disposal well	115,000
Plugging and clean up	<u>30,900</u>
	\$ 632,120

NORTH BEND, LA.
 NW/4 BELLE ISLE 15' QUADRANGLE
 N2937.5—W9122.5/7.5

1966

Conclusions

Gruy Federal recommends the use of the Sun Oil Company, No. 2 Alice C. Plantation well as a Geo² reentry prospect for the following reasons:

1. The aquifer qualifies as a hot (320° F), geopressured (14,500 psi) candidate for testing.
2. The well is located near a State highway which reduces the location preparation cost.
3. The well contains a known quantity of sand.
4. The opportunity exists to flow the well at very high rates.
5. The well appears to be on dry land.

The disadvantage is the relatively high cost of the tubular goods required to test this well.

GEOPRESSURED-GEOTHERMAL WELL-OF-OPPORTUNITY CLASSIFIER

WELL NAME: SUN OIL COMPANY No. 2 ALICE C. PLANTATION GRUY FEDERAL W.O.O. NO. L-9		UPPER SECTION		
		I. ALL TUBULAR GOODS IN PLACE WITHIN SURFACE CSG. SURFACE CSG. TO PROTECTION CSG. TO	II. PROTECTION CSG. CUT OFF WITHIN CONDUCTOR OR SUR- FACE CSG. BUT NO OH CUT WITHIN CONDUCTOR AT CUT WITHIN SURFACE CSG. AT 3537'	III. PROTECTION CST. CUT OFF BELOW SURFACE CSG. & OH EXISTS FROM: BOTTOM SURFACE CSG. AT TOP CUT OFF AT
39 LOWER SECTION	A. CASED THRU GEOPRESSURED ZONE OF INTEREST. ZONE OF INT. TO PRODN. CSG. TO PRODN. LINER TO PRODN. PACKER AT			
	B. PLUGGED ABOVE GEOPRESSURED ZONE, WITH OH FROM PLUG THRU GEOPRESSURED ZONE OF INT. PROTECTION CSG. AT 16,234' PLUG AT 16,234' ZONE OF INT. 16,810' TO 17,900' OF INT. > 2766^{OH} THRU ZONE			
	C. TO ABOVE GEOPRESSURED ZONE: REQUIRED TO DRILL DEEPER. TO ZONE OF INT. TO > ADDITIONAL DRILLING			

REMARKS:

NET SAND ISOPACHOUS MAP
LOWER MARGINULINA ASCENSIONENSIS SAND SERIES

L8

GRUY FEDERAL, INC.
Houston, Texas
South Garden City Area
St. Mary Parish, Louisiana
STRUCTURE: TOP OF POROSITY
LOWER MARGINULINA ASCENSIONENSIS SAND SERIES

L9

SUN OIL COMPANY
NO. 2 ALICE C. PLANTATION
SEC. 2, T-16-S, R-10E
SOUTH GARDEN CITY AREA
ST. MARY PARISH, LOUISIANA

CEMENT PLUG 0'-20'

CEMENT PLUG 3,325'-3,525'

9-5/8" CSG CUT OFF AT 3,425'

13-3/8" CSA 3,537'

CEMENT PLUG 16,020'-16,234'

9-5/8" CSA 16,234'

17.2 #/GAL MUD

8-3/4" OPEN HOLE TO 19,000'
TOP OF LOWER MARGINULINA SAND 16,810'

BASE OF LOWER MARGINULINA SAND 17,900'

T.D.
19,000'

CURRENT STATUS

L-9
SUN OIL COMPANY
Alice C. Plantation No. 2
St. Mary Parish, Louisiana

13-3/8" - 3537'
9-5/8" - 3425'/16,234'
Open hole - 16,234'/19,000'

GEO² TESTING PROGNOSIS

REENTRY PROCEDURE:

1. Prepare location.
2. Move in and rig up workover rig.
3. Dig out 13-3/8" casing, weld on casinghead and extension, if needed.
4. Pick up 3-1/2" work string and drill cement in interval 0-20' and 3325' - 3525'.
5. Dress off top of 9-5/8" casing at 3425'.
6. Run 9-5/8" casing with patch, tie into 9-5/8" and hang casing. Pressure test patch.
7. Nipple up 9-5/8" casinghead and install BOP's.
8. Continue to pick up 3-1/2" work string and wash to top of plug at 16,020'.
9. Circulate and condition hole. Pull work string and run casing inspection log and Cement Bond Log. Repair casing and squeeze cement if needed. Pressure test 9-5/8" casing.
10. Increase mud weight to 17.2#/gal. and drill cement plug at 16,020' - 16,234'.
11. Go in hole with 8-3/4" bit and wash to TD 19,000'.
12. Circulate, condition hole, and run open hole logs from 16,234' - 19,000'.
13. Set 7", 29#/ft., S-95, SFJ liner at 19,000' with setting tool at 16,100'. Cement liner full length.
14. Clean out 9-5/8" to top of liner and pressure test. Squeeze cement, if necessary.
15. Clean out 7" to float collar.
16. Circulate and condition hole, pull tubing and run Cement Bond Log. Squeeze cement liner, if needed.
17. Selectively perforate 85' with 4 shots/foot over gross sand interval 16,810' to 17,900'.

