GL04406

UNION 76

GEOTHERMAL DIVISION

TECHNICAL REPORT

COVE FORT SULPHURDALE UNIT

WELL #42-7

PERMIT #0045

INDEX

Geologic Report on the
Cove Fort-Sulphurdale Unit Well #42-7
Beaver County, Utah

Lithology

The #42-7 well reached a total depth of 7735 feet in serpentine marble. This well is unusual as it penetrated all three basic rock types--igneous, sedimentary and metamorphic. The following is a discussion, by section, of the rock types encountered based on the binocular microscope examination of the well cuttings;

Interval....60' - 2055'
Formation...Bullion Canyon volcanics
Age.........Oligocene and Miocene(?)
Lithology...Andesite

Comments: This sequence of extrusive Mid-Tertiary volcanics can be divided into three units based on variations in the fabric and composition of the samples. From 60' - 740' the upper unit of the Bullion Canyon consists of fine-grained porphyritic andesite. The fine-grained phenocrysts consist mainly of feldspar, with lesser amounts of biotite, augite and quartz. The percentage of quartz pheoncrysts approaches 10% in several samples indicating that the composition of this unit is near that of a quartz latite. Beginning at 620' the biotite and augite phenocrysts begin to exhibit signs of alteration--bleaching and microscopic chloritic alteration. However, the groundmass and feldspar phenocrysts remain fresh and unaltered.

The middle unit of the Bullion Canyon volcanics extends from 740' to 1500'. The rock type remains a fine-grained porphyritic andesite, but the composition of the phenocrysts and trace minerals differ slightly from the other units. Microscopic, anhedral grains of magnetite are very common. The percentage of quartz phenocrysts, generally below 3%, is noticeably less than in the upper unit. Phenocrysts of augite and biotite, which are present in varying amounts, continue to exhibit chloritic alteration and bleaching. This unit, especially the lower half, may be an andesite breccia for there is wide variation in the fabric, composition and color of the cuttings.

The lower unit of the Bullion Canyon volcanics extends from 1500' to 2055'. The rock type is a fine-grained porphyritic andesite breccia. As in the lower part of the middle unit, there is a wide variation of the fabric and composition of the cuttings, indicating the breccia makeup of the rock. Phenocrysts of quartz are scarce to absent. Phenocrysts of biotite, still showing some signs of bleaching or chloritic alteration, decrease in abundance and are absent below 1800'. Scattered grains of magnetite are still common but are less abundant than in the middle unit. The color of the felted groundmass varys from red to brown to gray to greenish-black. The first occurrence of finely disseminated pyrite (FeS) was noted at 1600'. Pyrite remains a trace secondary mineral throughout the rest of this unit.

Interval....2055' - 2800'
Formation...Coconino sandstone
Age.........Permian
Lithology...Quartzose sandstone

Comments: A major angular unconformity was penetrated at 2055' representing an apparent stratigraphic hiatus of over 200 million years. The presence of the Coconino sandstone below the Bullion Canyon volcanics and the attendant absence of the Permian Kaibab limestone, Triassic Moenkopi red beds, Jurassic Nugget sandstone, and the Late Cretaceous-Early Tertiary Claron formation indicates that the #42-7 location underwent considerable erosion sometime between Mid-Mesozoic and Mid-Tertiary time.

The Coconino sandstone consists of very fine-grained, well-cemented, clean, white, quartzose sandstone. All intergranular porosity is filled with secondary silica and/or calcite. Finely disseminated grains and crystals of pyrite are found throughout the sandstone. From the drilling characteristics, the section of the Coconino sandstone from 2120' to 2400' is soft and highly fractured.

The 745-foot thickness of the Coconino sandstone penetrated in the well is in sharp contrast to the 300-foot thickness of the formation on outcrop 5 miles to the north. Because the thickness of the Coconino is expected to be uniform, steep dip (confirmed by the dipmeter log in deeper formations) and/or faulting has caused the 150% increase in the apparent thickness of the formation. A minimum dip of 66° is needed to explain the increase in the apparent formation thickness by structure alone. (Maximum dip of 40° is present in the dipmeter log run between 3380' and 5442'.)

Interval....2800' - 3390'
Formation...Pakoon limestone
Age.........Lower Permian
Lithology...Dolomite

Comments: A sequence of aphanitic and cherty dolomite is present in this interval. The dolomite is generally gray to dark-gray in color and aphanitic to very finely crystalline. Cherty dolomite occurs at 3060' to 3240' and 3320' to 3360'. The chert is white to gray in color and glassy. The base of this sequence is placed at the top of a prominent sandstone at 3390', which may correlate with a cherty sandstone present on outcrop near the Permian-Pennsylvanian boundary. Secondary sulphide minerals are very common in this interval. Microscopic grains and anhedral crystals of pyrite and possibly other sulphide minerals (i.e., galena, arsenopyrite, marcasite) are present in nearly all samples.

Interval....3390' - 3980'

Formation...Oquirrh formation

Age.........Pennsylvanian

Lithology...Calcareous dolomite

Comments: Slightly fossiliferous calcareous dolomite, interbedded with dark-colored fine-grained sandstone is present in this interval. This sequence is tentatively correlated with the Oquirrh formation. The fossil fragments present from 3740' to 3800' are crinoid stems. Sulphide minerals are abundant in the dark-colored sandstones but are rare to absent in the carbonate rocks. During drilling a four-foot cavern was encountered between 3484' and 3488'.

The dipmeter log was run in this section of the well. The strike and dip of the Oquirrh formation varied from N28° to 64°E, 10° to 40°NW. The best average is N40°E, 27°NW.

From the 3980' to 7735' the well penetrated a contact metamorphic marble of uncertain age. This marble is a metamorphic facies of the carbonate-rich Pennsylvanian, Mississippian and possibly Devonian formations. A contact metamorphic zone, if measured perpendicular to the igneous contact, is generally no more than several hundred feet in thickness. The presence of over 3700 feet of contact metamorphic marble in the #42-7 well strongly suggests the possiblity that below 4000 feet a near-vertical igneous contact is close to the well. The presence of a migmatite zone between 7567' and 7590' is further evidence of a nearby igneous pluton.

The dipmeter log was run in the upper part of the contact metamorphic zone. The indicated strike and dip within the metamorphic formations varied from N64°E to S76°E, 10° to 40°NW to NE. The best average for the interval between 3980' and 5442' is N86°E, 30°NW. Since these figures differ only slightly from the strike and dip of the overlying sedimentary section, these figures probably represent relict bedding.

For descriptive purposes, the contact metamorphic zone is subdivided into the following five intervals:

(1) Interval....5160' - 6980'
Lithology...Marble

Comments: Finely crystalline, white to light-gray marble dominates this interval. However, several intervals are dark colored and still show relict sedimentary textures, indicating the lack of complete metamorphism of the carbonate rocks. Crinoid fossil fragments are recognizable in samples from 4000' to 4060' and 4330' to 4340'.

(2) Interval....5160' - 6980'
Lithology...Marble

Comments: This interval consists primarily of white to light gray finely-crystalline marble. Scattered microscopic graphite flakes is the major accessory mineral. Two wollastonite marble zones are present from 6080' to 6100' and 6170' to 6180'.

The wollastonite occurs as interpenetrating tabular crystals (up to 10 mm wide), creating framework porosity and permeability of impressive proportions. The open framework porosity of these zones is indicated by the impressive array of 2- to 4-mm, euhedral, scalenohedron crystals of calcite and 1-mm, euhedral crystals of quartz found in the samples from 6170' to 6180'.

From 6200' to 6980' the marble probably represents metamorphism of impure limestone for the samples contain an increasing array of metamorphic minerals such as wollastonite, diopside, chlorite, phlogopite, biotite and graphite. The occurrence of pyrite is erratic. Pyrite is common in several zones, specifically 5660'-5700', 6170'-6220' and 6480'-6520', but is uncommon to absent in the intervening sections. Frequently, pyrite has a ruby-red tarnish on its surface, identified as a hydrous iron oxide.

(3) Interval....6980' - 7100'

Lithology...Skarn

Comments: An actinolite biotite marble is present in this interval. The increase in iron-bearing minerals here identifies this interval as a skarn. The introduction of iron into the metamorphic assemblage is likely due to the proximity of the intrusive which caused the metamorphism of the carbonate rocks. Flakes of bright-green chlorite and scattered grains of pyrite are present in minor amounts.

(4) Interval....7100' - 7567'
7590' - 7735'

Lithology...Serpentine marble

Comments: These two intervals, separated by an intervening migmatite zone, consist of serpentine marble. The serpentine marble is yellow-green, green and dark green in color. The rock consists mainly of serpentine, with lesser amounts of fine, xenoblastic crystals of biotite, phlogopite, actinolite, grossularite garnet, chlorite and scapolite(?). The green-colored serpentine contains scattered microscopic patches of white marble. A thin zone of pure marble occurs from 7590' to 7610'.

The origin of the serpentine can be explained by the following two equations:

(1) $$2CaMg(CO_3)_2 + SiO_2 \xrightarrow[\text{Pressure}]{\text{Heat \&}} Mg_2SiO_4 + 2CaCO_3 + 2CO_2$$

dolomite — forsterite — marble

(2) $$4Mg_2SiO_4 + 6H_2O \longrightarrow Mg_6Si_4O_{10}(OH)_8 + 2Mg(OH)_2$$

forsterite — serpentine — brucite

In equation (1) forsterite is formed by thermal metamorphism of impure limestone and dolomite. In equation (2) the unstable forsterite is serpentinized in the presence of water vapor, forming serpentine and brucite. These mineralogically similar end products may be fine-grained and intimately mixed and are difficult to identify individually.

The upper contact of the serpentine marble at 7100 feet may possibly be a relict formation contact between the Lower

Mississippian limestone and the Upper Devonian impure dolomite and quartzite.

(5) Interval....7567' - 7590'

Lithology... Migmatite

Comments: This 23-foot interval is a vein of contaminated granitic rock, which probably extends from the nearby pluton that caused the metamorphism of the Paleozoic carbonates. The migmatite zone consists of anhedral fragments of light pink feldspar and stringy, glassy quartz. This interval can be identified on the gamma ray log because of its higher natural radioactivity, a common characteristic of granitic rocks.

Geochemistry

During aerated-water drilling operations (from 2620 to 7735 feet) formation water constantly flowed into the borehole, mixed with the injection water and circulated to the surface through the flowline. Therefore, to help understand the geochemistry of the geothermal reservoir, flowline samples were obtained near the end of several aerated-water drilling cycles when the drilling fluid system was rich in freshly-produced formation water. The chemical analyses of these samples, done by Ford Chemical Laboratory, Inc., Salt Lake City, are included in the appendix. Two partial analyses, at 6889' and 7735', were done by Union Research, Brea, California. Figures 1 and 2 are graphs of some of the more significant chemical elements plotted against the depth of the well when the samples were collected. Maximum salinity of 9405 ppm was found in the flowline discharge when the well was 5560 feet deep. The degree of dilution and contamination that these samples have had in the drilling fluid system is difficult to estimate. Some of these samples may have 90% formation water. The increase in salinity from 2633' to 5560' is likely due to a decrease in the contamination of the samples and an increase in salinity with depth of the geothermal reservoir. The decrease in salinity below 5560 feet is likely caused by the increase flow of lower-salinity water into the borehole after the wollastonite marble zones were drilled at 6080' and 6170'. These zones functioned as injection zones for the cooler, lower-salinity waters entering the borehole just below the 9-5/8" casing. Continued drilling permitted more dilution of deeper formation water by this shallow water flow, thus reducing the total salinity of the flowline discharge. Note that the chemistry of the flowline samples collected at 3380' and 7523' are very similar. It is thought, therefore, that the analyses of the sample taken at 5560' best represents the geochemistry of the deep geothermal reservoir. (The rapid decline in salinity at 7607 feet is caused by the one-day use of injection water with salinity less than 1000 ppm prior to collection of the last samples.)

Data based on the silica and Na-K-Ca geothermometer calculations of the flowline discharge are listed in Table 1 and

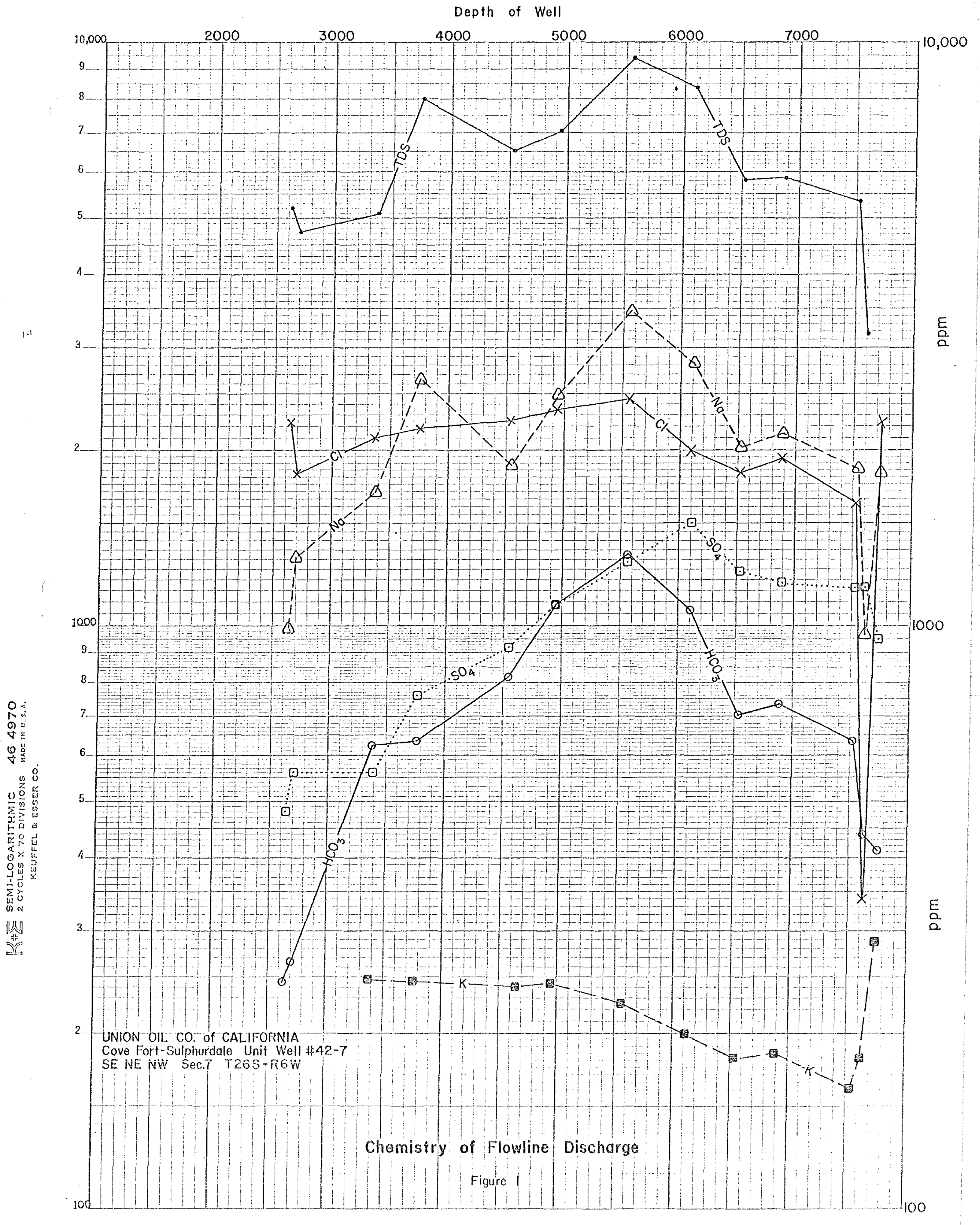
2. The best silica reservoir temperature estimate, 363°F, is from the sample collected at 6100' (Table 1). This sample reached the laboratory within one day and was collected when the TDS was near its maximum. Data on the diluted SiO_2 samples are variable but agree closely with the undiluted sample collected at 6100'.

The Na-K-Ca geothermometer calculations are listed in Table 2. The most reliable Na-K-Ca reservoir temperature estimate, 412°F, is from the sample collected at 5560'. This sample, with its high salinity, has been affected least by dilution and contamination. The 412°F reservoir temperature is a minimum among higher, less believable estimates based on more diluted and contaminated samples. This temperature also agrees best with the silica reservoir temperature estimates.

Discussion

The #42-7 well penetrated a liquid-dominated geothermal convective system at 2055', with a reservoir consisting of fractured sandstone, dolomite and marble. The reservoir is underpressured and is nearly isothermal. The free water level in the well stands at about +5100 feet above MSL, or about 1320 feet below the surface. A thermal conductive zone is present in the Bullion Canyon volcanics from the surface to 2055' (figure 3). Temperature gradients in this zone vary between 10 and 15 F°/100 ft. Based on the latest temperature surveys (April 4, 1978), the Coconino sandstone (from 2055' to 2800') is an isothermal reservoir at a temperature of 310°F (154°C). Formation temperatures decrease below the Coconino sandstone reaching a minimum of 293°F at 3000 feet. Slight temperature increases occur below 3000'. Temperature gradients between 3000' and 6000' are less than 0.5 F°/100 ft. A temperature jump of about 30°F occurs between 6000' and 6200'. This temperature increase corresponds to the two permeable wollastonite marble zones present at 6080' and 6170'. These zones were taking fluid prior to completion of the well and, to date, have not reached thermal equilibrium. Based on pre-completion temperature surveys (figure 3), a maximum temperature of 354°F was recorded at 7320' on February 27, 1978. These figures closely agree with the silica geothermometer estimates based on the chemistry of the flowline discharge.

As expected, the #42-7 well had Bullion Canyon volcanics from the surface to below the deep ground-water table (+5100' above MSL). The presence of andesite above the deep ground-water table avoided the possiblity of encountering the unconsolidated dolomite sand problem that contributed to the abandonment of the Forminco #1 well, at a total depth of 1051 feet, in August, 1976. Dolomite samples from below the water table in the #42-7 well (2800' to 3980') showed no signs of "sanding" (the formation of unconsolidated crystalline dolomite by acidic solutions), thus supporting the hypothesis that "sanded" dolomites are only a potential drilling hazard where these rocks are structurally above the deep ground-water table and have been exposed to acides formed by oxidized gases, such as H_2S.



Chemistry of Flowline Discharge

Figure 1

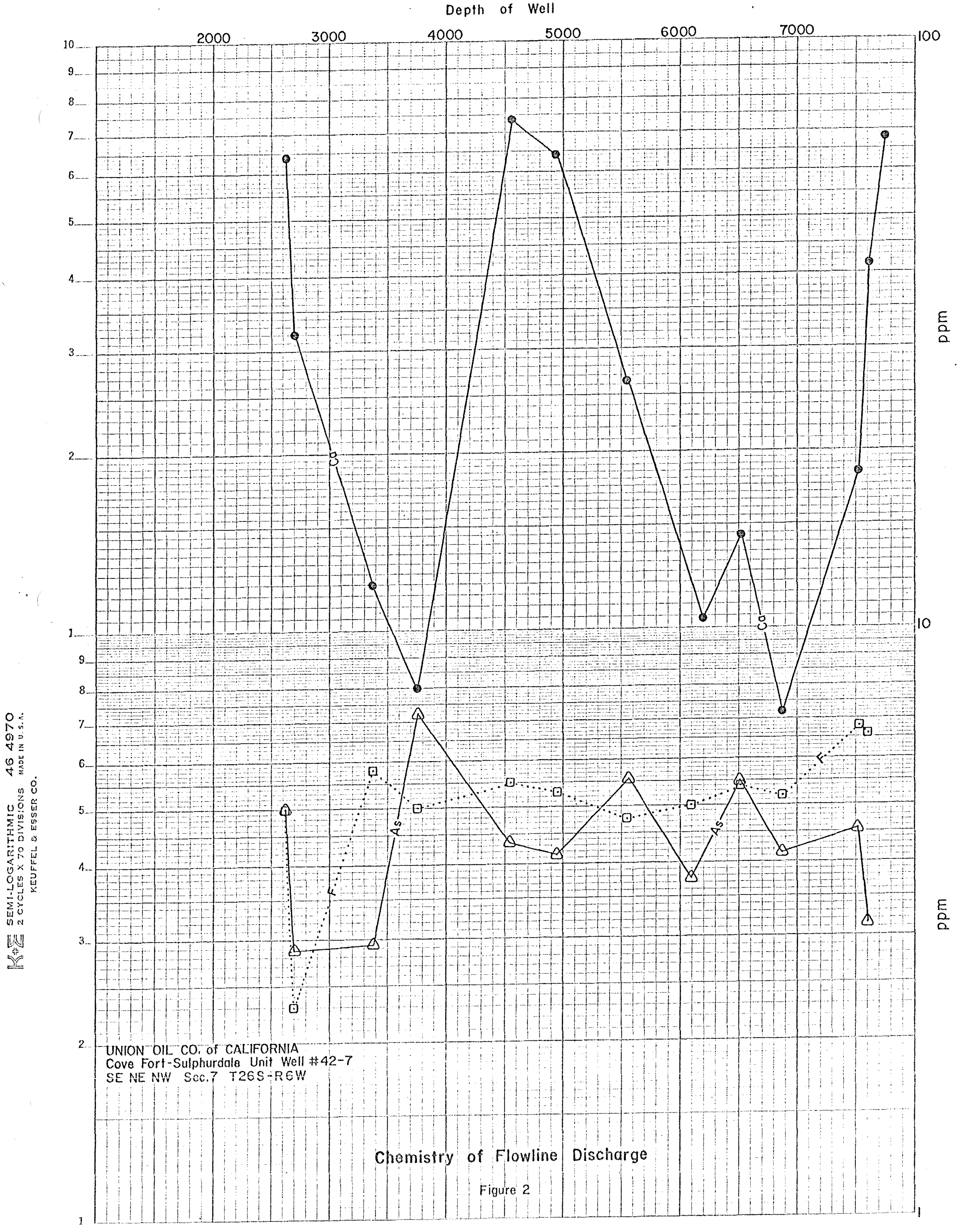

Depth of Well
2000
3000
4000
5000
6000
7000
ppm
ppm
Ca
As
F
UNION OIL CO. of CALIFORNIA
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Sec.7 T26S-R6W
Chemistry of Flowline Discharge
SEMI-LOGARITHMIC 46 4970
2 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