REENTRY PROCEDURE Continued

18. Set packer in 7" at 16,500' and test with weight and pressure.
19. Lay down 3-1/2" work string.
20. Pick up 3-1/2", 12.95#/ft., N-80, 8 Rd tubing and set in packer at 16,500'.
21. Install back pressure valve in 3-1/2".
22. Remove BOP's, nipple up and test tree, remove back pressure valve and displace tubing with water to 16,500'. Set tubing in packer and flange up tree. Test flange.
23. Release rig.

TESTING PROCEDURE:

1. Set rental separator and skid-mounted pump. Hook up source well and salt water disposal well.
2. Place well on production using small choke size.
3. Gradually increase flow rate to approximately 5000 barrels per day while monitoring surface flowing pressure, temperature, gas-water ratio, and sand production.
4. Shut well in until static pressure is reached.
5. Run pressure gauge.
6. Place well on production at 5000 barrels per day and record flowing BHP and surface flowing pressure.
7. Sample fluid and gas.
8. After three to five days of constant production rate, shut well in to measure pressure build-up.
9. When BHP has stabilized retrieve pressure gauge.
10. Place well back on production at successively higher rates until 10,000 barrels per day is obtained. Flow continuously at this rate for two weeks and shut-in.
11. Run pressure gauge to record final static bottom hole pressure.

SALTWATER DISPOSAL WELL

1. Move in water well rig and rig up.
2. Drive 13-3/8" casing to refusal.
3. Drill 12-1/4" to approximately 1500'.
4. Set and cement 9-5/8".
5. Drill 8-3/4" hole to approximately 2500'.
6. Run electric logs.
7. Set and cement 7" casing at TD.
8. Perforate 7" as indicated by log.
9. Set packer in 7".
10. Pick up 3-1/2" tubing and set in packer.
11. Install tree, test well and release rig.

PLUGGING PROCEDURE:

1. Move in and rig up workover rig.
2. Kill well and install BOP's.
3. Pull tubing and set cement plugs as required by Department of Conservation.
4. Lay down 3-1/2" tubing.
5. Cut off 9-5/8" casing and recover as much as is feasible.
6. Cut off 13-3/8" casing and weld plate on top. Release rig.

REENTRY COST:

1. Location preparation	\$ 50,000	
2. Rig time - 19 days	66,120	
3. Bits	26,000	
4. Mud and chemicals	25,000	
5. Casinghead	2,000	
6. Xmas tree (40 day rental)	5,200	
7. Casing patch	5,000	
8. Rental tools and equipment	12,000	
9. Inspection log	7,000	
10. Cement and services	7,000	
11. Cement Bond Log	6,500	
12. Liner setting	4,000	
13. Perforating (this can be negotiated)	22,000	
14. 2-7/8" drill pipe work string	16,000	
15. 2900' - 7" S-95 29# SFJ liner	38,000	
16. 4500' - 3-1/2" N-80 12.95# EUE 8 Rd tubing	31,000	(1)
17. Packer	3,500	
18. 3425' of 9-5/8" N-80 12# 8 Rd casing	56,200	
19. Supervision	6,200	
20. Trucking	5,000	
21. Miscellaneous	13,000	
22. Contingencies (10%)	<u>41,000</u>	
Total	\$ 447,720	

(1) Proposed to use approximately 12,000' of 3-1/2" tubing owned by U. S. Government and in storage in Broussard pipe yard in Intracoastal City (used on Delcambre test well).

TESTING COSTS:

1. Separator, pump, metering equipment	\$ 14,000
2. Air cooler	3,000
3. Pressure measurement	8,000
4. Labor	2,000
5. Material	3,000
6. Miscellaneous	3,000
7. Sampling devices	1,500
8. Contingencies	<u>4,000</u>
Total	\$ 38,500

SALTWATER DISPOSAL WELL COSTS:

1. Drill to 2500' and set casing	\$ 30,000	
2. 170' of 13-3/8" casing	2,500	
3. 1500' of 9-5/8" 36# J-55 8 Rd	16,600	
4. 2500' of 7" 26# J-55 8 Rd	11,000	(1)
5. 2500' of 3-1/2" 12.95# N-80 8 Rd	3,500	(2)
6. Cement and services	14,000	
7. Logging	2,700	
8. Perforating (100 feet)	7,200	
9. Wellhead equipment	5,000	
10. Packer	3,500	
11. Supervision	2,000	
12. Miscellaneous	5,000	
13. Contingencies	<u>12,000</u>	
Total	\$ 115,000	

(1) Assuming 1500' of pipe can be recovered, 90% of which can be reused on each of six wells.

(2) Assuming 90% of tubing is reusable on each of six wells.

PLUGGING COSTS:

1. Rig time - 5 days	\$ 17,400
2. Cement and services	5,000
3. Labor	1,000
4. Supervision	1,700
5. Miscellaneous	3,000
6. Contingencies	<u>2,800</u>
Total	\$ 30,900

SUMMARY OF ESTIMATED COSTS:

Reentry and Completion Costs	\$ 447,720
Cost of Testing	38,500
Cost of Plugging	30,900
Cost of Saltwater Disposal Well	<u>115,000</u>
Total Estimated Well Cost	\$ 632,120