Figure 2

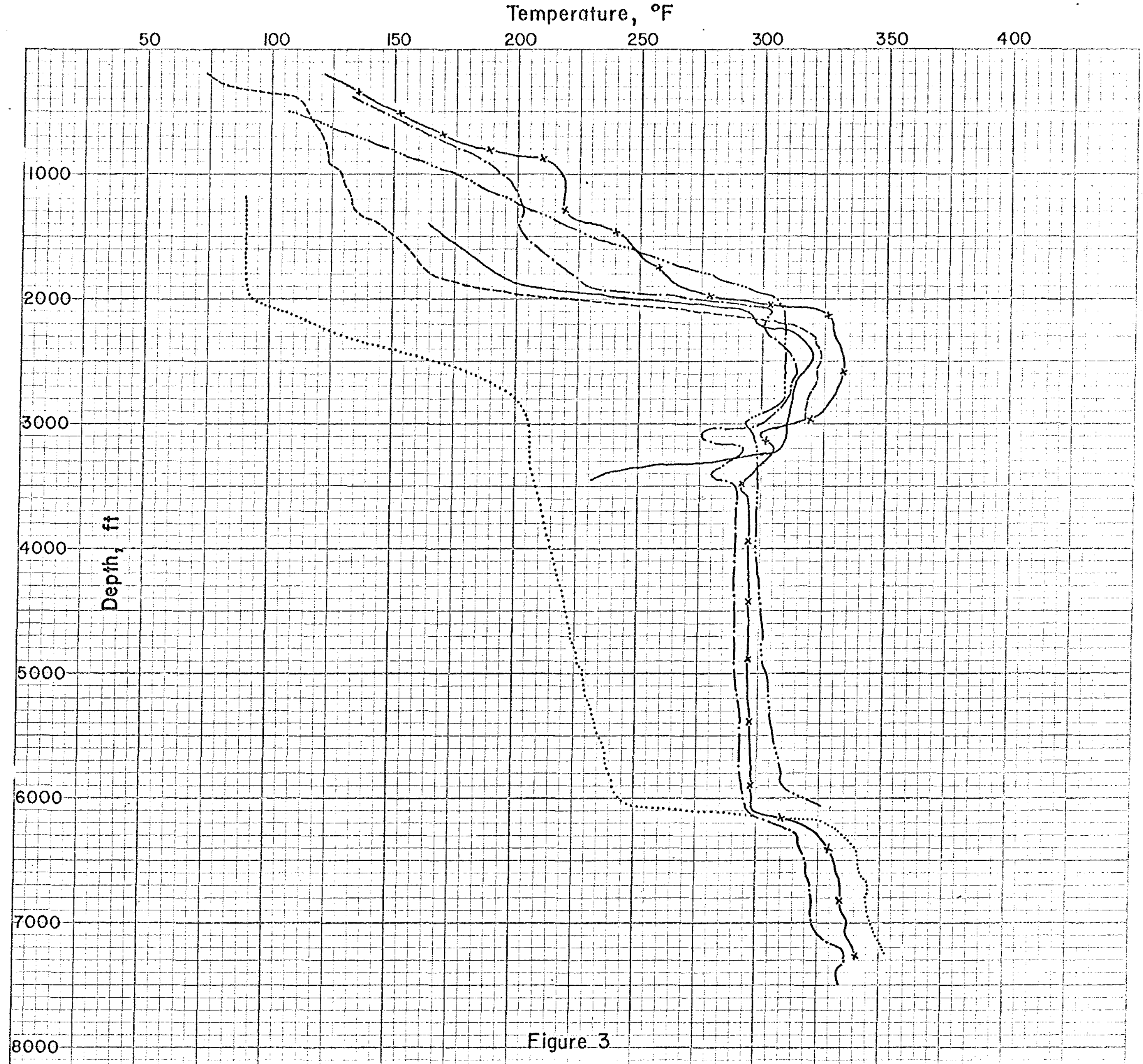


Figure 3

Temperature Surveys
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Sec.7 T 26 S - R 6 W
Beaver Co., Utah

DATE	STATIC TIME	CONTRACTOR
February 1, 1978	10 hrs	Schlumberger
February 5, 1978	50 hrs	Schlumberger
February 27, 1978	25 1/4 hrs	Gearhart - Owen
February 27, 1978	Well under injection, 533 gpm, 70°F	Gearhart - Owen
March 1, 1978	17 3/4 hrs	Schlumberger
April 5, 1978	22 days	Union

Estimation of Subsurface Temperatures from the Silica Content of Water from the Flowline Discharge while Drilling; CFSU No. 42-7, Beaver Co., Utah

Table 1

Depth,ft	Temperature of flowline, °F	pH	TDS	SiO_2 of diluting water	SiO_2 of diluted sample	Volumetric ratio of dilution: fresh wtr/sample	Calculated SiO_2 of sample	SiO_2 of undiluted sample	Estimated temperature from SiO_2, °F (diluted sample)	Estimated temperature from SiO_2, °F (undiluted sample)
2633	186°	8.52	5200	5.5	28	9:1	231	110	374°	288°
2700	170°	9.54	4775	5.5	23	9:1	181	170	345°	338°
3380	201°	8.99	5100	---	--	---	---	140	---	315°
3780	201°	11.76	8034	---	--	---	---	340	---	426°
4540	201°	9.36	6561	?	29	9:1	---	150	---	324°
4940	204°	9.34	7072	---	--	---	---	150	---	324°
5560	201°	9.98	9405	---	--	---	---	180	---	345°
6100	203°	10.02	8381	---	--	---	---	210	---	363°
6515	204°	9.15	5827	6.3	24	9:1	183	150	347°	324°
6889	204°	9.14	5858	2.15	25	9:1	231	150	374°	324°
7523	200°	9.27	5349	9.6	27	9:1	184	150	347°	324°
7607	206°	9.11	3178	9.6	30	9:1	214	160	365°	331°

Estimation of Subsurface Temperatures from the Empirical Na-K-Ca Geothermometer for Flowline Discharges during Drilling, CFSU #42-7, Beaver Co., Utah
Table 2

Depth, ft	Temperature of Flowline °F	TDS	Na	K	Ca	Na/K	Estimated Temperature from Na-K-Ca $\beta = 1/3$ °F
2633	186°	5200	1000	1158	64.0	1.5	778°
2700	170°	4775	1310	585	32.0	3.8	630°
3380	201°	5100	1700	247.5	12.0	11.7	497°
3780	201°	8034	2653	247	8.0	18.3	467°
4540	201°	6561	1885	241	63.6	13.3	447°
4940	204°	7072	2490	242	64.0	17.5	428°
5560	201°	9405	3460	225	26.4	26.2	412°
6100	203°	8381	2828	199	10.4	24.2	431°
6515	204°	5827	2020	181.8	14.4	18.9	440°
6889	204°	5858	2140	185	7.2	19.7	452°
7523	200°	5349	1860	161.9	18.4	19.5	428°
7607	206°	3178	966	181.5	41.6	9.1	479°
7735	202°	--	1830	288	68	10.8	473°

APPENDIX

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source.............................. Flowline
Collection date and time............. 1/26/78
Depth of well at time of collection.. 2633
Temperature of sample, °F........... 186°
Date analysis begun.................. 1/30/78

Turbidity	170	NTU	Total Hardness of $CaCO_3$	190	mg/l
Conductivity	8,000	umhos/cm	Iron as Fe (Total)	80.44	mg/l
pH	8.52	Units	Iron as Fe (Filtered)	5.520	mg/l
TDS at 180°C	5,200	mg/l	Lead as Pb	0.030	mg/l
Alkalinity as $CaCO_3$	250	mg/l	Magnesium as Mg	7.20	mg/l
Arsenic as As	5.060	mg/l	Manganese as Mn	2.64	mg/l
Bicarbonate as HCO_3	246.44	mg/l	Mercury as Hg	0.030	mg/l
Barium as Ba	0.53	mg/l	Nickel as Ni	0.006	mg/l
Boron as B	0.25	mg/l	Nitrate as NO_3-N	0.64	mg/l
Cadmium as Cd	0.010	mg/l	Nitrite as NO_2-N	<0.01	mg/l
Calcium as Ca	64.0	mg/l	Potassium as K	1158	mg/l
Carbonate as CO_3	48	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	2220	mg/l	Silica as SiO_2	110	mg/l
Chromium as Cr (Total)	0.432	mg/l	Silver as Ag	0.008	mg/l
Chromium as Cr (Hex)	0.036	mg/l	Sulfate as SO_4	480	mg/l
Copper as Cu	0.261	mg/l	Sodium as Na	1000	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	1.508	mg/l
Fluoride as F	5.0	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source.............................. Flowline
Collection date and time............ 1/27/78
Depth of well at time of collection.. 2700
Temperature of sample, °F........... 170°F
Date analysis begun................. 1/30/78

Turbidity	310	NTU	Total Hardness of $CaCO_3$	100	mg/l
Conductivity	3746	umhos/cm	Iron as Fe (Total)	64.88	mg/l
pH	9.54	Units	Iron as Fe (Filtered)	3.62	mg/l
TDS at 180°C	4775	mg/l	Lead as Pb	0.022	mg/l
Alkalinity as $CaCO_3$	470	mg/l	Magnesium as Mg	4.80	mg/l
Arsenic as As	2.880	mg/l	Manganese as Mn	4.261	mg/l
Bicarbonate as HCO_3	265.9	mg/l	Mercury as Hg	0.024	mg/l
Barium as Ba	0.57	mg/l	Nickel as Ni	0.007	mg/l
Boron as B	0.30	mg/l	Nitrate as NO_3-N	0.83	mg/l
Cadmium as Cd	0.010	mg/l	Nitrite as NO_2-N	<0.01	mg/l
Calcium as Ca	32.0	mg/l	Potassium as K	585.0	mg/l
Carbonate as CO_3	252	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	1820	mg/l	Silica as SiO_2	170	mg/l
Chromium as Cr (Total)	0.465	mg/l	Silver as Ag	0.011	mg/l
Chromium as Cr (Hex)	0.006	mg/l	Sulfate as SO_4	560	mg/l
Copper as Cu	0.271	mg/l	Sodium as Na	1310	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	1.811	mg/l
Fluoride as F	2.3	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source............................... Flowline
Collection date and time............. 1/31/78, 1240 Hrs
Depth of well at time of collection.. 3380
Temperature of sample, °F........... 201°
Date analysis begun.................. 2/2/78

Turbidity	320	NTU	Total Hardness of $CaCO_3$	60	mg/l
Conductivity	7846	umhos/cm	Iron as Fe (Total)	59.3	mg/l
pH	8.99	Units	Iron as Fe (Filtered)	28.0	mg/l
TDS at 180°C	5100	mg/l	Lead as Pb	0.003	mg/l
Alkalinity as $CaCO_3$	620	mg/l	Magnesium as Mg	7.2	mg/l
Arsenic as As	2.94	mg/l	Manganese as Mn	0.925	mg/l
Bicarbonate as HCO_3	624.6	mg/l	Mercury as Hg	<0.0002	mg/l
Barium as Ba	0.19	mg/l	Nickel as Ni	0.101	mg/l
Boron as B	13.0	mg/l	Nitrate as NO_3-N	0.48	mg/l
Cadmium as Cd	0.012	mg/l	Nitrite as NO_2-N	0.01	mg/l
Calcium as Ca	12.0	mg/l	Potassium as K	247.5	mg/l
Carbonate as CO_3	108	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	2100	mg/l	Silica as SiO_2	140	mg/l
Chromium as Cr (Total)	0.370	mg/l	Silver as Ag	0.013	mg/l
Chromium as Cr (Hex)	0.004	mg/l	Sulfate as SO_4	560	mg/l
Copper as Cu	0.016	mg/l	Sodium as Na	1700	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	0.161	mg/l
Fluoride as F	5.8	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source.............................. Flowline
Collection date and time............. 2/7/78, 1100 Hrs
Depth of well at time of collection.. 3760
Temperature of sample, °F........... 201°
Date analysis begun.................. 2/15/78

Turbidity	1000	NTU	Total Hardness of $CaCO_3$	20	mg/l
Conductivity	12,360	umhos/cm	Iron as Fe (Total)	2.589	mg/l
pH	11.76	Units	Iron as Fe (Filtered)	0.540	mg/l
TDS at 180°C	8034	mg/l	Lead as Pb	0.001	mg/l
Alkalinity as $CaCO_3$	2380	mg/l	Magnesium as Mg	<1.0	mg/l
Arsenic as As	7.26	mg/l	Manganese as Mn	0.047	mg/l
Bicarbonate as HCO_3	634.44	mg/l	Mercury as Hg	0.0010	mg/l
Barium as Ba	0.080	mg/l	Nickel as Ni	0.121	mg/l
Boron as B	0.150	mg/l	Nitrate as NO_3-N	2.00	mg/l
Cadmium as Cd	0.156	mg/l	Nitrite as NO_2-N	<0.01	mg/l
Calcium as Ca	8.0	mg/l	Potassium as K	247	mg/l
Carbonate as CO_3	<0.01	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	2190	mg/l	Silica as SiO_2	340	mg/l
Chromium as Cr (Total)	0.138	mg/l	Silver as Ag	0.021	mg/l
Chromium as Cr (Hex)	<0.001	mg/l	Sulfate as SO_4	760	mg/l
Copper as Cu	0.264	mg/l	Sodium as Na	2653	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	0.062	mg/l
Fluoride as F	5.0	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source............................... Flowline
Collection date and time............ 2/9/78, 0545 Hrs
Depth of well at time of collection.. 4540
Temperature of sample, °F........... 201°
Date analysis begun................. 2/15/78

Turbidity	380 NTU	Total Hardness of $CaCO_3$	226 mg/l
Conductivity	10,094 umhos/cm	Iron as Fe (Total)	3.406 mg/l
pH	9.36 Units	Iron as Fe (Filtered)	1.210 mg/l
TDS at 180°C	6561 mg/l	Lead as Pb	<0.001 mg/l
Alkalinity as $CaCO_3$	1030 mg/l	Magnesium as Mg	10.08 mg/l
Arsenic as As	4.36 mg/l	Manganese as Mn	0.131 mg/l
Bicarbonate as HCO_3	817.4 mg/l	Mercury as Hg	0.0012 mg/l
Barium as Ba	0.120 mg/l	Nickel as Ni	0.295 mg/l
Boron as B	0.240 mg/l	Nitrate as NO_3-N	1.30 mg/l
Cadmium as Cd	0.120 mg/l	Nitrite as NO_2-N	<0.01 mg/l
Calcium as Ca	73.6 mg/l	Potassium as K	241 mg/l
Carbonate as CO_3	360 mg/l	Selenium as Se	<0.001 mg/l
Chloride as Cl	2250 mg/l	Silica as SiO_2	150 mg/l
Chromium as Cr (Total)	0.083 mg/l	Silver as Ag	0.018 mg/l
Chromium as Cr (Hex)	0.005 mg/l	Sulfate as SO_4	920 mg/l
Copper as Cu	0.219 mg/l	Sodium as Na	1885 mg/l
Surfactants MBAS	<0.01 mg/l	Zinc as Zn	0.052 mg/l
Fluoride as F	5.5 mg/l		

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source.............................. Flowline
Collection date and time............ 2/10/78, 0545 Hrs
Depth of well at time of collection.. 4940
Temperature of sample, °F........... 204°
Date analysis begun................. 2/15/78

Turbidity	400	NTU	Total Hardness of $CaCO_3$	184	mg/l
Conductivity	10,880	umhos/cm	Iron as Fe (Total)	2.268	mg/l
pH	9.34	Units	Iron as Fe (Filtered)	0.450	mg/l
TDS at 180°C	7072	mg/l	Lead as Pb	<0.001	mg/l
Alkalinity as $CaCO_3$	1250	mg/l	Magnesium as Mg	5.76	mg/l
Arsenic as As	4.14	mg/l	Manganese as Mn	0.074	mg/l
Bicarbonate as HCO_3	1085	mg/l	Mercury as Hg	0.009	mg/l
Barium as Ba	0.120	mg/l	Nickel as Ni	0.284	mg/l
Boron as B	0.200	mg/l	Nitrate as NO_3-N	0.40	mg/l
Cadmium as Cd	0.156	mg/l	Nitrite as NO_2-N	<0.01	mg/l
Calcium as Ca	64.0	mg/l	Potassium as K	242	mg/l
Carbonate as CO_3	360	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	2340	mg/l	Silica as SiO_2	150	mg/l
Chromium as Cr (Total)	0.083	mg/l	Silver as Ag	0.016	mg/l
Chromium as Cr (Hex)	0.010	mg/l	Sulfate as SO_4	1080	mg/l
Copper as Cu	0.116	mg/l	Sodium as Na	2495	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	0.019	mg/l
Fluoride as F	5.3	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source.............................. Flowline
Collection date and time............. 2/12/78, 1700 Hrs
Depth of well at time of collection.. 5560
Temperature of sample, °F........... 201°
Date analysis begun.................. 2/15/78

Turbidity	550	NTU	Total Hardness of $CaCO_3$	116	mg/l
Conductivity	14,469	umhos/cm	Iron as Fe (Total)	2.829	mg/l
pH	9.98	Units	Iron as Fe (Filtered)	1.140	mg/l
TDS at 180°C	9405	mg/l	Lead as Pb	<0.001	mg/l
Alkalinity as $CaCO_3$	2380	mg/l	Magnesium as Mg	12.0	mg/l
Arsenic as As	6.080	mg/l	Manganese as Mn	0.098	mg/l
Bicarbonate as HCO_3	1322	mg/l	Mercury as Hg	0.014	mg/l
Barium as Ba	0.100	mg/l	Nickel as Ni	0.493	mg/l
Boron as B	0.180	mg/l	Nitrate as NO_3-N	1.8	mg/l
Cadmium as Cd	0.128	mg/l	Nitrite as NO_2-N	<0.01	mg/l
Calcium as Ca	26.4	mg/l	Potassium as K	225	mg/l
Carbonate as CO_3	<0.01	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	2450	mg/l	Silica as SiO_2	180	mg/l
Chromium as Cr (Total)	0.085	mg/l	Silver as Ag	0.015	mg/l
Chromium as Cr (Hex)	0.012	mg/l	Sulfate as SO_4	1280	mg/l
Copper as Cu	0.324	mg/l	Sodium as Na	3460	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	0.075	mg/l
Fluoride as F	4.7	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source	Flowline
Collection date and time	2/14/78, 1800 Hrs
Depth of well at time of collection	6100
Temperature of sample, °F	203°
Date analysis begun	2/15/78

Turbidity	590 NTU	Total Hardness of $CaCO_3$	26 mg/l
Conductivity	12,893 umhos/cm	Iron as Fe (Total)	1.125 mg/l
pH	10.02 Units	Iron as Fe (Filtered)	0.250 mg/l
TDS at 180°C	8381 mg/l	Lead as Pb	<0.001 mg/l
Alkalinity as $CaCO_3$	1650 mg/l	Magnesium as Mg	<1.0 mg/l
Arsenic as As	3.78 mg/l	Manganese as Mn	0.037 mg/l
Bicarbonate as HCO_3	1.061 mg/l	Mercury as Hg	0.0008 mg/l
Barium as Ba	0.040 mg/l	Nickel as Ni	0.383 mg/l
Boron as B	0.080 mg/l	Nitrate as NO_3-N	2.4 mg/l
Cadmium as Cd	0.089 mg/l	Nitrite as NO_2-N	<0.01 mg/l
Calcium as Ca	10.4 mg/l	Potassium as K	199 mg/l
Carbonate as CO_3	780 mg/l	Selenium as Se	<0.001 mg/l
Chloride as Cl	2000 mg/l	Silica as SiO_2	210 mg/l
Chromium as Cr (Total)	0.093 mg/l	Silver as Ag	0.017 mg/l
Chromium as Cr (Hex)	<0.001 mg/l	Sulfate as SO_4	1500 mg/l
Copper as Cu	0.096 mg/l	Sodium as Na	2828 mg/l
Surfactants MBAS	<0.01 mg/l	Zinc as Zn	0.021 mg/l
Fluoride as F	5.0 mg/l		

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source	Flowline
Collection date and time	2/18/78, 0910 Hrs
Depth of well at time of collection	6889
Temperature of sample, °F	204°
Date analysis begun	2/27/78

Turbidity	220	NTU	Total Hardness of $CaCO_3$	44	mg/l
Conductivity	8000	umhos/cm	Iron as Fe (Total)	0.827	mg/l
pH	9.14	Units	Iron as Fe (Filtered)	0.367	mg/l
TDS at 180°C	5858	mg/l	Lead as Pb	0.055	mg/l
Alkalinity as $CaCO_3$	1000	mg/l	Magnesium as Mg	6.24	mg/l
Arsenic as As	4.120	mg/l	Manganese as Mn	0.163	mg/l
Bicarbonate as HCO_3	732	mg/l	Mercury as Hg	0.0007	mg/l
Barium as Ba	0.08	mg/l	Nickel as Ni	0.104	mg/l
Boron as B	0.30	mg/l	Nitrate as NO_3-N	2.20	mg/l
Cadmium as Cd	0.020	mg/l	Nitrite as NO_2-N	<0.01	mg/l
Calcium as Ca	7.2	mg/l	Potassium as K	185	mg/l
Carbonate as CO_3	240	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	1940	mg/l	Silica as SiO_2	150	mg/l
Chromium as Cr (Total)	0.057	mg/l	Silver as Ag	0.028	mg/l
Chromium as Cr (Hex)	<0.001	mg/l	Sulfate as SO_4	1180	mg/l
Copper as Cu	0.108	mg/l	Sodium as Na	2140	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	0.053	mg/l
Fluoride as F	5.2	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source	Suction Pit
Collection date and time	2/18/78, 0910 Hrs
Depth of well at time of collection	6889
Temperature of sample, °F	160°
Date analysis begun	2/27/78

Turbidity	150	NTU	Total Hardness of $CaCO_3$	42	mg/l
Conductivity	8400	umhos/cm	Iron as Fe (Total)	4.710	mg/l
pH	9.23	Units	Iron as Fe (Filtered)	0.633	mg/l
TDS at 180°C	6426	mg/l	Lead as Pb	0.125	mg/l
Alkalinity as $CaCO_3$	1070	mg/l	Magnesium as Mg	2.88	mg/l
Arsenic as As	4.38	mg/l	Manganese as Mn	0.110	mg/l
Bicarbonate as HCO_3	768.6	mg/l	Mercury as Hg	0.0010	mg/l
Barium as Ba	0.11	mg/l	Nickel as Ni	0.225	mg/l
Boron as B	0.50	mg/l	Nitrate as NO_3-N	4.2	mg/l
Cadmium as Cd	0.022	mg/l	Nitrite as NO_2-N	<0.01	mg/l
Calcium as Ca	12.0	mg/l	Potassium as K	195	mg/l
Carbonate as CO_3	264	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	1930	mg/l	Silica as SiO_2	150	mg/l
Chromium as Cr (Total)	0.006	mg/l	Silver as Ag	0.030	mg/l
Chromium as Cr (Hex)	0.004	mg/l	Sulfate as SO_4	1400	mg/l
Copper as Cu	0.051	mg/l	Sodium as Na	2240	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	0.045	mg/l
Fluoride as F	5.2	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source..............................Suction
Collection date and time............2/18/78
Depth of well at time of collection..6889', 0910 Hrs
Temperature of sample, °F...........204°
Date analysis begun.................

Turbidity		NTU	Total Hardness of $CaCO_3$		mg/l
Conductivity		umhos/cm	Iron as Fe (Total)		mg/l
pH	9.1	Units	Iron as Fe (Filtered)		mg/l
TDS at 180°C		mg/l	Lead as Pb		mg/l
Alkalinity as $CaCO_3$		mg/l	Magnesium as Mg	5	mg/l
Arsenic as As		mg/l	Manganese as Mn		mg/l
Bicarbonate as HCO_3	603	mg/l	Mercury as Hg		mg/l
Barium as Ba		mg/l	Nickel as Ni		mg/l
Boron as B	7.0	mg/l	Nitrate as NO_3-N		mg/l
Cadmium as Cd		mg/l	Nitrite as NO_2-N		mg/l
Calcium as Ca	10	mg/l	Potassium as K	212	mg/l
Carbonate as CO_3	267	mg/l	Selenium as Se		mg/l
Chloride as Cl	1920	mg/l	Silica as SiO_2		mg/l
Chromium as Cr (Total)		mg/l	Silver as Ag		mg/l
Chromium as Cr (Hex)		mg/l	Sulfate as SO_4	1100	mg/l
Copper as Cu		mg/l	Sodium as Na	2200	mg/l
Surfactants MBAS		mg/l	Zinc as Zn		mg/l
Fluoride as F		mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source.................................. Flowline
Collection date and time............. 2/22/78, 1030 Hrs
Depth of well at time of collection.. 7523
Temperature of sample, °F........... 200°
Date analysis begun.................. 2/27/78

Turbidity	260	NTU	Total Hardness of $CaCO_3$	50	mg/l
Conductivity	7000	umhos/cm	Iron as Fe (Total)	0.925	mg/l
pH	9.27	Units	Iron as Fe (Filtered)	0.643	mg/l
TDS at 180°C	5349	mg/l	Lead as Pb	0.044	mg/l
Alkalinity as $CaCO_3$	880	mg/l	Magnesium as Mg	0.96	mg/l
Arsenic as As	4.560	mg/l	Manganese as Mn	0.344	mg/l
Bicarbonate as HCO_3	634.4	mg/l	Mercury as Hg	0.0006	mg/l
Barium as Ba	0.12	mg/l	Nickel as Ni	0.149	mg/l
Boron as B	0.50	mg/l	Nitrate as NO_3-N	4.4	mg/l
Cadmium as Cd	0.017	mg/l	Nitrite as NO_2-N	<0.01	mg/l
Calcium as Ca	18.4	mg/l	Potassium as K	161.9	mg/l
Carbonate as CO_3	216	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	1620	mg/l	Silica as SiO_2	150	mg/l
Chromium as Cr (Total)	0.116	mg/l	Silver as Ag	0.026	mg/l
Chromium as Cr (Hex)	<0.01	mg/l	Sulfate as SO_4	1160	mg/l
Copper as Cu	0.092	mg/l	Sodium as Na	1860	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	0.054	mg/l
Fluoride as F	6.8	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source................................ Flowline
Collection date and time............ 2/24/78, 1245 Hrs
Depth of well at time of collection.. 7607
Temperature of sample, °F........... 206°
Date analysis begun.................. 3/6/78

Turbidity	340	NTU	Total Hardness of $CaCO_3$	126	mg/l
Conductivity	5000	umhos/cm	Iron as Fe (Total)	17.69	mg/l
pH	9.11	Units	Iron as Fe (Filtered)	2.88	mg/l
TDS at 180°C	3178	mg/l	Lead as Pb	0.210	mg/l
Alkalinity as $CaCO_3$	780	mg/l	Magnesium as Mg	5.28	mg/l
Arsenic as As	3.170	mg/l	Manganese as Mn	0.370	mg/l
Bicarbonate as HCO_3	439.2	mg/l	Mercury as Hg	0.0015	mg/l
Barium as Ba	0.17	mg/l	Nickel as Ni	0.045	mg/l
Boron as B	0.65	mg/l	Nitrate as NO_3-N	3.85	mg/l
Cadmium as Cd	<0.001	mg/l	Nitrite as NO_2-N	<0.01	mg/l
Calcium as Ca	41.6	mg/l	Potassium as K	181.5	mg/l
Carbonate as CO_3	252	mg/l	Selenium as Se	<0.001	mg/l
Chloride as Cl	340	mg/l	Silica as SiO_2	160	mg/l
Chromium as Cr (Total)	0.177	mg/l	Silver as Ag	0.020	mg/l
Chromium as Cr (Hex)	<0.001	mg/l	Sulfate as SO_4	1160	mg/l
Copper as Cu	0.201	mg/l	Sodium as Na	966	mg/l
Surfactants MBAS	<0.01	mg/l	Zinc as Zn	0.072	mg/l
Fluoride as F	6.6	mg/l			

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit Well #42-7
SE NE NW Section 7, T.26S., R.6W.
Beaver County, Utah

Sample Information

Source..............................Flowline
Collection date and time.............2/26/78
Depth of well at time of collection..7735', 0845 Hrs
Temperature of sample, °F...........202°
Date analysis begun.................

Turbidity		NTU	Total Hardness of $CaCO_3$		mg/l
Conductivity		umhos/cm	Iron as Fe (Total)		mg/l
pH	7.7	Units	Iron as Fe (Filtered)		mg/l
TDS at 180°C		mg/l	Lead as Pb		mg/l
Alkalinity as $CaCO_3$		mg/l	Magnesium as Mg	13	mg/l
Arsenic as As		mg/l	Manganese as Mn		mg/l
Bicarbonate as HCO_3	412	mg/l	Mercury as Hg		mg/l
Barium as Ba	0.13	mg/l	Nickel as Ni		mg/l
Boron as B	10	mg/l	Nitrate as NO_3-N		mg/l
Cadmium as Cd		mg/l	Nitrite as NO_2-N		mg/l
Calcium as Ca	68	mg/l	Potassium as K	288	mg/l
Carbonate as CO_3	0	mg/l	Selenium as Se		mg/l
Chloride as Cl	2240	mg/l	Silica as SiO_2		mg/l
Chromium as Cr (Total)		mg/l	Silver as Ag		mg/l
Chromium as Cr (Hex)		mg/l	Sulfate as SO_4	900	mg/l
Copper as Cu		mg/l	Sodium as Na	1830	mg/l
Surfactants MBAS		mg/l	Zinc as Zn		mg/l
Fluoride as F		mg/l	Ammonia	13	mg/l

COVE FORT SULPHURDALE UNIT WELL 42-7

WELL SUMMARY

PREFACE

The well summary is as stated, a brief of the operation involved during the drilling of this well. All technical data is found within the confines of the main report.

The well summary gives a description of the problems encountered and procedures used to drill to depth.

Due to severe losses in circulation and formation water being produced when drilling, different techniques had to be developed to drill, properly set pipe at proposed depths and reach total depth.

Hopefully this summary will give you a guide to go by to pinpoint any technical areas you want to review in depth within the main part of this report.

COVE FORT SULPHURDALE UNIT WELL 42-7

OUTLINE

I. General Information

II. Drilling Operations

- A. Rig Information
- B. Preparation of Location and Setting Conductor
- C. Spudding (26" Hole at 255', 20" Casing at 251')
- D. 17-1/2" Hole 1557': 13-3/8" CAsing at 1552'
  - 1. General Description of Hole Drilled
  - 2. 17-1/2" Hole Section: Problems Encountered
    - a. Twist-off at 715'
      - (1) Resolution
    - b. Lost Circulation at 1388'
      - (1) Resolution
    - c. Twist-off at 1452'
      - (1) Resolution
    - d. Lost Circulation at 1494'
      - (1) Resolution
- E. 12-1/4" Hole 3448': 9-5/8" Liner 1345' to 3357'
  - 1. General Description of Hole Drilled
  - 2. 12-1/4" Hole: Problems Encountered
    - a. Lost Circulation (1559' to 3448')
      - (1) Resolution
    - b. 9-5/8" Liner - "Second Stage" Cement Job
      - (1) Resolution

F. 8-3/4" Hole 7735': 7" Liner 3084' to 7615'

1. General Description

2. 8-3/4" Hole: Problems Encountered

a. Lost Circulation 3495'

(1) Resolution

b. Failure of 7" Hanger Running Tool to Release

(1) Resolution

c. Second Stage 7" Liner Cementing Job

(1) Resolution

COVE FORT SULPHURDALE UNIT WELL 42-7

GENERAL INFORMATION SHEET

LOCATION:

1143.28' South and 2387.37' East of the Northwest corner of Section 7, T26S, R6W, S.L.M.

ELEVATION:

(Ground Level) 6421.6' above Mean Sea Level

SPUD DATE:

11/29/77 at 0400 hours

COMPLETION DATE:

3/14/77 at 2000 hours

HOLE AND CASING INTERVALS:

HOLE SIZE	HOLE DEPTH	CASING DATA	CASING DEPTH
36"	30' G.L.	30" Conductor	30' G.L.
26"	255' RKB	20" 94# H-40 Buttress Casing	251' RKB
17-1/2"	1557' RKB	13-3/8" 54.50# K-55 Buttress Casing	1552' RKB
12-1/4"	3448' RKB	9-5/8" 40# K-55 Buttress Casing	1345' - 3357'
8-3/4"	7735' RKB	7" 26# K-55 8RD LT&C Blank 72 Jts. - Perf. 36 Jts. Perfs. - (20-2-6-60)	3084' - 7615'

HOLE SIZE	HOLE DEPTH	CASING DATA	CASING DEPTH
13-3/8" Casing	Tie-Back	7" 26# K-55 8RD LT&C	0 - 3084'

T.D.:

7735' RKB

E.T.D.:

7610' RKB

TOTAL COST:

$2,056,000

COST PER FOOT:

$266

CONTRACTING SERVICES/AGENCIES:

AAA Welding

Bariod

Basin Power Tongs

Big "K" Corporation

Bovaird Supply

Byron Jackson

CONTRACTING SERVICES/AGENCIES (cont'd)

Del-Mar Construction

Dia-Log

Dotco

Dowell

Drilltrol

Duane Hall Trucking

Eastman Whipstock

EMCO

ESSE

Flint Engineering

Francis Engine Service

GO Wireline Services

Grant Oil Tool

Halliburton

Homeco

Hughes Tool Co.

IMCO

Jenkins Oil Co.

La Sal Oil Co.

Lynes

Mac's Welding

Magcobar (Dresser)

Mid-Continent Supply

Mountain States Inspection

Northwest Carriers

Oilind Safety Engineering

CONTRACTING SERVICES/AGENCIES (cont'd)

Oilwell Supply

Philadelphia Quartz

Pipe Sales Co.

R.F. Smith

Reed Tool

Republic Supply

San Juan Casing Service

Schlumberger

Smith Tool

Sperry-Sun

Texas Reamer Co.

Textillana (Henkel)

Thatcher Chemical

UNION OIL CO. OF CALIFORNIA

GEOTHERMAL DIVISION

WELL RECORD

LEASE Cove Fort Sulphurdale Unit
WELL # 42-7
FIELD Cove Fort
LOCATION 1143.28' South and 2387.37' East of the Northwest corner of Section 7, T26S, R6W, S.L.M.

B.H.L.
DEPTH: T.D. 7735' T.V.D. 7714' E.T.D. 7610'

COMPANY ENGINEER Harold Moss

SPUD DATE 11/28/77 COMP. DATE 3/14/78
CONTRACTOR Loffland Bros. Company
RIG #184
ELEVATIONS: GROUND 6421.6'
K.B. TO GROUND 20'
K.B. TO LOWER CASING HEAD 22.5'

TYPE WELL: EXPL. X DEV.
STM HOT WTR X INJ
DRY HOLE Subject to test
APPROVED Don L. Ash

CASING RECORD (K.B.)

SIZE	WEIGHT	GRADE	THREAD	TOP	BOTTOM	REMARKS
30"	.500 wall	H-40	Welded	G.L.	30' below G.L.	Cemented Surface to 30'
20"	94#	H-40	Buttress	20'	251'	Cemented 20' to 251'
13-3/8"	54.5#	K-55	Buttress	20'	1552'	Cemented 20' to 1552'
9-5/8"	40#	K-55	Buttress	1345'	3357'	Cemented 1345' to 3357'
7"	26#	K-55	LT&C	3084'	7615'	Combination blank & perf.
7" tie-back						Non cemented

WELL HEAD ASSEMBLY

	MAKE	TYPE	SIZE	PRESSURE RATING
CASING HEAD	Brewster	S.O.W.	12"	3000#
CASING HANGER SPOOL	Shaffer	Slip	12" x 10"	3000# to 2000#
SPACER SPOOL	Brewster	Spacer	10" x 10"	2000#
MASTER VALVE	Brewster	Gate	10"	1440#
STUDDED FLANGE	Brewster	Flat	10" x 3"	2000#
LUBRICATOR VALVE	Brewster	Full Opening Plug	3"	2000#

STEAM ENTRIES: DEPTH LBS. INCREASE

SLOTTED LINER	SLOTS FROM	SLOTS TO	BLANK FROM	BLANK TO

SEE ATTACHED LINER DETAIL

TEST DATA ORIFICE SIZE

RIG TEST DATE	WHP	FLP	TEMP	POUNDS/HOUR

REMARKS:

COVE FORT SULPHURDALE UNIT WELL 42-7

DRILLING OPERATIONS

A. RIG INFORMATION:

Loffland Brothers Rig #184. This is a Lee C. Moore Cantilever Mast and substructure with a Midcontinent U-712A drawworks. The rig is rated to drill to a depth of 15,000'. The rig is powered with three (3) caterpillar D-398TA rated at 640 INT. horsepower at 1100 RPM. The Cantilever Mast is 142' in height. The rotary table is an Oilwell 27-1/2". The rig is limited to a 450,000# casing capacity.

B. PREPARATION OF LOCATION AND SETTING CONDUCTOR:

Prior to moving the drilling rig on location, various operations were conducted to prepare for drilling. The location, sump and roads were built to specifications laid out in the "Approved Unit Plan of Operations". A 36" conductor hole was drilled to 30' G.L. by Dale Martin Rathole Service. Thirty inch (30") conductor pipe was run and cemented to surface at 30' G.L. with Ready-Mix Cement.

C. 26" HOLE SECTION - 255' (20" Casing Set at 251')

Loffland Rig #184 was moved in on location 11/28/77 at 0800 hours. Drilled mouse and ratholes. Well was spudded in at 0400 hours on 11/29/77.

The 26" hole section was drilled with no problems to 255'. A 17-1/2" pilot hole was drilled first, and then opened to 26". Twenty inch (20") casing was run and cemented to surface with no problems. The 20" casing head, double Shaffer and Hydril were nippled up. The B.O.E. were tested to Union Oil specifications and held okay.

D. 17-1/2" HOLE SECTION - 1557' (13-3/8" Casing at 1552')

1. General Description of Hole Drilled

The 17-1/2" hole section was drilled to 1557' with some hole problems. Briefly these problems consisted of two fishing jobs and two lost circulation zones. After overcoming these difficulties, the well was drilled to the effective total depth of 1557'. Here 13-3/8" casing was successfully run and cemented at 1552'. The 13-3/8" casing head, 12" 900 double Shaffer and Hydril were nippled up. The B.O.E. were tested to Union Oil specifications and held okay.

2. 17-1/2" Hole Section: Problems Encountered

a. Twist-off at 715'

Drilled 17-1/2" hole to 746' and lost pump pressure. P.O.H. and had parted pin on bottom stabilizer.

(1) Resolution

Caught and retrieved fish using 11-3/4" Bowen Overshot. Drilling assembly was inspected and drilling operations continued.

b. Lost Circulation at 1388'

The 17-1/2" hole was drilled to 1388' and a lost circulation zone was encountered.

(1) Resolution

Mixed lost circulation material and was able to regain circulation.

c. Twist-off at 1452'

The 17-1/2" hole was drilled to 1452' and twisted pin off stabilizer in BHA.

(1) Resolution

Caught and retrieved fish with 11-3/4" Bowen Overshot with 8" grapple. Drilled ahead after inspecting drilling assembly.

d. Lost Circulation at 1494'

The 17-1/2" hole was drilled to 1494' and lost returns.

(1) Resolution

Two cement lost circulation plugs totalling 398 ft^3 were required to seal off this thieving zone. The well was then drilled to 1557' and preparations were made to run casing.

E. <u>12-1/4" HOLE SECTION 3448': 9-5/8" LINER 1345' to 3357'</u>

1. General Description of Hole Drilled

The 12-1/4" hole was drilled to depth with severe lost circulation problems. After drilling good firm cement in the 13-3/8" casing through the casing, lost circulation was first encountered at 1559'. This loss of circulation was present from 1559' to casing point. A futile effort of 35 lost circulation cement plugs (6880 ft^3 cement) were attempted throughout drilling operations to casing point. When water was used as drilling fluid, loss of circulation occurred. Foam drilling was attempted. Due to the fact that formation water was produced at a rate of 600 bbls/hr and that the only means of disposing of this produced water was by trucking, foam drilling was discontinued. It was obvious that trucking could never keep up with drilling operations and the economics involved were massive. Aerated mud using jet subs was used to drill to a depth of 3448'. The procedure was to drill with aerated water until the sump filled, then drill by pumping the produced water thru the bit without returns to empty the sump. Electric logs were run at 3448'. The 9-5/8" liner was run from 1345' to 3357'. The first stage of cementation went okay. Due to heat, there was a problem with the isolation in the second stage of liner cementation. This was soon resolved using an RTTS tool to inflate an external casing open hole packer and the liner was cemented in place. The liner lap was tested to .86 psi/ft equivalent for 25 minutes and held okay. A cement bond log verified proper bond on liner.

2. 12-1/4" Hole: Problems Encountered

   a. Lost Circulation (Starting at 1559' to 3448' E.T.D.)

      The 12-1/4" hole was drilled to 1559' and the well started losing returns. In order to get the hole drilled to a point where the agreed "proposed casing point" was located and hopefully put these thief zones behind pipe, many cement plugs were required.

      (1) Resolution

         A total of 35 cement plugs for a total of 6880 ft^3 were used to get to casing point (see cement data sheet for details). When water was used as drilling fluid, the hole took fluid. Foam drilling caused formation water to be produced at a massive rate where it was neither economical or practical to use. Aerated mud was used until the sump became full and then drilling using sump water with no returns was the best method to drill the hole. Plug #35 was put in place at E.T.D. to establish circulation in order to get a good cementing job on the 9-5/8" liner.

   b. 9-5/8" Liner "Second Stage" Cement Job

      The F.O. isolation packer, due to heat, could not be used to inflate the open hole Lyons packer.

(1) Resolution

A 9-5/8" RTTS tool was used to successfully inflate the open hole Lyons packer for cementing the second stage of the 9-5/8" liner.

F. <u>8-3/4" HOLE SECTION TO 7735'</u> - 7" Liner 3084' to 7615'

1. General Description of Hole Drilled

The 8-3/4" hole was drilled to 3495' using mud as drilling fluid with full returns. At this point a 4' void plus lost circulation were encountered. The 8-3/4" hole was drilled using aerated mud. Again the hole made fluid using aerated mud and when the sump filled, the hole was drilled using produced water without returns. Jet subs were used when drilling with aerated mud to help lift the fluid in the hole. The 8-3/4" hole was drilled in this manner to 7735' where pipe was stuck while drilling. Pipe was worked free. At this point, evaluation logs were run and the decision made to run the 7" liner.

The 7" combination blank and slotted liner was run from 3084' to 7615'. After hanging the liner, the setting tools would not release from the 7" hanger. The 7" liner was pulled and a different type (Midway) liner hanger was run in hole.

Due to lost circulation, the liner cementation job was performed with difficulty. The first stage went okay, however on the second stage, it took six attempts for a total of

3304 ft^3 before a successful "lap" job could be accomplished.

A 7" casing tie-back was run from the liner hanger tie-back sleeve to surface in tension leaving a 38" free travel in tie-back receptacle. The liner was hung off in the 12" 900 x 10" 600 casing head spool. No cement job was done on the tie-back.

The well was left shut-in with 400 psi on well head. The location was cleaned and terminated in accordance with the approved plan of operations.

2. 8-3/4" Hole Section: Problems Encountered

a. Lost Circulation 3495'

An 8-3/4" hole was drilled with mud to 3495' where a 4' void and loss of circulation were encountered.

(1) Resolution

The 8-3/4" hole had to be drilled to 3495' E.T.D. using aerated mud until the sump became full and then switching over to drilling with sump water without returns until the sump drained.

b. Failure of Running Tool on 9-5/8" x 7" Burns Liner Hanger

The 7" liner was run and hung from 3163' to 7605'. Unable to release from setting tools.

(1) Resolution

Backed off above hanger and ran bumper sub. Hopefully due to past experiences, this would have jarred running tool free. However, what happened was that the hanger slips broke. This in turn released the liner. Therefore, the liner was pulled out of hole and Burns hanger was replaced with Midway 9-5/8" x 7" heavy duty hanger. The liner was run and successfully hung off from 3084' to 7615'.

c. Second Stage 7" Liner Cementing Job

Due to lost circulation problems, the second stage cementation process was very difficult.

(1) Resolution

A total of six squeeze jobs (3304 ft^3 of cement) were done before a good cement job was accomplished.

COVE FORT - SULPHURDALE

UNIT 42-7

DRILLING OPERATIONS

SPUDDING

Rigged up Dale Martin Rathole Services rig and drilled a 36" diameter hole to a depth of 30' below ground level. A 30" conductor pipe was run into the hole, on September 10, 1977, to a depth of 30' and cemented with 5-1/2 cubic yards of Ready-Mix cement. Moved in and rigged up Loffland Brothers Rig #184 on November 28, 1977. Rig commenced dayrate operations at 0800 hours, November 28, 1977. Installed the mouse hole and rat hole and picked up the kelly and 26" hole opener. Spudded 26" hole at 0400 hours, November 29, 1977.

26" HOLE SECTION 50' to 255' (Measured from Kelly Bushing)

Drilled 26" diameter hole from 50' to 55'. Changed over to 17-1/2" drilling assembly and drilled 17-1/2" hole from 55' to 255' with a maximum hole deviation of one degree from vertical. Opened the 17-1/2" hole to 26" from 55' to 255' with a Security pilot hole opener. The maximum flowline temperature was 116°F with a suction temperature of 90°F. A bottom hole temperature of 110°F was recorded during the deviation survey at a depth of 232'.

Ran 6 joints (252') of 20", 94#, H-40 buttress casing in the hole. Circulated to clean and condition the hole for cementing casing in place. Halliburton mixed and pumped 649 ft^3 of class

"B" cement, with 2% $CaCl_2$, through open ended 20" casing at 251'. Displaced cement with 464 ft^3 water. Pumped 175 ft^3 of excess cement to the sump. Waited on cement for three hours and landed 20" casing at 251'. Installed a 20" flange and nippled up blowout equipment consisting of a 20" double Shaffer and Hydril on the 20" x 2000# flange which was welded to the 20" casing. Installed the kill and choke lines and tested blowout equipment to 500 psig with water for thirty minutes. The test was approved by a U.S.G.S. representative.

<u>17-1/2" HOLE SECTION</u> 255' to 1557'

Changed over to 17-1/2" bottom hole assembly. Ran in the hole and cleaned out cement from 233' to 255'. Drilled 17-1/2" diameter hole from 255' to 746'. Pump pressure decreased. Pulled out of hole and found that the pin on the bottom stabilizer had parted leaving one 9" drill collar, reamer, and bit in the hole. Ran in hole to top of fish at 715' with 11-3/4" Bowen overshot with 8" grapple. Engaged the fish and chained out of the hole with full recovery of fish. Inspected the drilling assembly and continued drilling 17-1/2" hole from 746' to 1221'. Ran deviation survey and pulled out of hole to unplug bit. Ran back in the hole and drilled 17-1/2" hole from 1221' to 1257'. Lost 500 psi pump pressure. Pulled out of hole to check for washout. Changed out bit which was washed out around two jet nozzles. Ran in the hole and continued drilling 17-1/2" hole from 1257' to 1388'. Commenced losing circulation. Mixed mud and lost circulation materials. Lost approximately 650 barrels of mud prior to establishing full returns.

Loffland's corrosion coupons at this time showed a corrosion rate of 3.7468 lbs/ft^2/yr. Continued drilling from 1388' to 1452' with full returns. Drilling assembly parted, leaving a 17-1/2" bit, 3-point reamer, one drill collar, one stabilizer, one shock sub and two 8" drill collars in the hole. Ran in the hole with an overshot and engaged and recovered this portion of the bottom hole assembly. Replaced 17-1/2" bottom hole assembly and drilled 17-1/2" hole from 1452' to 1494'. Lost circulation at 1494'. Pulled drilling assembly out of hole and ran in hole to 1457' with open ended drill pipe. Halliburton mixed and pumped 198 ft^3 of class "B" cement mixed in a 1:1 ratio with Perlite with 40% Silica Flour, 3% Gel, 0.5% CFR-2, and 0.3% HR-7. Displaced cement with 100 ft^3 of water. Pulled to shoe of 20" casing and waited for cement to set up. Attempted unsuccessfully to fill the hole with 200 barrels of mud. Continued to wait on cement and subsequently fill the hole with 100 barrels of mud.

Ran in the hole with open ended drill pipe to top of cement at 1445'. Circulated with full mud returns to the surface. Pulled up the hole to a depth of 1353'. Closed the pipe rams and pressured to 100 psig. Pressure bled off as the hole took fluid. Halliburton mixed and pumped 200 ft^3 of class "B" cement, mixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel, 0.5% CFR-2 and 0.3% HR-7, through open ended drill pipe hung at 1353'. Displaced cement with 100 ft^3 water. Pulled out of hole and waited on cement for three hours. Filled the hole with 75 barrels of mud. Closed the complete shut-off rams and pressured to 100 psig. No pressure loss was observed. Installed 17-1/2" drilling assembly and ran in the hole to top of cement at 1335'. Drilled cement from 1335' to 1475'. Continued drilling 17-1/2" diameter hole from 1494' to 1557'. Circulated to clean and condition the hole for running casing.

Rigged up equipment and ran in hole with 40 joints of 13-3/8", 54.5#, K-55 buttress casing. Hung casing with shoe at 1552' and baffle plate at 1513'. Circulated drilling fluid to condition the hole for cementing. Halliburton mixed and pumped 2071 ft^3 of class "B" cement mixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel, 0.5% CFR-2 and 0.3% HR-7. Followed this slurry with 184 ft^3 of class "B" cement with 40% Silica Flour and 0.5% CFR-2. Maintained fluid flow to the surface throughout the job. Bumped plug against baffle plate with 600 psig during displacement. Rigged down blowout equipment and waited for cement to set up. Cut off 20" casing and welded on 13-3/8" x 12" - 900 casing head. Tested weld successfully to 1000 psig. Installed spacer spool, choke and kill spool, 12" - 900 double Shaffer and 12" - 900 Hydril. Thawed out lines repeatedly with cold water while testing blowout preventers to 1500 psig. Kelly cock lost pressure from 1500 psig to 1200 psig in 5 minutes. The test was witnessed and approved by Mr. John Reeves of the U.S.G.S.

Formation drilled during the interval of 55' to 1557' consisted primarily of Andesite. The maximum recorded flowline temperature was 132°F with a suction temperature of 120°F. The maximum recorded hole deviation was one degree and 30 minutes with a bottom hole temperature of 125°F.

<u>12-1/4" HOLE SECTION</u> 1557' to 3448'

Ran in the hole with 12-1/4" drilling assembly to top of hard cement at 1497'. Drilled cement to 1513', drilled baffle plate at 1513' and drilled cement to 1557'. Drilled 12-1/4" diameter hole to 1559'. Lost returns to the surface. Regained circulation after mixing mud and lost circulation materials. Total mud lost to the formation was approximately 350 barrels. Attempted unsuccessfully to continue drilling. Pulled out of the hole and found that the cones on the bit were locked up and also found indications that the bit had been rotating on junk. Inspected drill collars, subs, swivel and kelly. Laid down one cracked drill collar. Ran in the hole with 12-1/4" drilling assembly and continued drilling 12-1/4" hole from 1559' to 1836'. Lost all returns to the surface. Mixed mud and lost circulation materials. Regained circulation and continued drilling 12-1/4" hole from 1836' to 1850'. Lost returns at 1850'. Pulled bit up the hole to 1550'. Mixed and continued pumping mud. Regained circulation after a total loss of approximately 150 barrels of fluid. Drilled 12-1/4" hole from 1850' to 1970' with a loss of approximately 50 additional barrels of mud. Continued drilling 12-1/4" hole to 2123' prior to losing full returns. Pulled bit to 1450'. Mixed mud and lost circulation material in order to restore mud volume in tanks.

The additional mud loss was an estimated 475 barrels. Gained full returns and continued drilling to 2175'. Lost returns at 2175'. Estimated additional loss was 450 barrels. Pulled bit to 1390'. Mixed mud and lost circulation materials. Ran back in the hole to 2175' and continued drilling to 2218' with full returns. Lost returns totaling approximately 450 barrels. Pulled bit up hole to 1500'. Mixed mud and lost circulation materials and continued drilling to 2238' without returns. Lost an estimated 400 additional barrels of mud. Pulled bit to 1475'. Mixed mud and lost circulation materials. Ran back in the hole to top of fill at 2225'. Cleaned out fill to 2238'. Drilled 12-1/4" hole from 2238' to 2244' without returns, losing an additional 400 barrels of mud. Pulled out of the hole and stood back 12-1/4" drilling assembly. Ran in the hole to 2202' with open ended drill pipe. Halliburton mixed and pumped 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, and 3% Gel (plug #1). Displaced cement with 33 ft^3 of water. Pulled pipe up the hole to 1450' and waited on cement to set up. Ran in the hole to top of cement at 2119'. Attempted unsuccessfully to fill the hole with 300 barrels of mud. Pulled up the hole to 2046'. Halliburton mixed and pumped 120 ft^3 of class "B" cement, mixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel, through open ended drill pipe at 2046' (plug #2). Displaced cement with 30 ft^3 of water. Pulled up the hole to 1506' and waited four hours for cement to set up. Ran in the hole to top of cement at 2119'. Halliburton mixed and pumped 250 ft^3 of class "B" cement, mixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel, through open ended drill pipe at 2046' (plug #3). Pulled pipe to 1475' and waited for cement to set up. Ran in the hole to top of cement at 2084'. Attempted unsuccessfully to fill the hole with 250 barrels of mud. Halliburton mixed and pumped 150 ft^3 of class "B" cement, mixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel, through open ended drill pipe hung at 2060' (plug #4). Pulled out of the hole and waited on cement to set up for four hours. Filled the hole with 150 barrels of mud. Picked up the 12-1/4" drilling assembly and ran in the hole to a cement stringer at 1636'. Plugged the bit while attempting to clean out this stringer. Pulled out of the hole and cleaned out the bit and bottom drill collar. Ran back in the hole and continued cleaning out cement stringers from 1636' to 1990'. Drilled hard cement from 1990' to 2214' with only partial returns from 2184' to 2214'. Lost all returns at 2214'. Pulled out of the hole. Removed drilling assembly and ran in the hole to 2172' with open ended drill pipe. Halliburton mixed and pumped 396 ft^3 of class "B" cement mixed in a 2:1 ratio with Perlite, 40% Silica Flour and 3% Gel (plug #5). Displaced cement with 45 ft^3 of water. Pulled out of the hole and waited for cement to set up. Filled the hole with mud. Closed the pipe rams and pressured to 200 psig surface pressure. Continued waiting on cement an additional three hours. Ran in the hole and cleaned out cement stringers from 1760' to 1940'. Drilled firm cement from 1940' to 2244'. Lost circulation at 2244'. Continued drilling 12-1/4" hole from 2244' to 2250' without returns.

Lost a total of approximately 450 barrels of mud. Pulled out of hole and stood back bottom hole assembly. Ran in the hole to 2205' with open ended drill pipe. Halliburton mixed and pumped 142 ft^3 of Thix-Set cement premixed with 13% gilsonite and 1/2 lb of Flocele/sack (plug #6). Displaced cement with 196 ft^3 of water. Pulled out of hole and waited on cement to set up. Pumped 450 barrels of fluid in the hole over a seven hour period with no indications of hole filling. Ran back in the hole with open ended drill pipe to top of cement at 2222'. Pulled out of hole. Fluid level was at approximately 1850'. Ran in the hole to 2220' with 12-1/4" bit. Obtained a bottom hole temperature survey of 175°F. Drilled hard cement from 2222' to 2230'. Mixed mud and lost circulation material. Ran in the hole to 1829' with open ended drill pipe. Halliburton mixed and pumped 142 ft^3 of Thix-Set cement premixed with 13% gilsonite and 0.5% Flocele (plug #7). Displaced cement with 140 ft^3 of water. Pulled out of hole and pumped 200 barrels of mud over the next four hour period while waiting on cement. No returns to the surface. Ran in the hole to 2230' with no indication of top of cement plug. Pulled out of the hole. Fluid level remained at approximately 1700'. Ran in the hole with open ended drill pipe to 1860'. Halliburton mixed and pumped 240 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel (plug #8). Displaced cement with 151 ft^3 of water. Pulled out of the hole and waited for cement to set up. Ran in the hole to 2230' with no indication of top of cement plug. Pulled out of the hole. Found fluid level to be at approximately 1875'. Ran in hole with open ended drill pipe to 2209'. Mixed and pumped a 100 barrel lost circulation material plug. Halliburton mixed and pumped 120 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 3% Gel, through open ended drill pipe at 2209' (plug #9). Displaced cement with 196 ft^3 of water. Pulled out of the hole and waited on cement for ten hours. Fluid level in wellbore was at approximately 1500'. Ran in hole to 2230' without encountering obstructions. Pulled out of hole. Dry drill pipe indicated no fluid level. Ran in the hole to 2169' with open ended drill pipe. Pumped 45 barrels of water followed by 193 ft^3 of class "B" cement premixed in a 2:1 ratio with Perlite, 40% Silica Flour and 3% Gel (plug #10). Displaced cement with 196 ft^3 of water. Pulled out of the hole and waited for cement to set up. Ran back in the hole to 2230' with no obstructions. Pulled up hole to shoe of 13-3/8" casing. No fluid level was indicated on pipe. Ran back in the hole to 2220'. Pumped a treatment of 20 barrels of fresh water followed by 20 barrels of 3% $CaCl_2$ with 400 lbs of sand, followed by 5 barrels of water and 30 barrels of $NaSi_2$. Displaced with 30 barrels of fresh water. Pulled out of the hole and waited four hours for the solution to set up. Ran in the hole to 2170' with open ended drill pipe. Halliburton mixed and pumped 180 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel (plug #11). Displaced cement with 190 ft^3 of water. Pulled out of the hole and waited for cement to set up.

Ran in the hole with open ended drill pipe to top of cement plug at 1953'. Filled the wellbore with 325 barrels of mud. Lost returns after circulating for 2 hours. Pulled out of the hole. Fluid level was at approximately 179'. Ran in the hole to 1946' with open ended drill pipe. Halliburton mixed and pumped 100 ft^3 of Thix-Set cement premixed with 19% gilsonite, 0.5% Flocele, and 0.1% Tuff-Plug (plug #12). Displaced cement plug with 145 ft^3 of water. Pulled out of hole and waited four hours for cement to set up. Fluid level was at approximately 45' from the surface. Filled the hole with 75 barrels of mud. Ran in the hole and cleaned out cement stringers from 1535' to 1861'. Cleaned out firm cement from 1861' to 2235'. Cleaned out soft cement or fill from 2235' to 2250' while maintaining full returns. Drilled 12-1/4" hole to 2252'. Lost full returns. Hole on vacuum. Drilled from 2252' to 2275' without returns. Pulled bit into 13-3/8" casing. Mixed drilling mud. Ran in the hole to 2275'. No fill on bottom. Continued drilling 12-1/4" hole from 2275' to 2298' without returns. Lost approximately 500 barrels of mud. Pulled bit into 13-3/8" casing. Fluid level was at approximately 360'. Mixed mud and lost circulation materials. Ran in the hole to 2298'. No fill. Drilled 12-1/4" hole from 2298' to 2324' without returns to the surface. Pulled bit into the 13-3/8" casing and mixed mud and lost circulation materials. Ran in the hole and drilled 12-1/4" hole from 2324' to 2342' without returns to the surface. Pulled out of the hole and stood back drilling assembly. Ran in the hole to 2201' with open ended drill pipe. Halliburton mixed and pumped 112 ft^3 of water followed by 112 ft^3 of 6% $CaCl_2$ water with 400 lbs of plaster sand added followed by 28 ft^3 of water and 128 ft^3 of $NaSi_2$ mixed in a ratio of 1:1 with water (plug #13). Displaced with 196 ft^3 of water. Pulled pipe up hole to 2108'. Halliburton mixed and pumped 223 ft^3 of Thix-Set cement premixed with 25# gilsonite, 1-1/4# Flocele and 1/8# of Tuff Fiber per sack. Displaced with 182 ft^3 of water. Pulled pipe up the hole to 1475' and waited for cement to set up. Ran in the hole to top of cement at 2242'. Pulled pipe to 1475'. Unable to fill hole after pumping 400 barrels of mud. Ran in the hole to 2232'. Halliburton mixed and pumped 112 ft^3 of Gel water consisting of WG-11, CL-11 with 1680 lbs of Unibeads, 420# of gilsonite and 420# TLC-80, followed by 59 ft^3 of class "B" cement with 2% $CaCl_2$ and 100# Flocele (plug #14). Pulled pipe to 1495' and waited for cement to set up. Ran in hole to top of cement at 2242'. Attempted unsuccessfully to fill the wellbore. Pulled up hole to 2232'. Halliburton mixed and pumped 112 ft^3 of Gel water consisting of WG-11, CL-11 with 1680 lbs of Unibeads, 420# of gilsonite and 420# TLC-80, followed by 118 ft^3 of class "B" cement premixed with 2% $CaCl_2$ and 200# of Flocele (plug #15). Displaced with 157 ft^3 of water. Pulled pipe to 1510' and waited for cement to set up. Ran in the hole to top of cement at 2139'. Pulled back up the hole to 1475'. Filled the wellbore with 310 barrels of mud. Continued waiting for cement to set up. Ran in the hole and drilled firm cement from 2139' to 2244'. Commenced losing mud at a rate of 1 barrel per minute at 2219' and 3 barrels per minute at 2229'. Pulled out of the hole and stood back drilling assembly. Ran in the hole with open ended drill pipe to 2201'. Halliburton mixed and pumped 56 ft^3 of Frac Gel consisting of WG-11, CL-11, 840# Unibeads, 210# gilsonite and 210# TLC-80, followed by 210 ft^3 of class "B" cement premixed with 2% $CaCl_2$ and 75# of Flo Seal. Displaced with 151 ft^3 of water (plug #16). Pulled up the hole to 1450' and waited for cement to set up. Filled the hole with 170 barrels of mud. Mud fell away slowly. Ran in the hole to top of cement at 2184'. Pulled out of the hole to pick up drilling assembly and wait for cement to set up. Ran back in the hole to 2184' and filled the hole with 275 barrels of mud. Drilled solid cement to 2228' with full returns. Space from 2228' to 2244' was void. Commenced losing mud at a rate of three barrels per minute while circulating. Pulled out of the hole and stood back bottom hole assembly. Ran in the hole to fill at 2227'. Unable to clean out fill. Pulled out of the hole and picked up 12-1/4" bit. Ran in the hole and cleaned out fill from 2227' to 2231' with partial returns. Lost full returns while cleaning out from 2231' to 2242'. Lost a total of approximately 400 barrels of mud. Pulled out of the hole and stood back drilling assembly. Ran in the hole with open ended drill pipe to 2232'. Halliburton mixed and pumped 56 ft^3 of Frac Gel consisting of 25# WG-11, and 7# CL-11 followed by 112 ft^3 of 3% $CaCl_2$ water, 56 ft^3 water, 258 ft^3 $NaSi_2$ mixed in a 1:1 ratio with water, 56 ft^3 water and 136 ft^3 of class "B" cement with 2% $CaCl_2$ and 1/2 lb/sack Flocele (plug #17).

Displaced with 168 ft^3 of water. Pulled drill pipe to 1490' and waited for cement to set up. Ran back down the hole to 2239' and didn't locate the top of plug #17. Halliburton mixed and pumped 112 ft^3 of Frac Gel consisting of 500 lbs of gilsonite, 500 lbs of Unibeads, 350 lbs of moth balls, 50 lbs of WG-11 and 15 lbs of CL-11 followed by 136 ft^3 of class "B" cement with 2% $CaCl_2$ and 1/2 lb Flocele/sack (plug #18). Pulled drill pipe to 1430' and waited for cement to set up. Ran back in the hole to 2240' with no trace of plug #18. Also, the hole appeared to be void of any fluid. Halliburton mixed and pumped 112 ft^3 of 3% $CaCl_2$ water, 56 ft^3 of water and 134 ft^3 of $NaSi_2$. Displaced with 65 ft^3 of water. Pulled drill pipe to 2201' and pumped 98 ft^3 of class "B" cement with 6% gilsonite, 1/2 lb Flocele and 2% $CaCl_2$. Displaced with 57 ft^3 of water (plug #19). Pulled drill pipe to 1490' and waited for cement to set up. Ran in hole to top of cement plug at 2187'. Pulled out of the hole and picked up drilling assembly. Ran in the hole and drilled cement from 2187' to 2250' with full returns. Drilled without returns from 2250' to 2280', losing approximately 350 barrels of fluid. Pulled out of the hole and stood back drilling assembly. Ran in the hole with open ended drill pipe to top of fill at 2260'. Attempted unsuccessfully to wash through fill. Ran in the hole with 12-1/4" bit and cleaned fill from 2260' to 2278' without returns. Lost an additional 400 barrels of fluid. Ran in the hole to 2263' with open ended drill pipe. Halliburton mixed and pumped 112 ft^3 of water, 112 ft^3 of $CaCl_2$ water, 67 ft^3 of water and 67 ft^3 of $NaSi_2$. Displaced with 112 ft^3 of water. Pulled pipe to 1496' and waited for cement to set up. Ran in the hole to 2232'. Halliburton mixed and pumped 88 ft^3 of class "B" cement with 2% $CaCl_2$, 12% gilsonite and 1/2 lb of Flocele/sack. Displaced with 156 ft^3 of water (plug #20). Pulled up hole and waited for cement to set up. Ran in the hole with open ended drill pipe to top of cement plug at 2240'. Unable to fill the hole with water. Pulled pipe to 2233'. Halliburton mixed and pumped 88 ft^3 of class "B" cement with 8 lbs gilsonite, 2% $CaCl_2$ and 1/2 lb Flocele/sack. Displaced with 168 ft^3 of water (plug #21). Pulled pipe to 1510' and waited for cement to set up. Ran in hole to top of plug #20 at 2240'. No trace of plug #21. Hung open ended drill pipe at 2232'. Halliburton mixed and pumped 112 ft^3 of Frac Gel consisting of 500 lbs Unibeads, 150 lbs Flocele, 150 lbs gilsonite, 150 lbs moth balls, 75 lbs WG-11 and 15 lbs CL-11. Followed by 161 ft^3 of class "B" cement premixed in a 2:1 ratio with Perlite, 40% Silica Flour and 3% Gel followed by 98 ft^3 of class "B" cement with 2% $CaCl_2$, 1/2 lb Flocele and 8 lbs gilsonite/sack. Displaced with 86 ft^3 of water (plug #22). Pulled pipe to 1505' and waited for cement to set up. Ran in the hole to 2240' with no trace of plug #22. Pulled pipe to 2232'. Halliburton mixed and pumped 112 ft^3 of water, 112 ft^3 of 3% $CaCl_2$ water, 28 ft^3 of water and 67 ft^3 of $NaSi_2$. Displaced with 162 ft^3 of water. Pulled drill pipe to 2201' and waited 2 hours. Mixed and pumped 161 ft^3 of class "B" cement premixed in a 2:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 3% $CaCl_2$. Displaced with 168 ft^3 of water (plug #23). Pulled pipe up hole and waited for cement to set up. Ran in the hole to top of cement at 2215'. Pulled pipe up hole to 1500' and attempted unsuccessfully to fill the hole with 300 barrels of fluid. Ran in the hole to 2201'. Halliburton mixed and pumped a 112 ft^3 slurry consisting of 600 lbs Gel, 75 lbs Flo-cele, 100 lbs Unibeads and 300 lbs of lost circulation material followed by 352 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 3% $CaCl_2$. Displaced with 134 ft^3 of water (plug #24). Pulled pipe to 1475' and waited for cement to set up. Filled the wellbore with 30 barrels of water. Repaired rig drawworks and laid down 75 joints of drill pipe. Installed banjo box, Grant rotating head and flowline in preparation for aerated drilling. Picked up 50 joints of 5", 19.5 #/ft, Grade-3 drill pipe. Successfully tested blowout equipment. Ran in the hole to 1535' with 12-1/4" drilling assembly. Blew the wellbore dry in attempt to aerate fluid. Continued running in the hole to 1601'. Cleaned out cement stringer from 1601' to 1842' with full returns of non-aerated mud. Cleaned out solid cement from 1842' to 2090' with full returns using mud as the circulating medium. Commenced aerating mud with a 35-1 air-mud ratio. Cleaned out cement and fill from 2090' to 2342' with full returns, using aerated mud as the circulating medium. Drilled 12-1/4" hole from 2342' to 2400' with intermittent returns to 2390' and no returns from 2390' to 2400'. Pulled bit to 1475'. (Fluid level at 1750'.) Formation takes air at 325 psig surface pressure. Ran in the hole to 1750' and broke circulation with aerated mud. Ran in the hole to 2400'. Unable to circulate.

Pulled to 2000' and broke circulation with aerated mud. Ran in the hole to 2400'. Unable to circulate. Pulled out of the hole to rig up for foam drilling. Ran in the hole to 2375'. Unable to circulate with foam. Pulled up hole to 2015' and broke circulation. Drilled 12-1/4" hole from 2400' to 2486' using foam as circulating medium. Hole was producing water at a rate of 600 barrels per hour. After filling the sump with water, drilled 12-1/4" hole from 2486' to 2606' by pumping water back into the hole without returns. Pulled four stands of drill pipe to replace rotating head rubber. Encountered 34' of fill while running to bottom. Unable to break circulation with air foam below 2100'. Pulled out of hole and stood back drilling assembly. Ran in the hole to 2575' with open ended drill pipe. Ran maximum reading thermometer to 2575'. Temperature after 14 hours static was 192°F. Pumped 425 barrels of water through drill pipe. Halliburton mixed and pumped 367 ft^3 of class "B" cement premixed in a ratio of 1:2 with Perlite, 5% Gel and 2% $CaCl_2$. Displaced with 34 ft^3 of water. Stuck drill pipe while cementing. Worked free with 200,000# pull over weight of drill pipe. Pulled up hole to 1575' and cleared drill pipe with 168 ft^3 of water. Pulled out of hole and waited for cement to set up. Ran in the hole to top of soft cement at 2089'. Pulled out of hole and picked up bottom hole assembly. Ran in the hole to top of cement at 2027'. Drilled cement stringers with foam and aerated mud from 2027' to 2089'. Drilled hard cement from 2089' to 2165'. The hole produced approximately 1680 barrels of water at approximately

10 barrels/minute while drilling from 2120' to 2165'. Pulled out of hole and stood back drilling assembly. Ran in the hole to 1500' with open ended drill pipe. Pumped 1680 barrels of water in the hole. Unable to fill the wellbore. Ran in the hole to 2139'. Halliburton mixed and pumped 215 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 4% Gel and 2% $CaCl_2$. Displaced with 168 ft^3 of water (plug #29). Pulled drill pipe to 1475' and pumped 280 ft^3 of water on top of cement. Pulled up hole and waited for cement to set up. Ran in the hole to top of cement at 2077'. Pulled up hole to 2046'. Halliburton mixed and pumped 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced cement with 100 ft^3 of water (plug #30). Pipe commenced sticking. Worked pipe up the hole pulling 150,000# over weight of pipe. Pumped 500 barrels in the hole. Unable to fill the wellbore. Ran down hole and tagged top of cement at 1885'. Pulled up hole to 1860'. Halliburton mixed and pumped 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced cement with 140 ft^3 of water (plug #31). Pulled pipe to 1425' and waited for cement to set up. Ran in the hole to top of cement at 1697'. Pulled up hole to 1675'. Halliburton mixed and pumped 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 2% $CaCl_2$. Displaced with 134 ft^3 of water (plug #32). Pulled out of hole and waited for cement to set up. Filled the wellbore with 125 barrels of water. Ran in the hole to top of cement at 1553'. Closed pipe rams and squeezed away 168 ft^3 of water to the formation at 250 psi surface pressure. Halliburton mixed and pumped through

open ended drill pipe at 1490', 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced with 112 ft^3 of water (plug #33). Pulled drill pipe to 560'. Closed pipe rams and squeezed away 14 ft^3 of mud at 900 psig surface pressure. Released pressure and pulled out of hole. Ran in the hole with 12-1/4" bit to top of cement at 1368'. Shut down operations due to heavy snows and ground blizzard on January 23, 1978, opened road to the rig and relieved crews. Drilled firm cement from 1368' to 2006', using mud, with full returns. Circulated to clean the wellbore and pulled out of the hole to change the drilling assembly. Installed a jet sub and rigged up for aerated drilling. Ran in the hole and broke circulation with aerated mud. Drilled firm cement from 2006' to 2300' with full returns and no additional fluid entry in the wellbore. Drilled soft cement from 2300' to 2393' and firm cement from 2393' to 2582'. Cleaned out fill from 2582' to 2606' with good returns using aerated mud. There was no indication of fluid entries. Drilled 12-1/4" hole from 2606' to 2616'. Hole commenced making approximately 300 barrels of water per hour. Continued drilling 12-1/4" hole from 2616' to 2804' using aerated fluid. The producing rate of water from well continued increasing with depth from 300 barrels/hour at 2680' to 750 barrels/hour at 2760'. Due to the lack of freeboard in sump, the hole was drilled from 2760' to 2804' by pumping water through bit, without air, with no returns. Pulled out of hole and stood back drilling assembly. Ran in the hole to an obstruction at 2780' with open ended drill pipe. Pumped 9000 barrels of water into the wellbore from the sump. Halliburton mixed and pumped, through open ended drill pipe at 2765', 312 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 0.5% CFR-2, and 3% Gel. Displaced cement with 224 ft^3 of water. Pulled drill pipe to 1472' and waited seven hours for cement to set up. Ran in the hole to top of cement at 2754'. Pulled drill pipe to 2731'. Halliburton mixed and pumped 312 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, and 3% Gel. Displaced cement with 223 ft^3 of water (plug #34). Pulled drill pipe to 1510' and waited for cement to set up. Ran in the hole to top of cement at 2543'. Pulled out of hole and made up drilling assembly. Ran back in the hole to top of cement at 2543' and broke circulation with aerated mud. Cleaned out cement from 2543' to 2804'. Had a water entry at 2650'. Drilled 12-1/4" hole with aerated mud from 2804' to 3304'. Pulled out of hole and stood back drilling assembly. Ran in the hole with open ended drill pipe to top of fill at 3201'. Ran drift surveys and maximum reading thermometers as follows: 3192': 5°15', 282°F at 5 hours static and 288°F at 6 hours static. Pulled out of the hole. Made up 12-1/4" bit and relocated jet subs. Ran in the hole and cleaned out fill from 3201' to 3304'. Drilled 12-1/4" hole from 3304' to 3448'. Pulled out of the hole and prepared to run Electric Logs. Pumped sump water to cool the wellbore while rigging up Schlumberger equipment. Ran DIL-8 from 3443' to 1552'. Ran Neutron-Gamma Ray with Caliper from 3443' to 1552'. Ran Temperature Log from 3443' to the surface. Rigged down Schlumberger equipment. Ran in the hole with open ended drill pipe to 3259'. Pumped 600 barrels of water down the wellbore. Ran down hole to 3440'. Halliburton mixed and pumped 187 ft^3 of class "B" cement premixed in a ratio of 1:1 with Perlite, 40% Silica Flour, 3% Gel and 0.5% CFR-2. Displaced cement with 258 ft^3 of water while working pipe up and down. Pipe commenced sticking. Stopped displacing and worked pipe free. Pulled out of the hole to wait for cement to set up. Picked up drilling assembly and ran in the hole to top of cement at 3165'. Unable to break circulation. Pulled out of the hole and installed jet subs in the drill string. Drilled cement from 3165' to 3360' while circulating with aerated fluid. Continued circulating with aerated system to clean and condition the wellbore for running casing. Rigged up equipment and ran 51 joints (2014.55') of 9-5/8", 40#, K-55 buttress casing. Hung casing inside of 13-3/8" casing with shoe at 3357', baffle collar at 3278', Lyons ECP packer at 2014', HOWCO F.O. cementer at 2004' and Burns 13-3/8" x 9-5/8" single slip liner hanger at 1345'. Pulled out of the hole and laid down liner setting tools. Ran in the hole with HOWCO F.O. running tools and stabbed into the baffle collar. Pumped 300 barrels of water to cool the wellbore and prepare for cementing first stage. Halliburton cemented the first stage, through drill pipe stabbed into the baffle collar at 3278' as follows: preceded cement with 336 ft^3 of water and 112 ft^3 of HY-VIS Gel pill. Mixed and pumped 1250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel, 0.5% CFR-2 and 0.4% HR-7, followed by 326 ft^3 of class "B" cement premixed with 40% Silica Flour, 0.75% CFR-2 and 0.2% HR-7. Displaced with 294 ft^3 of water. Seated latch-in plug with 1500 psig surface pressure. Pulled the F.O. isolation packer up hole to 470'. Attempted to inflate Lyons packer. Isolation packer failed. Pulled out of the hole and replaced cups on isolation packer. Ran in the hole and worked packer into the liner. Pressured to 1600 psig to inflate Lyons packer. Experienced a sudden loss of pressure. Pulled out of the hole and replaced damaged packer cups. Ran back in the hole and attempted unsuccessfully to pressure Lyons packer. Pulled out of the hole and found by-pass valve stuck in open position. Repaired valve and ran back in the hole. Packer failed again. Pulled out of the hole and found cups damaged. Ran in the hole and set 9-5/8" RTTS at 1918'. Inflated Lyons packer with 1500 psig. Released pressure and opened F.O. cementer. Pulled out of the hole and laid down RTTS packer. Ran in the hole and set HOWCO EZSV Retainer at 1805'. Pumped 500 barrels of sump water through F.O. ports to cool the wellbore. Halliburton mixed and pumped, through F.O. ports at 2004', 750 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 0.5% CFR-2. Displaced with 185 ft^3 of water. Pressure built up during last half of job. Maximum pump pressure was 800 psig. Pulled out of the hole and changed out drill collars while waiting for cement to set up. Ran in the hole with 12-1/4" bit and cleaned out cement from 1323' to 1345'. Pulled out of the hole and stood back 12-1/4" drilling assembly. Ran in the hole with 8-3/4" drilling assembly and drilled cement stringers from 1345' to 1805'. Successfully tested liner lap to 580 psig surface pressure (1162 psig at the lap) for 25 minutes. The test was witnessed by a U.S.G.S. representative. Ran in the hole with 8-3/4" assembly and drilled out EZSV Retainer. Continued cleaning out cement from 1810' to 2007'. Made wiper run to 3065' and pulled out of the hole. Rigged up Schlumberger equipment and ran temperature log from 3052' to surface. Maximum temperature at 3052' was 322°F. Ran in the hole with 8-3/4" bit and cleaned out cement from 3065' to 3278'. Drilled baffle collar at 3278' and cement to 3312'. Pulled out of the hole. Rigged up Schlumberger equipment and ran "Cement Bond Log" from 3310' to 1345' with the following results: poor bond from 3310' to 3130'; poor bond from 3130' to 2990'; fair bond from 2990' to 2700'; good bond from 2700' to 2014'; and excellent bond from 2014' to 1345'. Rigged down Schlumberger equipment and ran in the hole to 3312' with 8-3/4" drilling assembly. Cleaned out cement to 3448'. The maximum recorded deviation in the 12-1/4" hole was 5 degrees and 30 minutes at a depth of 2776' with a temperature of 300°F.

<u>8-3/4" HOLE SECTION</u> 3448' to

Drilled 8-3/4" hole from 3448' to 3495' with full returns, using mud as the circulating medium. Encountered a 4' void at 3495' and lost full returns. Drilled 8-3/4" hole from 3499' to 3629' while pumping water through the bit, without returns to the surface. Unable to register surface pressure with a pump rate of 960 gallons per minute. Pulled out of the hole and placed jet subs 500' and 1000' above the bit. Ran in the hole to 3629' and broke circulation with aerated mud. Drilled 8-3/4" hole from 3629' to 3800' with aerated water with returns to the surface. Drilled from 3800' to 3975' by injecting water at a rate of 720 gallons per minute without returns to the surface. Broke circulation at 3960' and cleaned fill from 3960' to 3975' after tripping for new bit. Drilled with aerated water from 3975' to 4135'. Drilled 8-3/4" hole from 4135' to 4325' without returns while injecting sump water through bit at a rate of 880 gallons per minute (gpm). Broke circulation with aerated water and continued drilling 8-3/4" hole from 4325' to 4415'. Cleaned out fill from 4372' to 4415' after tripping for new bit. Continued drilling 8-3/4" hole from 4415' to 4550' using aerated water as the circulating medium. Due to lack of sump capacity, shut off air and continued drilling 8-3/4" hole from 4550' to 4789' by injecting sump water through the bit without returns. Broke circulation with aerated water and cleaned out fill from 4716' to 4789' after tripping for bit. Drilled 8-3/4" hole from 4789' to 4944' with aerated water; from 4944' to 5018' while pumping sump water through the bit without returns; from 5018' to 5023' using aerated water; from 5023' to 5140' while pumping produced water through the bit without returns and from 5140' to 5216' with aerated water. Drilled 8-3/4" hole from 5216' to 5385' while pumping water through the bit without returns; from 5385' to 5414' with aerated water; from 5414' to 5486' pumping sump water through the bit without returns and from 5486' to 5619' with aerated water. Spline on compound shaft parted while pulling out of the hole. Continued pulling out of the hole with one engine. Changed bit and ran in the hole to 5619' with no fill. Drilled 8-3/4" hole to 5710' with aerated water. Sump full. Unable to drill while injecting because of inability to use #1 pump due to parted shaft in compound.

Pulled bit up hole to 3205' and injected sump water while repairing compound. After repairing compound, injected with both pumps for four hours. Ran to bottom without encountering fill and broke circulation with aerated water. Drilled 8-3/4" hole from 5710' to 5815' with aerated water; from 5815' to 5980' by pumping sump water through the bit without returns; from 5980' to 6120' with aerated water and from 6120' to 6168' while pumping sump water through the bit without returns. Tripped to change out bit and reposition jet subs. Ran in the hole to 6158' and broke circulation. Drilled 8-3/4" hole from 6158' to 6290' with aerated water; from 6290' to 6451' while injecting sump water through bit without returns; from 6451' to 6555' with aerated water and from 6555' to 6671' while pumping sump water through bit without returns. Drilled with aerated water from 6671' to 6727' and drilled from 6727' to 6835' while pumping sump water through the bit without returns. Tripped for new bit and continued drilling 8-3/4" hole from 6835' to 6875' with aerated water. Pump suction collapsed while attempting to pump sump water. Pulled bit to 3300' and replaced suction on pumps. Ran in the hole. Pumped sump water through bit without returns while drilling 8-3/4" hole from 6875' to 6947'. Drilled from 6947' to 7003' with aerated water. Rigged and ran temperature survey at 6970'. Temperature = 326°F. Drilled 8-3/4" hole from 7003' to 7069' while pumping water through the bit without returns; from 7069' to 7167' with aerated water; from 7167' to 7273' while pumping sump water through the bit without returns and from 7273' to 7323' with aerated water.

Pulled out of the hole and laid down two joints of split drill pipe. Ran in the hole to 7323' without encountering fill. Drilled 8-3/4" hole from 7323' to 7386' while pumping sump water through bit without returns and from 7386' to 7512' with aerated water. Commenced pumping sump water through bit. Pressure built to 1700 psig as bit plugged, then decreased to 300 psig. Hole commenced circulating with aerated water. Worked stuck pipe free and pulled out of the hole checking for washout in drill pipe. Moved jet subs up the hole to 1760' and 2260' respectively and ran in the hole to top of fill at 7312'. Washed fill from 7312' to 7354' with aerated water. Unable to circulate cuttings out of the hole. Pulled out of the hole to check for washed out drill pipe. Laid down one joint of split pipe. Ran in the hole to 3325' with a slick bottom hole assembly. Jets were placed at a distance of 4000' and 5000' from the bit. Pumped sump water into the hole and ran in the hole to fill at 7316'. Broke circulation with aerated water and cleaned out fill from 7316' to 7485'. Hole was clean from 7485' to 7512'. Drilled 8-3/4" hole from 7512' to 7530' with aerated water. Pulled the bit up hole to 3345'. Hole was tight from 7485' to 7316'. Pumped approximately 12,000 barrels of sump water into the hole. Pulled out of the hole to check bit. Ran in the hole to an obstruction at 7316'. Washed and reamed from 7316' to 7327' with aerated fresh water. Hole was clean from 7327' to 7530'. Continued drilling 8-3/4" hole with aerated fresh water from 7530' to 7542'. Pipe commenced sticking while running survey at 7482'. Cut survey wire, dropping instrument and worked pipe, from 7482' to 7400' before pulling free. Pulled out of the hole. No tight hole indicated from 7327' to 7316'. Pumped sump water down hole to cool wellbore for casing inspection log. Rigged and ran Dia-Log 13-3/8" Casing Profile Caliper Log from 1345' to surface. Log indicated 74% to 90% of wall thickness remaining. Ran Dia-Log 9-5/8" Casing Profile Caliper Log. Tool failed. Pulled out of the hole and pumped water to cool the wellbore. Re-ran 9-5/8" Casing Caliper Log from 3325' to 1345'. Log indicates less than 50% of original wall thickness from 1814' to 1815' and a loss of wall thickness varying from 5% to 21% for remainder of 9-5/8" casing. Rigged down Dia-Log equipment. Ran in the hole to 3325' with 8-3/4" drilling assembly. Pumped remaining sump water into the hole. Ran in the hole to 7414'. Washed and reamed from 7414' to 7542' and drilled from 7542' to 7615' with aerated water. Tripped for bit. Ran in the hole to 3320' and injected water from sump into the hole. Ran in the hole to 7495' and broke circulation with aerated water. Washed and reamed from 7495' to 7615' and drilled 8-3/4" hole from 7615' to 7700'. Pulled bit to 6250' and pumped approximately 12,000 barrels of sump water into the hole. Ran in the hole to 7625' and broke circulation with aerated water. Washed and reamed to 7700' and drilled 8-3/4" hole from 7700' to 7735'. Pipe stuck while drilling. Worked pipe free after two hours. Pulled out of the hole and stood back bottom hole assembly. Ran in the hole to 3312' with open ended drill pipe. Injected air through drill pipe at 3312' unloading water for 30 minutes while rigging up "Go International" logging equipment. Ran "Go International" temperature survey to top of obstruction at 7320'. The recorded temperature from 3440' to 6125' started at 299°F and increased gradually to 339°F at 7320'. Ran Spinner Survey. Fluid level was at 1310'. Tool failed. Pulled out of the hole and waited 12 hours for temperature build-up. Re-ran temperature survey. Survey indicated 340°F at 2500' and 298° to 300°F from 3500' to 6000'. Temperature gradually increased from 300°F at 6000' to 344°F at 7300'. Waited 9 additional hours for temperature build-up. Ran "Go International" temperature log #3 to 7334' and recorded temperatures as follows: 200' = 120°F, 1000' = 218°F, 2500' = 332°F, 3000' = 320°F, 4000' = 295°F, 5000' = 295°F, 6000' = 297°F and 7334' = 341°F. Ran "Go International" Spinner Survey. Survey indicated no fluid movement at 3450'. Fluid was moving down the hole at a rate of 55 gallons per minute at 3515' and at a rate of 73 gallons per minute at 3900'. Tool failed. Pumped water thru kill line at a rate of 522 gallons per minute with no response from Spinner. Ran temperature log #4 with the following results: 3300' = 207°F, 6000' = 242°F, 6200' = 327°F, and 7320' = 353°F. Pulled out of the hole and rigged down "Go International" logging equipment. Pulled drill pipe out of the hole and made up 8-3/4" drilling assembly. Ran in the hole to 7375' and broke circulation with aerated water. Washed and rotated through tight hole from 7375' to 7425'. Ran in the hole to 7641'. Broke circulation with aerated water and washed and reamed from 7641' to 7705'. Circulated to clean the wellbore and pulled up the hole to 7200'. Pumped water from sump into the wellbore. Made wiper run to 7700'. Pulled out of the hole and rigged up Schlumberger equipment. Ran DIL-SP Log from 7682' to 3357'. Maximum temperature reading was 331°F. Ran Gamma Ray-Sonic Log from 7681' to 3357' and Gamma Ray-Neutron Density with Caliper from 7678' to 3357'. Schlumberger ran temperature log from 7550' to surface with a maximum temperature of 337°F at 7550'. Ran Dipmeter from 6000' to 3357'. Rigged down Schlumberger and ran in the hole with 8-3/4" bit to obstruction and tight hole at 7663'. Pulled out of the hole and prepared to run 7" combination blank and slotted liner. Ran 106 joints (4441.77') of 7", 26#, K-55, LT&C combination blank and slotted (20-2-6-60) casing liner. Hung liner with Halliburton cement guide shoe at 7605', Baker baffle collar at 4049', Lyons ECP packer at 3995', cementing port collar at 3992', and top of Burns 9-5/8" x 7" liner hanger at 3163'. Slotted joints were spaced at various intervals from 7560' to 4200'. Unable to release setting tools after setting liner hanger. Also, liner would not move up hole. With Lyons packer set and cementing ports open, pumped cool water through drill pipe in an attempt to shrink setting nut. Continued working right-hand torque into setting tools in an attempt to release from liner hanger. Rigged up "Go International" and fired three separate string shots in liner hanger in an attempt to jar tools free. All attempts were unsuccessful. Fired string shot and backed off at top of setting tools. Pulled out of the hole and ran in the hole with bumper sub and six 7" drill collars. Screwed into top of setting tools.

Pumped cold water through hanger while bumping down and torquing to the right. Unable to move the setting nut. After ten hours, slips on casing hanger released. Pulled casing up the hole to replace Burns liner hanger. Burns liner hanger was distorted (necked down below slip area, slip grooves bulged and top of tie-back receptacle rolled inward). Rigged up to lay down 7" liner. Laid down Burns liner hanger, Lyons ECP packer (rubber element missing) and 106 joints of 7", 26#, LT&C blank and slotted casing. Damaged four joints of casing while attempting to break connections. Rigged down casing tools. Made up 8-3/4" bit on three 7" drill collars. Ran in hole to obstruction at 7653'. Pulled bit to 3345' and broke circulation with aerated water. Circulated for four hours and let well die. Ran in the hole to 5480' and regained circulation. Circulated for two hours to cool the wellbore, then let the well die. Ran in the hole to 7653' with no additional fill. Pulled out of the hole and rigged up to rerun 7" liner. Ran 72 joints of 7", 26#, K-55, LT&C blank casing and 36 joints of 7", 26#, K-55, LT&C perforated casing (4507'). Hung liner with Halliburton cement guide shoe at 7615', Baker baffle plate at 4053', Lynes ECP packer at 3999', cementing collar at 3997' and Midway liner hanger at 3084'. Halliburton mixed and pumped 560 ft^3 of H_2O and 138 ft^3 of gel H_2O followed by 187 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel, 0.5% CFR-2 and 0.4% HR-7. Followed this with 81 ft^3 of class "B" cement with 40% Silica Flour. Displaced with 49 ft^3 H_2O. Closed cementing port with 800 psig surface pressure. Pulled out of the hole and laid down liner setting and cementing tools. Ran in the hole to 2850' with open ended drill pipe. Laid down 5" drill pipe, 15 - 7" drill collars and 6 - 8" drill collars. Ran in the hole with 8-3/4" bit to top of 7" liner at 3084'. Attempted unsuccessfully to fill the wellbore with water. Pulled out of the hole and picked up Halliburton 9-5/8" RTTS packer. Ran in the hole and set packer at 3034'. Filled annulus with water. Halliburton mixed and pumped through packer, 560 ft^3 of water followed by 187 ft^3 class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 0.5% CFR-2 followed by 81 ft^3 class "B" cement with 40% Silica Flour. Displaced cement with 330 ft^3 water. No pressure build-up. Pulled out of the hole and ran back in with packer and unsuccessfully tried to set it. Pulled out of hole and found rubber packing elements missing. Ran O.E.D.P. to 2100'. and pumped water to cool hole. Ran and set RTTS packer at 3034'. Filled annulus with water and then pumped 560 ft^3 water through the packer at a flow rate of 8 barrels per minute and with a surface pressure of 800 psig. Mixed and pumped 244ft^3 "B" cement premixed with 40% Silica Flour and 0.5% CFR-2. The pressure increased to 850 psig. The packer started leaking at that pressure. The packer was released and pulled out of the hole. The packer rubbers were damaged and had to be changed. Ran and set packer at 2921'. The annulus was filled with water. Halliburton mixed and pumped 560 ft^3 water through the drill pipe. The water was followed by 1000 ft^3 "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel, and 0.5% CFR-2. It was displaced with 336 ft^3 water. Pressure built to 900psig and then broke back to 400 psig. Released the packer and pulled out of the hole. Ran in the hole with 6-1/8" bit to an obstruction in the 7" casing at 3137'. Started circulating with water and cleaned out cement and rubber from 3137' to 3140' with full circulation. Pulled out of hole. Ran and attempted to set a 7" RTTS packer at 3100'. The packer failed and was pulled out of the hole. Ran and set a 9-5/8" RTTS packer at 3010'. Pressure tested liner lap to a surface pressure of 400 psig. The hole went on vacuum. The packer was pulled and reset to 2915', and the annulus was filled with water. Halliburton mixed and pumped 280 ft^3 water followed by 675 ft^3 "B" cement premixed in a 1:1 ratio with Perlite, 3% Gel, 40% Silica Flour, and 0.5% CFR-2. That was followed by 200 ft^3 of the same mixture plus 2% $CaCl_2$. It was displaced with 319 ft^3 water. Unseated packer and pulled out of the hole. Cleaned out cement with 8-3/4" bit from 2427' to 3084'. Pulled out of hole and ran in with 6-1/8" bit to 3243'. Pushed packing rubber which was obstructing the hole to 3990'. Pulled out of hole and ran and set a 9-5/8" RTTS packer at 3040'. Tested lap to a surface pressure of 300 psig. Hole went on vacuum. Halliburton mixed and pumped 112 ft^3 gel-water mixture followed by 750 ft^3 "B" cement, premixed in a 1:1 ratio with Perlite, 40% Silica Flour, and 3% Gel. Pump pressure built to 500 psig and then broke to 100 psig. The mixture was displaced with 360 ft^3 water. Ran in hole with 8-3/4" bit to top of liner at 3084'. No cement was found on the top of the liner. Pulled out of hole and ran in with open ended drill pipe to 3080'. Halliburton mixed and pumped 56 ft^3 high viscosity gel-water mixture followed

by 167 ft^3 "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 2% $CaCl_2$. That was displaced with 263 ft^3 water. Pulled out of hole and ran in to top of cement at 2920' with an 8-3/4" bit. Drilled out cement from 2920' to liner top at 3084'. No fluid was lost. Pulled out of hole and ran in with a 6-1/8" bit to 3084'. Attempted to circulate, but the bit plugged. Pulled out of hole and cleaned bit. Ran in hole and started circulating. Drilled cement from 3084' to 3088'. Ran in hole to 3990'. Drilled plug in port collar from 3990' to 4001' with full returns. Ran in hole to baffle at 4050'. Drilled out baffle and lost returns. Pulled out of hole and ran in with a 6-1/8" bit to 7610' pushing junk from baffle and plugs ahead. Pulled out of hole. Removed the blow out preventers and installed a casing hanger spool, spacer spool, and a WKM master valve. Reinstalled the blow out preventers. Ran 75 joints (3095.15') of 7", 26#, K-55, LT&C casing into the tie-back receptacle at 3084'. Picked up the blow out preventers and installed the casing head slips. The 7" liner was landed with stab-in mandrel, 14" inside the tie-back receptacle, leaving room for 38" of free travel to the bottom of the receptacle. Reinstalled the blow out preventers and ran in hole with a 6-1/8" bit to 4710'. Pulled out of hole laying down drill pipe and tools. Closed the master valve and removed the blow out equipment.
Pumped water from sump into well followed by 400 barrels of fresh water. Applied 400 psig air surface pressure to well. Closed well in and released the rig.

Well History

Union Oil Company of California

UNION

TYPE WELL	
(Geothermal)	Hot Water

COMPANY	SEC	T	R	M
Union Oil Company of California	7	26S	6W	Salt Lake

LEASE	WELL NO.	COUNTY
Cove Fort Sulphurdale Unit	42-7	Beaver

LOCATION	AREA
SE 1/4 NE 1/4 NW 1/4	Cove Fort - Sulphurdale

ELEVATION	SPUD	COMP.	ABAND.	TOTAL DEPTH	PLUG	RECOMP.
6422'	11/28/77	3/14/78		7735'		

HOLE DEVIATION 511.69 B.H.L.

CASING RECORD

SIZE	CEM. LDD.	DEPTH	ft^3 CFM	W.S.O. - PERFS. - REMARKS
30"		50'	$142 ft^3$	
20"		251'	$649 ft^3$	
13-3/8"		1552'	$2071 ft^3$	
9-5/8"		1345-3357'	$2000 ft^3$	Tested liner lap to 580 psig
7"		3084-7615'	$3491 ft^3$	Combination blank and slotted liner
7" Tie-Back		Surf.-3085'		

WELL DATA

ELEC. LOG	50' - 7695'
DIPMETER	3358' - 6003'
CORE RECORD	
HISTORY	
CORE ANALYSIS	
PALEO. LETTER	

MARKERS - HORIZONS

DATE	DEPTH	PROGRESS HISTORY
9/10/77		Rigged up Dale Martin Rathole Services rig and drilled a 36" diameter hole to a depth of 30' below ground level. A 30" conductor pipe was run into the hole to a depth of 30' and cemented with 5-1/2 cubic yards of Ready-Mix cement.
11/28/77		Moved in and rigged up Loffland Brothers Rig #184 on 11/28/77. Rig commenced dayrate operations at 0800 hours, 11/28/77. Installed the mouse hole and rat hole and picked up the kelly and 26" hole opener.
11/29/77	157'	Spudded 26" hole at 0400 hours. Center punched 26" hole from 50' to 55'. Made up 17-1/2" drilling assembly. Drilled 17-1/2" hole from 55' to 157'.
11/30/77	255'	Drilled 17-1/2" hole from 157' to 255'. R.I.H. with 26" pilot hole opener and opened 17-1/2" hole to 26" hole from 55' to 85'.
12/01/77	255'	Opened 17-1/2" hole to 26" hole from 85' to 255'.
12/02/77	255'	Rigged and ran 6 joints, 20", 94#, H-40, buttress casing (252') landed at 251'. Halliburton mixed and pumped through the open ended 20" casing, 649 cu. ft. class "B" cement, with 2% $CaCl_2$, displaced with 464 cu. ft. water. Pumped 175 cu. ft. excess to sump. Waited on cement for

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2/02/77		Continued - 3 hours. Cut off 30" conductor and 20" casing. Installed 20" flange. Nippled up blowout preventers.
12/03/77	255'	Continued installing blowout equipment, which consisted of a 20" double Shaffer and Hydril on the 20" x 2000# flange which was welded to the 20" casing. Attempted to test blowout equipment.
12/04/77	259'	Repaired leaks in connections and piping between mud pumps and standpipe manifold. Attempted unsuccessfully to test blowout equipment. Isolated pumps and tested blowout equipment to 500 psi for 30 minutes. Test was approved by U.S.G.S. representative. Drilled cement from 233' to 255'. Drilled 17-1/2"hole from 255' to 259'.
12/05/77	347'	Drilled 17-1/2" hole from 259' to 347'.
12/06/77	492'	Drilled 17-1/2" hole from 347' to 492'.
12/07/77	611'	Drilled 17-1/2" hole from 492' to 586'. P.O.H. and replaced shock sub. R.I.H. and drilled 17-1/2" hole from 586' to 611'.
12/08/77	746'	Drilled 17-1/2" hole from 611' to 746'. Lost pump pressure. P.O.H. Parted pin on bottom stabilizer leaving one 9" drill collar, bit and reamer in hole. Top of fish at 715'. R.I.H. with 11-3/4" Bowen overshot with 8" grapple.
12/09/77	819'	Engaged fish. Chained out of hole. Laid fish down and inspected drilling assembly. R.I.H. and drilled 17-1/2" hole from 746' to 819'.
12/10/77	905'	Drilled 17-1/2" hole from 819' to 905'.
12/11/77	1096'	Drilled 17-1/2" hole from 905' to 1096'.
12/12/77	1221'	Drilled 17-1/2" hole from 1096' to 1221'. P.O.H. to unplug bit. R.I.H.
12/13/77	1313'	Drilled 17-1/2" hole from 1221' to 1257'. Lost 500 psig pump pressure. P.O.H. and checked for washout. Bit washed out around two jet nozzles. Changed bit and R.I.H. Drilled 17-1/2" hole from 1257' to 1313'.
12/14/77	1388'	Drilled 17-1/2" hole from 1313' to 1388'. Lost circulation. Mixed mud and lost circulation material to regain circulation. Lost 650 bbls of mud to the hole.

12/15/77	1452'	Regained circulation. Drilled from 1388' to 1452'. Twisted off and left a bit, reamer, drill collar, shock sub, and two 8" drill collars in the hole. The pin had twisted off of the top stabilizer. R.I.H. with overshot and caught fish.
12/16/77	1494'	Recovered fish and changed tools. R.I.H. and drilled 17-1/2" hole from 1452' to 1494'. Lost circulation and P.O.H. R.I.H. with O.E.D.P. to 1457'. Mixed and pumped 198 ft^3 of class "B" cement, 1:1 Perlite, 40% Silica Flour, 3% Gel, 0.5% CFR-2, 0.3% HR-7. That was displaced with 100 ft^3 of water. Cement in place at 2400 hours.
12/17/77	1494'	Pulled out to shoe of the 20" casing and waited for cement to set up. Attempted unsuccessfully to fill the hole with 200 bbls of mud. W.O.C. and mixed mud. Pumped 100 bbls of mud and filled the hole. Found the top of the cement at 1445'. Circulated with no mud loss. P.O.H. to 1353' and closed rams. Pressurized the hole to 100 psig at the surface and the hole took fluid. Mixed and pumped through O.E.D.P. at 1353', 200 ft^3 class "B" 1:1 Perlite cement with 40% Silica Flour, 3% Gel, 0.5% CFR-2 and 0.3% HR-7. The cement was displaced with 100 ft^3 water. P.O.H. and W.O.C. for 3 hours. Filled the hole with 75 bbls mud. The rams were closed and the well was pressurized to 100 psig at the surface with no fluid loss. R.I.H. with 17-1/2" drilling assembly and located cement at 1335'.
12/18/77	1557'	Drilled cement from 1335' to 1475'. Drilled 17-1/2" hole from 1494' to 1557' and circulated. P.O.H. and laid down tools.
12/19/77	1557'	Rigged up and ran 40 joints of 13-3/8", 54.5# K-55 buttress casing. The shoe was located at 1552' and the baffle at 1513'. Halliburton mixed and pumped 2071 ft^3 of class "B" 1:1 Perlite cement with 40% Silica Flour, 3% Gel, 0.5% CFR-2, 0.3% HR-7. That was followed by 184 ft^3 class "B" cement with 40% Silica Flour and 0.5% CFR-2. Fluid flow to the surface was maintained throughout the job. Bumped plug with 600 psig. W.O.C. and rigged down the blowout equipment.
12/20/77	1557'	The blowout preventers were removed and the 20" casing cut off. A 13-3/8" casing head was welded on and tested to 1000 psig. No pressure was lost. A spacer spool, choke-kill spool and 12" - 900 double Shaffer and Hydril were installed.
12/21/77	1557'	Completed blowout preventer installation. The blowout preventers were tested to 1500 psig. The lines had to be thawed out repeatedly while conducting

12/21/77		Continued -
		tests. The Kelly cock would not hold full pressure. It would bleed from 1500 psig to 1200 psig in five minutes. The test was witnessed and approved by a U.S.G.S. representative.
12/22/77	1576'	R.I.H. with a 12-1/4" bit to top of cement at 1497'. Drilled out cement to 1557'. Drilled 12-1/4" hole to 1559' and lost 350 bbls mud. Mixed mud and lost circulation material and regained circulation. P.O.H. and found bit locked. Changed bottom hole assembly and R.I.H. Drilled 12-1/4" hole from 1559' to 1576'.
12/23/77	1806'	Drilled 12-1/4" hole from 1576' to 1806'.
12/24/77	1970'	Drilled 12-1/4" hole from 1806' to 1836' and lost total returns. Mixed mud and lost circulation material and regained circulation. Drilled 12-1/4" hole from 1836' to 1850' and lost circulation. Pulled bit to 1550' and mixed mud. Regained circulation after a mud loss of 150 bbls. Drilled 12-1/4" hole from 1850' to 1970' with a loss of 50 bbls of mud.
12/25/77	2218'	Continued drilling 12-1/4" hole to 2123' prior to losing full returns. Pulled bit to 1450'. Mixed mud and lost circulation material in order to restore mud volume in tanks. The additional mud loss was an estimated 475 barrels. Gained full returns and continued drilling to 2175'. Lost returns at 2175'. Estimated additional loss was 450 bbls. Pulled bit to 1390'. Mixed mud and lost circulation materials. Ran back in the hole to 2175' and continued drilling to 2218' with full returns. Lost returns totaling approximately 450 bbls. Pulled bit up hole to 1500'. Mixed mud and lost circulation materials.
12/26/77	2244'	Continued drilling to 2238' without returns. Lost an estimated 400 additional barrels of mud. Pulled bit to 1475'. Mixed mud and lost circulation materials. Ran back in the hole to top of fill at 2225'. Cleaned out fill to 2238'. Drilled 12-1/4" hole from 2238' to 2244' without returns, losing an additional 400 bbls of mud. P.O.H. and stood back 12-1/4" drilling assembly. R.I.H. to 2202' with O.E.D.P. Halliburton mixed and pumped 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced cement with 33 ft^3 of water. Pulled pipe up the hole to 1450' and W.O.C. to set up.

12/27/77 2244' R.I.H. to top of cement at 2119'. Attempted unsuccessfully to fill the hole with 300 bbls of mud. Pulled up the hole to 2046'. Halliburton mixed and pumped 120 ft^3 of class "B" cement, mixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel, through O.E.D.P. at 2046'. Displaced cement with 30 ft^3 of water. Pulled up the hole to 1506' and waited four hours for cement to set up. R.I.H. to top of cement at 2119'. Halliburton mixed and pumped 250 ft^3 of class "B" cement, mixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel, through O.E.D.P. at 2046'. Pulled pipe to 1475' and waited for cement to set up. R.I.H. to top of cement at 2084'. Attempted unsuccessfully to fill the hole with 250 bbls of mud. Halliburton mixed and pumped 150 ft^3 of class "B" cement, mixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel, through O.E.D.P. hung at 2060'. P.O.H. and W.O.C. to set up for four hours. Filled the hole with 150 bbls of mud. Picked up the 12-1/4" drilling assembly and R.I.H. to a cement stringer at 1636'. Plugged the bit while attempting to clean out this stringer.

12/28/77 2244' P.O.H. and cleaned out the bit and bottom drill collar. Ran back in the hole and continued cleaning out cement stringers from 1636' to 1990'. Drilled hard cement from 1990' to 2214' with only partial returns from 2184' to 2214'. Lost all returns at 2214'. P.O.H. Removed drilling assembly and R.I.H. to 2172' with O.E.D.P. Halliburton mixed and pumped 396 ft^3 of class "B" cement mixed in a 2:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced cement with 45 ft^3 of water. Pulled out of the hole and waited for cement to set up. Filled the hole with mud. Closed the pipe rams and pressured to 200 psig surface pressure. Continued W.O.C. an additional three hours.

12/29/77 R.I.H. and cleaned out cement stringers from 1760' to 1940'. Drilled firm cement from 1940' to 2244'. Lost circulation at 2244'. Continued drilling 12-1/4" hole from 2244' to 2250' without returns. Lost a total of approximately 450 bbls of mud. P.O.H. and stood back bottom hole assembly. R.I.H. to 2205' with O.E.D.P. Halliburton mixed and pumped 142 ft^3 of Thix-Set cement premixed with 13% Gilsonite and 1/2# of Flocele/sack. Displaced cement with 196 ft^3 of water. P.O.H. and W.O.C. to set up.

2/30/77	2250'	Pumped 450 bbls of fluid in the hole over a seven hour period with no indications of hole filling. Ran back in the hole with O.E.D.P. to top of cement at 2222'. P.O.H. Fluid level was at approximately 1850'. R.I.H. to 2220' with 12-1/4" bit. Obtained a bottom hole temperature survey of 175°F. Drilled hard cement from 2222' to 2230'. Mixed mud and lost circulation material. R.I.H. to 1829' with O.E.D.P. Halliburton mixed and pumped 142 ft^3 of Thix-Set cement premixed with 13% gilsonite and 0.5% Flocele. Displaced cement with 140 ft^3 of water. P.O.H. and pumped 200 bbls of mud over the next four hour period while waiting on cement. No returns to the surface. R.I.H. to 2230' with no indication of top of cement plug.
12/31/77	2250'	P.O.H. Fluid level remained at approximately 1700'. R.I.H. with O.E.D.P. to 1860'. Halliburton mixed and pumped 240 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced cement with 151 ft^3 of water. P.O.H. and waited for cement to set up. R.I.H. to 2230' with no indication of top of cement plug. P.O.H. Found fluid level to be at approximately 1875'. R.I.H. with O.E.D.P. to 2209'. Mixed and pumped a 100 barrel lost circulation material plug. Halliburton mixed and pumped 120 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 3% Gel, through O.E.D.P. at 2209'. Displaced cement with 196 ft^3 of water. P.O.H. and W.O.C. for ten hours. Fluid level in wellbore was at approximately 1500'. R.I.H. to 2230' without encountering obstructions. P.O.H. Dry drill pipe indicated no fluid level.
1/01/78	2250'	R.I.H. to 2169' with O.E.D.P. Pumped 45 bbls of water followed by 193 ft^3 of class "B" cement premixed in a 2:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced cement with 196 ft^3 of water. P.O.H. and waited for cement to set up. Ran back in the hole to 2230' with no obstructions. Pulled up hole to shoe of 13-3/8" casing. No fluid level was indicated on pipe. Ran back in the hole to 2220'. Pumped a treatment of 20 bbls of fresh water followed by 20 bbls of 3% $CaCl_2$ with 400 # of sand, followed by 5 bbls of water and 30 bbls of $NaSi_2$. Displaced with 30 bbls of fresh water. P.O.H. and waited four hours for the solution to set up. R.I.H. to 2170' with O.E.D.P. Halliburton mixed and pumped 180 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced cement with 190 ft^3 of water. P.O.H. and waited for cement to set up.

/02/78	2250'	R.I.H. with O.E.D.P. to top of cement plug at 1953'. Filled the wellbore with 325 bbls of mud. Lost returns after circulating for two hours. P.O.H. Fluid level was at approximately 179'. R.I.H. to 1946' with O.E.D.P. Halliburton mixed and pumped 100 ft^3 of Thix-Set cement premixed with 19% gilsonite, 0.5% Flocele, and 0.1% Tuff-Plug. Displaced cement plug with 145ft^3 of water. P.O.H. and waited four hours for cement to set up. Fluid level was at approximately 45' from the surface. Filled the hole with 75 bbls of mud. R.I.H. and cleaned out cement stringers from 1535' to 1861'. Cleaned out firm cement from 1861' to 1994'.
1/03/78	2307'	Cleaned out hard cement from 1994' to 2235'. Cleaned out soft cement or fill from 2235' to 2250' while maintaining full returns. Drilled 12-1/4" hole to 2252'. Lost full returns. Hole on vacuum. Drilled from 2252' to 2275' without returns. Pulled bit into 13-3/8" casing. Mixed drilling mud. R.I.H. to 2275'. No fill on bottom. Continued drilling 12-1/4" hole from 2275' to 2298' without returns. Lost approximately 500 bbls of mud. Pulled bit into 13-3/8" casing. Fluid level was at approximately 360'. Mixed mud and lost circulation materials. R.I.H. to 2298'. No fill. Drilled 12-1/4" hole from 2298' to 2307' without returns to the surface.
1/04/78	2342'	Drilled without returns from 2307' to 2324'. Pulled bit into the 13-3/8" casing and mixed mud and lost circulation materials. R.I.H. and drilled 12-1/4" hole from 2324' to 2342' without returns to the surface. P.O.H. and stood back drilling assembly. R.I.H. to 2201' with O.E.D.P. Halliburton mixed and pumped 112 ft^3 of water followed by 112 ft^3 of 6% $CaCl_2$ water with 400# of plaster sand followed by 28 ft^3 of water and 128 ft^3 of $NaSi_2$ mixed in a ratio of 1:1 with water. It was displaced with 196 ft^3 water. Pulled pipe up hole to 2108'. Halliburton mixed and pumped 223 ft^3 of Thix-Set cement premixed with 25# gilsonite, 1-1/4# Flocele and 1/8# of Tuff Fiber per sack. Displaced with 182 ft^3 water. Pulled pipe up the hole to 1475' and waited for cement to set up.
1/05/78	2342'	R.I.H. to top of cement at 2242'. Pulled pipe to 1475'. Unable to fill hole after pumping 400 bbls mud. R.I.H. to 2232'. Halliburton mixed and pumped 112 ft^3 of Gel water consisting of WG-11, CL-11 with 1680# of Unibeads, 420# of gilsonite and 420# TLC-80, followed by 59 ft^3 of class "B" cement with 2% $CaCl_2$ and 100# Flocele. Pulled pipe to 1495' and waited for cement to set up. R.I.H. to top of cement at 2242'. Attempted unsuccessfully to fill the wellbore. Pulled up hole to 2232'. Halliburton

/05/78 Continued -

mixed and pumped 112 ft^3 of Gel water consisting of WG-11, CL-11 with 1680# Unibeads, 420# of gilsonite, and 420# TLC-80, followed by 118 ft^3 of class "B" cement premixed with 2% $CaCl_2$ and 200# Flocele. Displaced with 157 ft^3 of water. Pulled pipe to 1510' and waited for cement to set up.

1/06/78 R.I.H. to top of cement at 2139'. Pulled back up the hole to 1475'. Filled the wellbore with 310 bbls of mud. Continued waiting for cement to set up. R.I.H. and drilled firm cement from 2139' to 2244'. Commenced losing mud at a rate of 1 bbl per minute at 2219' and 3 bbls per minute at 2229'. P.O.H. and stood back drilling assembly. R.I.H. with O.E.D.P. to 2201'. Halliburton mixed and pumped 56 ft^3 of Frac Gel consisting of WG-11, CL-11, 840# Unibeads, 210# gilsonite and 210# TLC-80, followed by 210 ft^3 of class "B" cement premixed with 2% $CaCl_2$ and 75# of Flocele. Displaced with 151 ft^3 of water. Pulled up the hole to 1450' and waited for cement to set up. Filled the hole with 170 bbls of mud. Mud fell away slowly. R.I.H. to top of cement at 2184'.

1/07/78 2342' P.O.H. to pick up drilling assembly and wait for cement to set up. Ran back in the hole to 2184' and filled the hole with 275 bbls of mud. Drilled solid cement to 2228' with full returns. Space from 2228' to 2244' was void. Commenced losing mud at a rate of 3 bbls per minute while circulating. Pulled out of the hole and stood back bottom hole assembly. R.I.H. to fill at 2227'. Unable to clean out fill. P.O.H. and picked up 12-1/4" bit. R.I.H. and cleaned out fill from 2227' to 2231' with partial returns. Lost full returns while cleaning out from 2231' to 2242'. Lost a total of approximately 400 bbls of mud. P.O.H. and stood back drilling assembly. R.I.H. with O.E.D.P. to 2232'. Halliburton mixed and pumped 56 ft^3 of Frac Gel consisting of 25# WG-11, and 7# of CL-11 followed by 112 ft^3 of 3% $CaCl_2$ water, 56 ft^3 water, 258 ft^3 $NaSi_2$ mixed in a 1:1 ratio with water, and 136 ft^3 of class "B" cement with 2% $CaCl_2$ and 1/2 #/sack Flocele. Displaced with 168 ft^3 of water. Pulled drill pipe to 1490' and waited for cement to set up.

1/08/78	2342'	Ran back down the hole to 2239' and didn't locate the top of plug. Halliburton mixed and pumped 112 ft^3 of Frac Gel consisting of 500# gilsonite, 500# Unibeads, 350# moth balls, 50# WG-11 and 15# Cl-11 followed by 136 ft^3 of class "B" cement with 2% $CaCl_2$ and 1/2# Flocele/sack. Pulled drill pipe to 1430' and waited for cement to set up. Ran back in the hole to 2240' with no trace of the plug. Also, the hole appeared to be void of any fluid. Halliburton mixed and pumped 112 ft^3 of 3% $CaCl_2$ water, 56 ft^3 of water and 134 ft^3 of $NaSi_2$. Displaced with 65 ft^3 of water. Pulled drill pipe to 2201' and pumped 98 ft^3 of class "B" cement with 6% gilsonite, 1/2# Flocele and 2% $CaCl_2$. Displaced with 57 ft^3 of water. Pulled drill pipe to 1490' and waited for cement to set up.
1/09/78		R.I.H. to top of cement plug at 2187'. Pulled out of the hole and picked up drilling assembly. R.I.H. and drilled cement from 2187' to 2250' with full returns. Drilled without returns from 2250' to 2280', losing approximately 350 bbls of fluid. P.O.H. and stood back drilling assembly. R.I.H. with O.E.D.P. to top of fill at 2260'. Attempted unsuccessfully to wash through fill. R.I.H. with 12-1/4" bit and cleaned fill from 2260' to 2278' without returns. Lost an additional 400 bbls of fluid. R.I.H. to 2263' with O.E.D.P. Halliburton mixed and pumped 112 ft^3 of water, 112 ft^3 of $CaCl_2$ water, 67 ft^3 of water and 67 ft^3 of $NaSi_2$. Displaced with 112 ft^3 of water. Pulled pipe to 1496' and waited for cement to set up. R.I.H. to 2232'. Halliburton mixed and pumped 88 ft^3 of class "B" cement with 2% $CaCl_2$, 12% gilsonite and 1/2# Flocele/sack. Displaced with 156 ft^3 of water. Pulled up hole and waited for cement to set up.
1/10/78	2342'	R.I.H. with O.E.D.P. to top of cement plug at 2240'. Unable to fill the hole with water. Pulled pipe to 2233'. Halliburton mixed and pumped 88 ft^3 of class "B" cement with 8# gilsonite, 2% $CaCl_2$ and 1/2# Flocele/sack. Displaced with 168 ft^3 of water. Pulled pipe to 1510' and waited for cement to set up. R.I.H. to top of plug at 2240'. No trace of the plug. Hung open ended drill pipe at 2232'. Halliburton mixed and pumped 112 ft^3 of Frac Gel consisting of 500# Unibeads, 150# Flocele, 150# gilsonite, 150# moth balls, 75# WG-11 and 15# CL-11. Followed by 161 ft^3 of class "B" cement premixed in a 2:1 ratio with Perlite, 40% Silica Flour and 3% Gel followed by 98 ft^3 of class 'B' cement with 2% $CaCl_2$, 1/2# Flocele and 8# gilsonite/sack. Displaced with 86 ft^3 of water. Pulled pipe to 1505' and waited for cement to set up. R.I.H. to 2240' with no trace of the plug. Pulled pipe to 2232'. Halliburton mixed and

./10/78		Continued -
		pumped 112 ft^3 of water, 112 ft^3 of 3% $CaCl_2$ water, 28 ft^3 of water and 67 ft^3 of $NaSi_2$. Displaced with 162 ft^3 water. Pulled drill pipe to 2201' and waited two hours. Mixed and pumped 161 ft^3 of class "B" cement premixed in a 2:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 3% $CaCl_2$. Displaced with 168 ft^3 of water. Pulled pipe up hole and waited for cement to set up. R.I.H. to top of cement at 2215'.
1/11/78	2342'	Pulled pipe up hole to 1500' and attempted unsuccessfully to fill the hole with 300 bbls of fluid. R.I.H. to 2201'. Halliburton mixed and pumped a 112 ft^3 slurry consisting of 600# Gel, 75# Flocele, 100# Unibeads and 300# of lost circulation material followed by 352 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 3% $CaCl_2$. Displaced with 134 ft^3 of water. Pulled pipe to 1475' and waited for cement to set up. Filled the wellbore with 30 bbls of water. P.O.H. and repaired rig drawworks. R.I.H. and laid down 75 joints of drill pipe.
1/12/78		Installed banjo box, Grant rotating head and flowline in preparation for aerated drilling.
1/13/78	2342'	Continued rigging up for aerated mud. Fabricated 12" blooie line and muffler and installed the surge tanks. The choke and kill lines were remodeled.
1/14/78	2342'	Continued rigging for aerated circulating system. Fabricated flowlines and installed a diffuser in the sump.
1/15/78	2342'	Picked up 50 joints of 5", 19.5#/ft, Grade-3 drill pipe. Successfully tested blowout equipment. R.I.H. to 1535' with 12-1/4" drilling assembly. Blew the wellbore dry while attempting to aerate fluid. Continued running in the hole to 1601'. Cleaned out cement stringer from 1601' to 1842' with full returns of non-aerated mud. Cleaned out solid cement from 1842' to 2090' with full returns using mud as the circulating medium. Commenced aerating mud with 35-1 air-mud ratio. Cleaned out cement and fill from 2090' to 2245' with full returns, using aerated mud as the circulating medium.
1/16/78	2400'	Continued cleaning out cement from 2245' to 2342' with full returns. Drilled 12-1/4" hole from 2342' to 2400' with intermittent returns to 2390' and no returns from 2390' to 2400'. Pulled bit to 1475'. (Fluid level at 1750'.) Formation took air at 325 psig surface pressure.

/16/78		Continued -
		R.I.H. to 1750' and broke circulation with aerated mud. R.I.H. to 2400'. Unable to circulate. Pulled to 2000' and broke circulation with aerated mud. R.I.H. to 2400'. Unable to circulate. P.O.H. to rig up for foam drilling. R.I.H. to 1510'.
1/17/78	2543'	R.I.H. to 2375'. Unable to circulate with foam. Pulled up hole to 2015' and broke circulation. Drilled 12-1/4" hole from 2400' to 2486' using foam as circulating medium. Hole was producing water at a rate of 600 bbls per hour. After filling the sump with water, drilled 12-1/4" hole from 2486' to 2543' by pumping water back into the hole without returns.
1/18/78	2606'	Continued drilling to 2606' while pumping sump water through bit without returns. Pulled four stands of drill pipe to replace rotating head rubber. Encountered 34' of fill while running to bottom. Unable to break circulation with air foam below 2100'. P.O.H. and stood back drilling assembly.
1/19/78	2606'	R.I.H. to 2575' with O.E.D.P. Ran maximum reading thermometer to 2575'. The temperature after having the hole static for 14 hours was 192°F. Pumped 425 bbls of water through drill pipe. Halliburton mixed and pumped 174 ft^3 of Thix-Set cement premixed with 10# gilsonite per sack, and 2% $CaCl_2$. It was displaced with 234 ft^3 of water. Pulled drill pipe to 1455' and waited on cement for four hours. R.I.H. and located the top of the plug at 2468'. Halliburton mixed and pumped through O.E.D.P. set at 2448', 175 ft^3 Thix-Set cement premixed with 10# gilsonite per sack and 2% $CaCl_2$. It was displaced with 212 ft^3 of water. W.O.C. for four hours. Located the top of the cement at 2449'. Halliburton mixed and pumped through drill pipe set at 2418', 247 ft^3 "B" cement premixed in a 2:1 ratio with Perlite, 5% Gel and 2% $CaCl_2$. It was displaced with 196 ft^3 of water.
1/20/78	2606'	R.I.H. with O.E.D.P. and located the top of the cement at 2248'. Halliburton mixed and pumped 367 ft^3 of class "B" cement premixed in a ratio of 2:1 Perlite, 5% Gel and 2% $CaCl_2$. Displaced with 34 ft^3 of water. Stuck drill pipe while cementing. Worked free with 200,000# pull over weight of drill pipe. Pulled up hole to 1575' and cleared drill pipe with 168 ft^3 of water. P.O.H. and waited for cement to set up. R.I.H. to top of soft cement at 2089'.
/21/78	2606'	P.O.H. and picked up bottom hole assembly. R.I.H. to top of cement at 2027'. Drilled cement stringers

/21/78 Continued -

with foam and aerated mud from 2027' to 2089'. Drilled hard cement from 2089' to 2165'. The hole produced approximately 1680 bbls of water at approximately 10 bbls/minute while drilling from 2120' to 2165'. P.O.H. and stood back drilling assembly. R.I.H. to 1500' with O.E.D.P. Pumped 1680 bbls of water in the hole. Unable to fill the wellbore. R.I.H. to 2139'. Halliburton mixed and pumped 215 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 4% Gel and 2% $CaCl_2$. Displaced with 168 ft^3 of water. Pulled drill pipe to 1475' and pumped 280 ft^3 of water on top of cement. Pulled up hole and waited for cement to set up.

1/22/78 R.I.H. to top of cement at 2077'. Pulled up hole to 2046'. Halliburton mixed and pumped 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced cement with 100 ft^3 of water. Pipe commenced sticking. Worked pipe up the hole pulling 150,000# over weight of pipe. Pumped 500 bbls in the hole. Unable to fill the wellbore. Ran down hole and tagged top of cement at 1885'. Pulled up hole to 1860'. Halliburton mixed and pumped 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced cement with 140 ft^3 of water. Pulled pipe to 1425' and waited for cement to set up. R.I.H. to top of cement at 1697'. Pulled up hole to 1675'. Halliburton mixed and pumped 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 2% $CaCl_2$. Displaced with 134 ft^3 of water. P.O.H. and waited for cement to set up. Filled the wellbore with 125 bbls of water. R.I.H. to top of cement at 1553'. Closed pipe rams and squeezed away 168 ft^3 of water to the formation at 250 psi surface pressure. Halliburton mixed and pumped through O.E.D.P. at 1490', 250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Displaced with 112 ft^3 of water.

1/23/78 2606' Pulled drill pipe to 560'. Closed pipe rams and squeezed away 14 ft^3 of mud at 900 psig surface pressure. Released pressure and pulled out of hole. R.I.H. with 12-1/4" bit to top of cement at 1368'. Shut down operations due to heavy snows and ground blizzard.

1/24/78 2606' Opened road to the rig and relieved crews. Drilled firm cement from 1368' to 1750' using mud, with full returns.

/25/78	2606'	Drilled firm cement from 1750' to 2006' with full returns. Circulated to clean the wellbore and P.O.H. to change the drilling assembly. Installed a jet sub and rigged up for aerated drilling. R.I.H. and broke circulation with aerated mud. Drilled firm cement from 2006' to 2300' with full returns and no additional fluid entry in the wellbore.
1/26/78	2681'	Drilled soft cement from 2300' to 2393' and firm cement from 2393' to 2582'. Cleaned out fill from 2582' to 2606' with good returns using aerated mud. There was no indication of fluid entries. Drilled 12-1/4" hole from 2606' to 2616'. Hole commenced making approximately 300 bbls of water per hour. Continued drilling 12-1/4" hole from 2616' to 2681' using aerated fluid.
1/27/78	2804'	Drilled 12-1/4" hole from 2681' to 2760'. The producing rate of water from well continued increasing with depth from 300 bbls/hour at 2680', to 750 bbls/hour at 2760'. Due to the lack of freeboard in sump, the hole was drilled from 2760' to 2804' by pumping water through bit, without air, with no returns. P.O.H. and stood back drilling assembly. R.I.H. to an obstruction at 2780' with O.E.D.P. Pumped 7000 bbls of water into the wellbore from the sump.
1/28/78	2804'	Continued pumping sump water into the hole for a total of 9000 bbls. Halliburton mixed and pumped, through O.E.D.P. at 2765', 312 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 0.5% CFR-2, and 3% Gel. Displaced cement with 224 ft^3 of water. Pulled drill pipe to 1472' and waited seven hours for cement to set up. R.I.H. to top of cement at 2754'. Pulled drill pipe to 2731'. Halliburton mixed and pumped 312 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, and 3% Gel. Displaced cement with 223 ft^3 of water. Pulled drill pipe to 1510' and waited for cement to set up. R.I.H. to top of cement at 2543'. P.O.H. and made up drilling assembly. Ran back in the hole to 1500'.
1/29/78	3029'	Continued running in hole to top of cement at 2543', and broke circulation with aerated mud. Cleaned out cement from 2543' to 2804'. Had a water entry at 2650'. Drilled 12-1/4" hole with aerated mud from 2804' to 3029'.
1/30/78	3304'	Drilled 12-1/4"hole from 3029' to 3304'. P.O.H. and stood back drilling assembly. R.I.H. with O.E.D.P. to top of fill at 3201'. Ran drift surveys and maximum reading thermometers as follows: 3192': 5°15',

/30/78 Continued -

282°F at 5 hours static and 288°F at 6 hours static. P.O.H.

1/31/78 3448' Made up 12-1/4" bit and relocated jet subs. R.I.H. and cleaned out fill from 3201' to 3304'. Drilled 12-1/4" hole from 3304' to 3448'. P.O.H. and prepared to run Electric Logs.

2/01/78 3448' Pumped sump water to cool the wellbore while rigging up Schlumberger equipment. Ran DIL-8 from 3443' to 1552'. Ran Neutron-Gamma Ray with Caliper from 3443' to 1552'. Ran Temperature Log from 3443' to the surface. Rigged down Schlumberger equipment. R.I.H. with O.E.D.P. to 3259'. Pumped 600 bbls of water down the wellbore. Ran down hole to 3440'. Halliburton mixed and pumped 187 ft^3 of class "B" cement premixed in a ratio of 1:1 with Perlite, 40% Silica Flour, 3% Gel and 0.5% CFR-2. Displaced cement with 258 ft^3 of water while working pipe up and down. Pipe commenced sticking. Stopped displacing and worked pipe free. P.O.H. to wait for cement to set up. Picked up drilling assembly and R.I.H. to top of cement at 3165'.

2/02/78 3448' Unable to break circulation. P.O.H. and installed jet subs in the drill string. Drilled cement from 3165' to 3360' while circulating with aerated fluid. Continued circulating with aerated system to clean and condition the wellbore for running casing. Rigged up equipment and ran 51 joints (2014.55') of 9-5/8", 40#, K-55 buttress casing. Hung casing inside of 13-3/8" casing with shoe at 3357', baffle collar at 3278', Lyons ECP packer at 2014', HOWCO F.O. cementer at 2004' and Burns 13-3/8" x 9-5/8" single slip liner hanger at 1345'. P.O.H. and laid down liner setting tools. R.I.H. with HOWCO F.O. running tools and stabbed into the baffle collar. Pumped 300 bbls of water to cool the wellbore and prepare for cementing first stage.

2/03/78 3448' Halliburton cemented the first stage, through drill pipe stabbed into the baffle collar at 3278' as follows: preceded cement with 336 ft^3 of water and 112 ft^3 of HY-VIS Gel pill. Mixed and pumped 1250 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel, 0.5% CFR-2 and 0.4% HR-7, followed by 326 ft^3 of class "B" cement premixed with 40% Silica Flour, 0.75% CFR-2 and 0.2% HR-7. Displaced with 294 ft^3 of water. Seated latch-in plug with 1500 psig surface pressure. Pulled the

/03/78 Continued -

F.O. isolation packer up hole to 470'. Attempted to inflate Lyons packer. Isolation packer failed. P.O.H. and replaced cups on isolation packer. R.I.H. and worked packer into the liner. Pressured to 1600 psig to inflate Lyons packer. Experienced a sudden loss of pressure. P.O.H. and replaced damaged packer cups. Ran back in the hole and attempted unsuccessfully to pressure Lyons packer. P.O.H. and found by-pass valve stuck in open position. Repaired valve and ran back in the hole. Packer failed again. P.O.H. and found cups damaged. R.I.H. and set 9-5/8" RTTS at 1918'. Inflated Lyons packer with 1500 psig. Released pressure and opened F.O. cementer.

2/04/78 3448' P.O.H. and laid down RTTS packer. R.I.H. and set HOWCO EZSV Retainer at 1805'. Pumped 500 bbls of sump water through F.O. ports to cool the wellbore. Halliburton mixed and pumped, through F.O. ports at 2004', 750 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 0.5% CFR-2. Displaced with 185 ft^3 of water. Pressure built up during last half of job. Maximum pump pressure was 800 psig. P.O.H. and changed out drill collars while waiting for cement to set up. R.I.H. with 12-1/4" bit and cleaned out cement from 1323' to 1345'. P.O.H. and stood back 12-1/4" drilling assembly. R.I.H. with 8-3/4" drilling assembly and drilled cement stringers from 1345' to 1805'. Successfully tested liner lap to 580 psig surface pressure (1162 psig at the lap) for 25 minutes. The test was witnessed by a U.S.G.S. representative. R.I.H. with 8-3/4" assembly and drilled out EZSV retainer.

2/05/78 3448' Continued drilling EZSV retainer. Cleaned out cement from 1810' to 2007'. Made wiper run to 3065' and P.O.H. Rigged up Schlumberger equipment and ran Temperature Log from 3052' to surface. Maximum temperature at 3052' was 322°F. R.I.H. with 8-3/4" bit and cleaned out cement from 3065' to 3278'. Drilled baffle collar at 3278' and cement to 3312'. P.O.H. Rigged up Schlumberger equipment and ran "Cement Bond Log" from 3310' to 1345' with the following results: poor bond from 3310' to 3130'; poor bond from 3130' to 2990'; fair bond from 2990' to 2700'; good bond from 2700' to 2014'; and excellent bond from 2014' to 1345'.

2/06/78 3629' Rigged down Schlumberger equipment and R.I.H. to 3312' with 8-3/4" drilling assembly. Cleaned out cement to 3448'. Drilled 8-3/4" hole from 3448' to 3495' with full returns, using mud as the circulating medium.

.06/78		Continued - Encountered a 4' void at 3495' and lost full returns. Drilled 8-3/4" hole from 3499' to 3629' while pumping water through the bit, without returns to the surface. Unable to register surface pressure with a pump rate of 960 gallons per minute.
2/07/78	3975'	P.O.H. and placed jet subs 500' and 1000' above the bit. R.I.H. to 3629' and broke circulation with aerated mud. Drilled 8-3/4" hole from 3629' to 3800' with aerated water with returns to the surface. Drilled from 3800' to 3975' by injecting water at a rate of 720 gallons per minute without returns to the surface.
2/08/78	4336'	Broke circulation at 3960' and cleaned fill from 3960' to 3975' after tripping for new bit. Drilled with aerated water from 3975' to 4135'. Drilled 8-3/4" hole from 4135' to 4325' without returns while injecting sump water through bit at a rate of 880 gallons per minute (gpm). Broke circulation with aerated water and continued drilling 8-3/4" hole from 4325' to 4336'.
2/09/78	4690'	Drilled 8-3/4" hole from 4336' to 4415'. Cleaned out fill from 4372' to 4415' after tripping for new bit. Continued drilling 8-3/4" hole from 4415' to 4550' using aerated water as the circulating medium. Due to lack of sump capacity, shut off air and continued drilling 8-3/4" hole from 4550' to 4690' by injecting sump water through the bit without returns.
2/10/78	5023'	Drilled 8-3/4" hole from 4690' to 4789' on sump water. Broke circulation with aerated water and cleaned out fill from 4716' to 4789' after tripping for bit. Drilled 8-3/4" hole from 4789' to 4944' with aerated water; from 4944' to 5018' while pumping sump water through the bit without returns; from 5018' to 5023' using aerated water.
2/11/78	5291'	Drilled 8-3/4" hole from 5023' to 5140' while pumping produced water through the bit without returns and from 5140' to 5216' with aerated water. Drilled 8-3/4" hole from 5216' to 5272' while pumping water through the bit without returns; from 5272' to 5291' with aerated water.
2/12/78	5619'	Drilled 8-3/4" hole from 5291' to 5385' pumping sump water through the bit without returns and from 5385' to 5414' with aerated water. Drilled from 5414' to 5486' pumping sump water through the bit without returns and from 5486' to 5619' using aerated water.

_/13/78	5740'	Spline on compound shaft parted while pulling out of the hole with one engine. Changed bit and R.I.H. to 5619' with no fill. Drilled 8-3/4" hole to 5710' with aerated water. Sump full. Unable to drill while injecting because of inability to use #1 pump due to parted shaft in compound. Pulled bit up hole to 3205' and injected sump water while repairing the compound shaft. After repairing the compound shaft, injected with both pumps for four hours. Ran to bottom without encountering fill and broke circulation with aerated water. Drilled 8-3/4" hole from 5710' to 5740' with aerated water.
2/14/78	6159'	Drilled with aerated water from 5740' to 5815', and from 5815' to 5980' by pumping sump water through the bit without returns. Drilled from 5980' to 6120' with aerated water and from 6120' to 6159' while pumping sump water through the bit without returns.
2/15/78	6329'	Drilled 8-3/4" hole from 6159' to 6168' while pumping sump water without returns. Tripped to change out bit and reposition jet subs. R.I.H. to 6158' and broke circulation. Drilled 8-3/4" hole from 6158' to 6290' with aerated water; from 6290' to 6329' while injecting sump water through bit without returns.
2/16/78	6555'	Drilled 8-3/4" hole from 6329' to 6451' while pumping sump water through the bit without returns. Drilled from 6451' to 6555' with aerated water.
2/17/78	6835'	Drilled from 6555' to 6671' while pumping sump water through bit without returns. Drilled with aerated water from 6671' to 6727' and drilled from 6727' to 6835' while pumping sump water through the bit without returns.
2/18/78	6973'	Tripped for new bit and continued drilling 8-3/4" hole from 6835' to 6875' with aerated water. Pump suction collapsed while attempting to pump sump water. Pulled bit to 3300' and replaced suction on pumps. R.I.H. Pumped sump water through bit without returns while drilling 8-3/4" hole from 6875' to 6947'. Drilled from 6947' to 6973' with aerated water.
2/19/78	7125'	Drilled from 6973' to 7003' with aerated water. Rigged and ran temperature survey at 6970'. Temperature = 326°F. Drilled 8-3/4" hole from 7003' to 7069' while pumping water through the bit without returns; from 7069' to 7125' with aerated water.

/20/78	7386'	Drilled 8-3/4" hole from 7125' to 7167' with aerated water; from 7167' to 7273' while pumping sump water through bit without returns and from 7273' to 7323' with aerated water. P.O.H. and laid down two joints of split drill pipe. R.I.H. to 7323' without encountering fill. Drilled 8-3/4" hole from 7323' to 7386' while pumping sump water through bit without returns.
2/21/78	7512'	Drilled from 7386' to 7512' with aerated water. Commenced pumping sump water through bit. Pressure built to 1700 psig as bit plugged, then decreased to 300 psig. Hole commenced circulating with aerated water. Worked stuck pipe free and P.O.H. checking for washout in drill pipe. Moved jet subs up the hole to 1760' and 2260' respectively and R.I.H. to top of fill at 7312'. Washed fill from 7312' to 7354' with aerated water. Unable to circulate cuttings out of the hole. P.O.H. to check for washed out drill pipe. Laid down one joint of split pipe.
2/22/78	7530'	R.I.H. to 3325' with a slick bottom hole assembly. Jets were placed at a distance of 4000' and 5000' from the bit. Pumped sump water into the hole and R.I.H. to fill at 7316'. Broke circulation with aerated water and cleaned out fill from 7316' to 7485'. Hole was clean from 7485' to 7512'. Drilled 8-3/4" hole from 7512' to 7530' with aerated water. Pulled the bit up hole to 3345'. Hole was tight from 7485' to 7316'. Pumped approximately 12,000 bbls of sump water into the hole.
2/23/78	7542'	P.O.H. to check bit. R.I.H. to an obstruction at 7316'. Washed and reamed from 7316' to 7327' with aerated fresh water. Hole was clean from 7327' to 7530'. Continued drilling 8-3/4" hole with aerated fresh water from 7530' to 7542'. Pipe commenced sticking while running survey at 7482'. Cut survey wire, dropping instrument and worked pipe from 7482' to 7400' before pulling free. P.O.H. No tight hole indicated from 7327' to 7316'. Pumped sump water down hole to cool wellbore for casing inspection log. Rigged and ran Dia-Log 13-3/8" Casing Profile Caliper Log. Tool failed. P.O.H. and pumped water to cool the wellbore. Re-ran 9-5/8" Casing Caliper Log from 3325' to 1345'. Log indicates less than 50% of original wall thickness from 1814' to 1815' and a loss of wall thickness varying from 5% to 21% for remainder of 9-5/8" casing.

24/78 Rigged down Dia-Log equipment. R.I.H. to 3325' with 8-3/4" drilling assembly. Pumped remaining sump water into the hole. R.I.H. to 7414'. Washed and reamed from 7414' to 7542' and drilled from 7542' to 7615' with aerated water. Tripped for bit. R.I.H. to 3320' and injected water from sump into the hole.

2/25/78 7735' R.I.H. to 7495' and broke circulation with aerated water. Washed and reamed from 7495' to 7516' and drilled 8-3/4" hole from 7615' to 7700'. Pulled bit to 6250' and pumped approximately 12,000 bbls of sump water into the hole. R.I.H. to 7625' and broke circulation with aerated water. Washed and reamed to 7700' and drilled 8-3/4" hole from 7700' to 7735'. Pipe stuck while drilling. Worked pipe free after two hours.

2/26/78 7735' Pulled out of the hole and stood back bottom hole assembly. R.I.H. to 3312' unloading water for 30 minutes while rigging up "Go International" logging equipment. Ran "Go International" temperature survey to top of obstruction at 7320'. The recorded temperature from 3440' to 6125' started at 299°F and increased gradually to 339°F at 7320'. Ran Spinner Survey. Fluid level was at 1310'. Tool failed. P.O.H. and waited 12 hours for temperature build-up. Re-ran temperature survey. Survey indicated 340°F at 2500' and 298° to 300°F from 3500' to 6000'. Temperature gradually increased from 300°F at 6000' to 344°F at 7300'.

2/27/78 7735' Waited 9 additional hours for temperature build-up. Ran "Go International" Temperature Log #3 to 7334' and recorded temperatures as follows: 200' = 120°F, 1000' = 218°F, 2500' = 332°F, 3000' = 320°F, 4000' = 295°F, 5000' = 295°F, 6000' = 297°F and 7334' = 341°F. Ran "Go International" Spinner Survey. Survey indicated no fluid movement at 3450'. Fluid was moving down the hole at a rate of 55 gallons per minute at 3515' and at a rate of 73 gallons per minute at 3900'. Tool failed. Pumped water thru kill line at a rate of 522 gallons per minute with no response from Spinner. Ran Temperature Log #4 with the following results: 3300' = 207°F, 6000' = 242°F, 6200' = 327°F, and 7320' = 353°F. P.O.H. and rigged down "Go International" logging equipment. Pulled drill pipe out of the hole and made up 8-3/4" drilling assembly.

2/28/78 R.I.H. to 7375' and broke circulation with aerated water. Washed and rotated through tight hole from 7375' to 7425'. R.I.H. to 7641'. Broke circulation

/28/78 Continued -

with aerated water and washed and reamed from 7641' to 7705'. Circulated to clean the wellbore and pulled up the hole to 7200'. Pumped water from sump into the wellbore. Made wiper run to 7700'. P.O.H. and rigged up Schlumberger equipment. Ran DIL-SP Log from 7682' to 3357'. Maximum temperature reading was 331°F. Ran Gamma Ray-Sonic Log from 7681' to 3357' and Gamma Ray-Neutron Density with Caliper from 7678' to 3357'.

3/01/78 7735' Schlumberger ran Temperature Log from 7550' to surface with a maximum temperature of 337°F at 7550'. Ran Dipmeter from 6000' to 3357'. Rigged down Schlumberger and R.I.H. with 8-3/4" bit to obstruction and tight hole at 7663'. P.O.H. and prepared to run 7" combination blank and slotted liner.

3/02/78 7735' Ran 106 joints (4441.77') of 7", 26#, K-55, LT&C combination blank and slotted (20-2-6-60) casing liner. Hung liner with Halliburton cement guide shoe at 7605', Baker baffle collar at 4049', Lyons ECP packer at 3995', cementing port collar at 3992', and top of Burns 9-5/8" x 7" liner hanger at 3163'. Slotted joints were spaced at various intervals from 7560' to 4200'. Unable to release setting tools after setting liner hanger. Also, liner would not move up hole. With Lyons packer set and cementing ports open, pumped cool water through drill pipe in an attempt to shrink setting nut.

3/03/78 7735' Continued working right-hand torque into setting tools in an attempt to release from liner hanger. Rigged up "Go International" and fired three separate string shots in liner hanger in an attempt to jar tools free. All attempts were unsuccessful. Fired string shot and backed off at top of setting tools. P.O.H. and R.I.H. with bumper sub and six 7" drill collars. Screwed into top of setting tools. Pumped cold water through hanger while bumping down and torquing to the right. Unable to move the setting nut. After ten hours, slips on casing hanger released.

3/04/78 7735' Pulled casing up the hole to replace Burns liner hanger. Burns liner hanger was distorted (necked down below slip area, slip grooves bulged and top of tie-back receptacle rolled inward). Rigged up to lay down 7" liner. Laid down Burns liner hanger, Lyons ECP packer (rubber element missing) and 106 joints of 7", 26#, LT&C blank and slotted casing. Damaged four joints of casing while attempting to break connections. Rigged down casing tools.

/05/78	7735'	Made up 8-3/4" bit on three 7" drill collars. R.I.H. to obstruction at 7653'. Pulled bit to 3345' and broke circulation with aerated water. Circulated for four hours and let well die. R.I.H. to 5480' and regained circulation. Circulated for two hours to cool the wellbore, then let the well die. R.I.H. to 7653' with no additional fill.
3/06/78	7735'	P.O.H. and rigged up to rerun 7" liner. Ran 72 joints of 7", 26#, K-55, LT&C blank casing and 36 joints of 7", 26#, K-55, LT&C perforated casing (4507'). Hung liner with Halliburton cement guide shoe at 7615', Baker baffle plate at 4053', Lynes ECP packer at 3999', cementing collar at 3997' and Midway liner hanger at 3084'. Halliburton mixed and pumped 560 ft^3 of H_2O and 138 ft^3 of gel H_2O followed by 187 ft^3 of class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel, 0.5% CFR-2 and 0.4% HR-7. Followed this with 81 ft^3 of class "B" cement with 40% Silica Flour, Displaced with 49 ft^3 of H_2O. Closed cementing port with 800 psig surface pressure.
3/07/78	7735'	P.O.H. and laid down liner setting and cementing tools. R.I.H. to 2850' with O.E.D.P.. Laid down 5" drill pipe, 15 - 7" drill collars and 6 - 8" drill collars. R.I.H. with 8-3/4" bit to top of 7" liner at 3084'. Attempted unsuccessfully to fill the wellbore with water. P.O.H. and picked up Halliburton 9-5/8" RTTS packer. R.I.H. and set packer at 3034'. Filled annulus with water. Halliburton mixed and pumped through packer, 560 ft^3 of water followed by 187 ft^3 class "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 0.5% CFR-2 followed by 81 ft^3 of class "B" cement with 40% Silica Flour. Displaced cement with 330 ft^3 of water. No pressure build-up.
3/08/78	7735'	P.O.H. and ran back in with packer and unsuccessfully tried to set it. P.O.H. and found rubber packer elements missing. Ran O.E.D.P. to 2100' and pumped water to cool hole.
3/09/78	7735'	Ran and set RTTS packer at 3034'. Filled annulus with water and then pumped 560 ft^3 water through the packer. Pressurized to a surface pressure of 800 psig. Mixed and pumped 244 ft^3 "B" cement premixed with 40% Silica Flour and 0.5% CFR-2. The pressure increased to 850 psig. The packer started leaking at that pressure. The packer was released and P.O.H. The packer rubbers were damaged and had to be changed. Ran and set packer at 2921'. The annulus was filled with water. Halliburton mixed and pumped 560 ft^3 water through the drill pipe. The water was followed by

-/09/78		Continued -
		1000 ft^3 "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel, and 0.5% CFR-2. It was displaced with 336 ft^3 water. Pressure built to 900 psig and then broke back to 400 psig. Released the packer and P.O.H. R.I.H. with 6-1/8" bit to an obstruction in the 7" casing at 3137'. Started circulating with water and cleaned out cement and rubber from 3137' to 3140' with full circulation. P.O.H. Ran and attempted to set a 7" RTTS packer at 3100'. The packer failed and was P.O.H.
3/10/78	7735'	Ran and set a 9-5/8" RTTS packer at 3010'. Pressure tested liner lap to a surface pressure of 400 psig. The hole went on vacuum. The packer was pulled and reset to 2915', and the annulus was filled with water. Halliburton mixed and pumped 280 ft^3 water followed by 675 ft^3 "B" cement premixed in a 1:1 ratio with Perlite, 3% Gel, 40% Silica Flour and 0.5% CFR-2. That was followed by 200 ft^3 of the same mixture plus 2% $CaCl_2$. It was displaced with 319 ft^3 water. Unseated packer and P.O.H. Cleaned out cement with 8-3/4" bit from 2927' to 3084'. P.O.H. and ran in with 6-1/8" bit to 3243'. Pushed packer rubber which was obstructing the hole to 3990'. P.O.H.
3/11/78	7735'	Ran and set a 9-5/8" RTTS packer at 3040'. Tested lap to a surface pressure of 300 psig. Hole went on vacuum. Halliburton mixed and pumped 112 ft^3 gel-water mixture followed by 750 ft^3 "B" cement, premixed in a 1:1 ratio with Perlite, 40% Silica Flour and 3% Gel. Pump pressure built to 500 psig and then broke to 100 psig. The mixture was displaced with 360 ft^3 water. R.I.H. with 8-3/4" bit to top of liner at 3084'. No cement was found on the top of the liner. P.O.H. and ran in with O.E.D.P. to 3080'. Halliburton mixed and pumped 56 ft^3 of high viscosity gel-water mixture followed by 167 ft^3 "B" cement premixed in a 1:1 ratio with Perlite, 40% Silica Flour, 3% Gel and 2% $CaCl_2$. That was displaced with 263 ft^3 water. P.O.H. and ran in to top of cement at 2920' with 8-3/4" bit.
3/12/78	7735'	Drilled out cement from 2920' to liner top at 3084'. No fluid was lost. P.O.H. and ran in with a 6-1/8" bit to 3084'. Attempted to circulate, but the bit plugged. P.O.H. and cleaned bit. R.I.H. and started circulating. Drilled cement from 3084' to 3088'. R.I.H. to 3990'. Drilled plug in port collar from 3990' to 4001' with full returns. R.I.H. to baffle at 4050'. Drilled out baffle and lost returns. P.O.H.
3/13/78	7735'	Ran in with a 6-1/8" bit to 7610' pushing junk from

3/13/78 Continued -

baffle and plugs ahead. P.O.H. Removed the blow out preventers and installed a 12" - 900 x 10" - 600 casing hanger spool, 10" - 600 x 10" - 600 spacer spool, and 10" - 600 WKM master valve. Reinstalled the blow out preventers. Ran 75 joints (3095.15') of 7", 26#, K-55, LT&C casing into the tie-back receptacle at 3084'. Picked up the blow out preventers and installed the casing head slips. The 7" liner was landed with stab-in mandrel, 14" inside the tie-back receptacle, leaving room for 38" of free travel to the bottom of the receptacle. Reinstalled the blow out preventers and R.I.H. with a 6-1/8" bit to 4710'.

3/14/78 7735' P.O.H. laying down drill pipe and tools. Closed the master valve and removed the blow out equipment. Pumped water from sump into well followed by 400 bbls of fresh water. Applied 400 psig air surface pressure to well. Closed well in and released the rig.

Cove Fort Sulphurdale Unit Well 42-7

CASING DETAIL

NO. JTS.	DESCRIPTION	LENGTH	TOP	BOTTOM
1	30" Conductor Pipe	--	--	35.00
	20" CASING			
6	94# H-40 Buttress Casing	--	Surface	251
	13-3/8" CASING			
1	HOWCO Guide Shoe	2.05	1549.95	1552
40	13-3/8" 54.5# K-55 Buttress Casing	1525.70	24.25	1549.95
1	12" 900 x 13-3/8" WKM S.O.W. Casing Head	1.75	22.50	24.25
	Landed Below Zero	22.50	--	22.50
	TOTAL:	1552.00		
	9-5/8" CASING			
1	HOWCO Guide Shoe	1.98	3355.02	3357
2	9-5/8" 36# K-55 Buttress Casing	79.06	3275.96	3355.02
1	HOWCO Baffle Collar	1.74	3274.22	3275.96
32	9-5/8" 36# K-55 Buttress Casing	1259.55	2014.67	3274.22
1	Lynes E.C.P. Packer	9.65	2005.02	2014.67
1	HOWCO F.O. Cementing Tool	4.85	2000.17	2005.02
17	9-5/8" 36# K-55 Buttress Casing	649.38	1350.79	2000.17
1	9-5/8" x 13-3/8" Burns Liner Hanger	5.28	1345.51	1350.70
	Landed Below Zero	1345.51		
	TOTAL:	3357.00		
	7" LINER			
1	7" HOWCO Guide Shoe	1.58	7613.42	7615
86	7" 26# K-55 8RD (Blank and Slotted)	3602.51	4010.91	7613.42
1	7" Lynes E.C.P. Packer	11.60	3999.31	4010.91
1	7" Lynes Cement Collar	2.35	3996.96	3999.31
22	7" 26# K-55 8RD Blank	904.07	3092.89	3996.96
1	7" x 9-5/8" Midway Liner Hanger	8.70	3084.19	3092.89
	Landed Below Zero	3084.19		
	TOTAL:	7615.00		
	7" TIE-BACK			
1	7" 26# K-55 Cut-off	36.04 (14" tie-back)	3049.13	3085.17
74	7" 26# K-55 8RD Blank	3028.63	20.50	3049.13
1	12" 900 - 10" 600 with 7" Slips and Packer - Shaffer Casing Hanger	2.00	18.50	20.50
	R.K.B.	18.50	--	18.50
	TOTAL:	3085.17		

Cove Fort Sulphurdale Unit Well 42-7

CASING DETAIL

7", 26#, K-55, LT and C 8 Rd, Blank and Slotted Liner Detail

Type Liner	Bottom	Top
Blank	7613.42	7576.37
Slotted	7576.37	7532.67
Blank	7532.67	7496.38
Blank	7496.38	7453.16
Blank	7453.16	7413.66
Blank	7413.66	7375.40
Slotted	7375.40	7331.60
Slotted	7331.60	7288.93
Blank	7288.93	7249.65
Slotted	7249.65	7207.35
Blank	7207.35	7167.41
Blank	7167.41	7128.75
Blank	7128.75	7085.60
Blank	7085.60	7047.53
Slotted	7047.53	7005.18
Slotted	7005.18	6962.65
Blank	6962.65	6919.24
Blank	6919.24	6879.00
Slotted	6879.00	6836.82
Slotted	6836.82	6794.14
Blank	6794.14	6759.14
Blank	6759.14	6716.52
Slotted	6716.52	6673.82
Slotted	6673.82	6631.08
Blank	6631.08	6587.38
Blank	6587.38	6550.91
Blank	6550.91	6508.95
Blank	6508.95	6456.27
Blank	6465.27	6422.33
Slotted	6422.33	6379.98
Slotted	6379.98	6338.46
Slotted	6338.46	6296.31
Blank	6296.31	6254.03

Type Liner	Bottom	Top
Blank	6254.03	6210.40
Blank	6210.40	6168.80
Slotted	6168.80	6126.53
Slotted	6126.53	6084.30
Slotted	6084.30	6039.92
Blank	6039.92	5996.47
Slotted	5996.47	5953.12
Slotted	5953.12	5911.36
Slotted	5911.36	5874.40
Slotted	5874.40	5833.54
Blank	5833.54	5790.00
Blank	5790.00	5746.14
Blank	5746.14	5702.76
Blank	5702.76	5660.28
Slotted	5660.28	5618.36
Slotted	5618.36	5575.32
Slotted	5575.32	5533.71
Blank	5533.71	5489.86
Blank	5489.86	5447.44
Blank	5447.44	5404.51
Blank	5404.51	5361.59
Blank	5361.59	5318.62
Slotted	5318.62	5277.59
Slotted	5277.59	5233.09
Slotted	5233.09	5190.96
Slotted	5190.96	5153.71
Slotted	5153.71	5111.78
Blank	5111.78	5067.16
Blank	5067.16	5023.73
Blank	5023.73	4988.53
Slotted	4988.53	4945.97
Slotted	4945.97	4902.54
Slotted	4902.54	4860.32
Blank	4860.32	4818.25
Blank	4818.25	4775.01

Type Liner	Bottom	Top
Blank	4775.01	4732.61
Slotted	4732.61	4691.44
Slotted	4691.44	4648.56
Slotted	4648.56	4605.59
Blank	4605.59	4561.36
Blank	4561.36	4516.78
Blank	4516.78	4472.96
Slotted	4472.96	4432.33
Slotted	4432.33	4397.18
Slotted	4397.18	4353.25
Blank	4353.25	4310.30
Blank	4310.30	4267.72
Blank	4267.72	4226.99
Blank	4226.99	4183.81
Blank	4183.81	4138.97
Blank	4138.97	4095.99
Blank	4095.99	4053.22
Blank	4053.22	4010.91
Lynes Packer	4010.91	3999.31
Cementing Collar	3999.31	3096.96
22 JTS. Blank	3096.96	3092.89
Liner Hanger	3092.89	3084.19

Cove Fort Sulphurdale Unit 42-7

DEVIATION SURVEYS

MEASURED DEPTH	DRIFT ANGLE	TRUE VERTICAL DEPTH	MAXIMUM POSSIBLE COURSE DEVIATION
116'	0°45'	115.99	1.52
143'	0°45'	142.99	1.87
232'	1°0'	231.97	3.42
306'	1°0'	305.96	4.71
420'	2°0'	419.89	8.69
581'	1°15'	580.86	12.20
704'	1°15'	703.83	14.88
865'	1°0'	864.80	17.69
1022'	1°15'	1021.76	21.11
1210'	1°30'	1209.70	26.03
1550'	1°0'	1549.65	31.96
1750'	0°15'	1749.65	32.83
1938'	0°15'	1937.65	33.65
2730'	Not Good		
2776'	3°0'	2774.50	77.51
3192'	5°15'	3188.75	115.57
3525'	5°30'	3520.22	147.49
3930'	Not Good		
4374'	5°15'	4365.66	225.17
5156'	5°30'	5144.06	300.12
5570'	5°0'	5556.48	336.20
6440'	4°30'	6423.80	404.46
7482'	Not Good		
7250'	4°45'	7231.02	471.53
7735'	4°45' **	7714.35	511.69

** No survey was taken at total depth of 7735' so the previous drift angle of 4°45' was used to extrapolate to total depth.

FISHING

Fishing Job #1

Well Depth: 746'

Date : 12/8 to 12/9/77

Cause : Parted pin on stabilizer

Results : Fish was recovered with overshot

DETAILS OF OPERATION

While drilling a 17-1/2" hole through Andesite, pump pressure was lost. When pulling out of the hole, the pin on the bottom stabilizer parted, leaving a bit, 3 point reamer and one 9" drill collar in the hole.

The top of the fish was located at 715'. An 11-3/4" Bowen overshot with an 8" grapple was run in the hole and the fish was recovered immediately.

Fishing Job #2

Well Depth: 1452'

Date : 12/15/77

Cause : Pin on stabilizer twisted off

Results : Fish was recovered with overshot

DETAILS OF OPERATION

While drilling a 17-1/2" hole through Andesite the pin on the top stabilizer twisted off. A bit, 3 point reamer, stabilizer, shock sub, and three 8" drill collars were left in the hole. An overshot was run in the hole and the fish was recovered without problems.


Report #4
Original
COVE FORT - SULPHURDALE WELL # 42-7
DAYS / DEPTH
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
1000
2000
3000
4000
5000
6000
7000
8000
26" HOLE
36" HOLE
to 50'
17 1/2" HOLE
RAN & CMT'D 20"
CASING TO 251'
12 1/4" HOLE
RAN & CMT'D 13 3/8"
CASING at 1552'
RAN 9 5/8" LINER FROM 1345 to 3357'
8 3/4" HOLE
LOSS CIRCULATION ENCOUNTERED AT 1559' AND REMAINED TO T. D.
A TOTAL OF 35 LOSS CIRCULATION PLUGS (6,880 FT.3 CMT).
AERATED MUD WAS FOUND TO BE THE BEST METHOD TO DRILL THE
WELL TO T.D.
RAN 7" LINER FROM 3084 to 7615'
RAN 7" TIE BACK FROM
3084 to SURFACE
TOOK A TOTAL OF SIX (6)
SQUEEZES (3,304 FT.3 CMT)
TO GET A PROPER LINER-LAP
CEMENTATION
RELEASED RIG
20:00 HRS
3/14/78

COVE FORT-SULPHURDALE #42-7

SCHLUMBERGER LOGGING DATA

DATE	TYPE OF LOG RUN	LOGGED INTERVAL	TOTAL DEPTH
1 Feb. 78	Dual Induction-Laterolog with linear correlating log; SP	1520' - 3444'	3447'
1 Feb. 78	Compensated Neutron Log; GR	50' - 3428'	3445'
1 Feb. 78	Temperature Log	1320' - 3447'	3447'
4 Feb. 78	Cement Bond Log	162' - 3314'	3323'
4 Feb. 78	Temperature Log	0' - 3058'	3065'
28 Feb. 78	Dual Induction-Laterolog with linear correlation log; SP	3358' - 7692'	7695'
28 Feb. 78	Borehole Compensated Sonic Log; GR	3358' - 7674'	7681'
28 Feb. 78	Compensated Neutron-Formation Density with GR, Caliper	3358' - 7679'	7680'
28 Feb. 78	Temperature Log	300' - 7550'	7680'
1 Mar. 78	Four-arm continuous Dipmeter	3358' - 6003'	6004'

"GO-INTERNATIONAL" LOGGING DATA

DATE	TYPE OF LOG RUN	LOGGED INTERVAL	TOTAL DEPTH
26 Feb. 78	Temperature Log	3450' - 7327'	7332'
26 Feb. 78	Temperature Log	300' - 7327'	7332'
27 Feb. 78	Temperature Log	300' - 7327'	7332'
27 Feb. 78	Temperature Log	1200' - 7320'	7332'

BIT RECORD PM-683

SECURITY OPERATIONS
OILFIELD PRODUCTS DIVISION Dresser Industries, Inc.
P. O. BOX 6504 HOUSTON, TEXAS 77005 (713) 781-5900

FILE NO. 2-470023

SALESMAN: ______ Page ____ of ____

CONTRACTOR Lottland BRO RIG NO. 184
COMPANY Union Oil Co. of Cal. FIELD Cove Fort
LEASE So. P. 4 WELL NO. 42-7
STATE UTAH COUNTY Beaver
SEC./T'SHIP/RANGE ______

RIG MAKE Unit
RIG SIZE 728
PUMP NO. 1 D-1000
PUMP NO. 2 750
MUD TYPE ______

COLLARS: OD X ID X LENGTH
___ x ___ x ___
___ x ___ x ___
DRILL PIPE 5" O.D.
TOOL JOINT 4½ IF

MO. / DAY / YR.
SPUD / /
UNDER SURFACE / /
UNDER INTER. / /
TOTAL DEPTH / /

T.P.-DRILLERS
WATER SOURCE ______
FUEL SOURCE ______

RUN NO.	SIZE	MAKE	TYPE	SERIAL NO.	JETS - 32nds Reg. R or RO 1	2	3	DEPTH OUT	FEET	HOURS	FEET PER HOUR	CUM. HOURS	WT. 1000 LBS.	R.P.M.	PUMP PRESS	PUMP NO. 1 Liner	PUMP NO. 1 SPM	PUMP NO. 2 Liner	PUMP NO. 2 SPM	MUD PROPERTIES Wt.	W.L.	F.V.	P.V.	Y.P.	Ver. Dev.	Dull. Cond. T	B	G	RG	Date
1	12¼	Sec	S42J	768956	15	15	15	Drilled Mouse + Rat Hole																		2	1	I		
2	17½	Reed	Y-13J	625936	14	14	14	133	78	11½	6.8		20	40/50	1500	6½	60			8.8	20	53	30	40		3	3	I		
3	17½	Reed	Y31J	315305	13	13	13	255	122	12	10.2		5/30	50	1500	6½	60			9.2	22	43	20	35		3	2	I		
HO#1	26"	Sec	H.O.	68674	20	20	20	255	200	37½	7.3		5/20	32	250	6½	38			9.2	22	43	20	35		3	2	I		
RR 3	17½	Reed	Y13J	315305	13	13	13	288	33	10	3.3		20	25	600	6½	54			8.8	15	41	10	20		4	4	I		
4	17½	STC	4JS	BB439	16	16	16	892	604	104	5.8		20	30	1000	6½	65			8.8	14	43	23	6		4	2	I		
5	17½	Sec	S-84	711851	16	16	16	1257	365	48	7.6		25	50	1200	6½	65			8.9	9	45	25	12		3	2	I		
4RR	17½	STC	4JS	BB439	16	16	16	1452	195	40¼	4.8		30	45	1200	6½	65			9.2	15	43	22	20		4	2	I		
5RR	17½	Sec	S-84	711851	16	16	16	1494	42	10.5	4		30	35	1100	6½	65			8.8	14	40	25	15		3	2	I		
5RR	17½	Sec	S-84	711851	16	16	16	1557	63	26¾	2.36		30	50	950	6½	65			8.6	8	41	14	3		3	4	I		
1RR	12¼	Sec.	S42J	768956	15	15	15	1559	2	1	2		20	50	950	6½	65			8.6	8	41	14	3		8	8	I		
6	12¼	Reed	S21J	403908	15	15	15	1613	54	3½	15.4		35	50	1000			5¾	64	8.5	13	42	12	3		3	2	I		
7	12¼	HTC	J-33	257-YL	15	15	15	2400	187	56¼	14		35	60	350	6½	40			64		28				5	6	3/8		
8	12¼	STC	3JS	129-LP	—	—	—	2606	206	25¼	8		10	35	1100	6½	45													
9	12¼	STC	7JA	984-JZ	—	—	—	2804	198	18½	11		30	60	400	6½	60			62		29				3	7	1/4		
10	12¼	SEC	H7SG	763636	—	—	—	2804	used to clean out cement																					
11	12¼	STC	7JA	688-RJ	—	—	—	3304	500	25¾	19		30	65	320	6½	32			62		38				3	5	I		
12	12¼	Reed	S62J	333653	—	—	—	3448	144	7½	19		30	60	800	6½	64			62		29				3	4	I		
13	8¾	STC	T2H	133FT.	* Damaged when made up.																									
14.	8¾	HTC	HH44	HJ217	16	16	16	Clean out Cement.																						
15	8¾	Reed	Y-13T	163052	16	16	16	3453	5	½	10		20	60	100	6½	64			65		42				4	6	1/8		
14RR	8¾	HTC.	HH44	HJ217	16	16	16	3629	176	9¼	19		20	62	100	6½	64			65		42				3	7	1/8		

*DENOTE BY (N)—NO, (L)—LIGHT, (M)—MEDIUM OR (H)—HEAVY ROUNDING OF GAGE

BIT RECORD PM-683

SECURITY OPERATIONS
OILFIELD PRODUCTS DIVISION **Dresser Industries, Inc.**
P. O. BOX 6504 HOUSTON, TEXAS 77005 (713) 781-5900

FILE NO. 2-47cc27

SALESMAN: ____ Page ____ of ____

CONTRACTOR Loffland Bro. RIG NO. 184	RIG MAKE Unit.	COLLARS: OD X ID X LENGTH	MO. / DAY / YR.
COMPANY Union Oil Co. of Cal. FIELD Cove Fort	RIG SIZE 728	__ x __ x __	SPUD / /
LEASE S. D. U. WELL NO. 42-7	PUMP NO. 1 D1000	__ x __ x __	UNDER SURFACE / /
STATE Utah COUNTY Beaver	PUMP NO. 2 750	DRILL PIPE 5" 0d	UNDER INTER. / /
SEC./ T'SHIP/RANGE	MUD TYPE	TOOL JOINT 4½ IF.	TOTAL DEPTH / /

T.P.-DRILLERS ____
WATER SOURCE ____
FUEL SOURCE ____

RUN NO.	SIZE	MAKE	TYPE	SERIAL NO.	JETS - 32nds Reg. R or RO 1	2	3	DEPTH OUT	FEET	HOURS	FEET PER HOUR	CUM. HOURS	WT. 1000 LBS.	R.P.M.	PUMP PRESS	PUMP NO. 1 Liner	PUMP NO. 1 SPM	PUMP NO. 2 Liner	PUMP NO. 2 SPM	MUD PROPERTIES Wt.	W.L.	F.V.	P.V.	Y.P.	Ver. Dev.	Dull Cond. T	B	G	RG		Date
16	8¾	Reed	FP12J	4:1432	—	—		3975	346	17½			25	45/45		Aircated water										3	4	I			
17	8¾	HTC	HH44	HJ.222	—	—		4414	429	24½			25	60												3	6	¼			
18	8¾	Smith	F5	837 MJ.				4789	375	15½			25	60												5	5	I			
19	8¾	Sec.	M84F	753240				5216	427	23¼			25	60												3	6	⅛			
20	8¾	Smith	F5	721NE.				5619	403	24¾			25	60												2	4	I			
21	8¾	Reed	FP52	625516				6168	549	29¼			25	50												5	6	I			
22	8¾	Smith	F57	654NF.				6489	321	21½			25	55												5	7	⅛		No other bits	
23	8¾	Smith	F5	772MJ.				6835	346	24½			25	60												3	6	I		to Run.	
24	8¾	Smith	F5	972LL				7003	168	18¼			25	55												6	7	I			
25	8¾	Smith	F6	416KE				7323	320	22			25	45												3	6	I			
26	8¾	Sec.	M89TF	639556				7512	189	9¾			25	50												2	3	I			
27	8¾	Sec	M89TF	690384				7615	103	11½			25	45												5	6	I			
28	8¾	Smith	F6	797LZ				7735	120	8			25	50		Aireated water										3	5	I			

*DENOTE BY (N)–NO, (L)–LIGHT, (M)–MEDIUM OR (H)–HEAVY ROUNDING OF GAGE

CEMENTING

LOST CIRCULATION PLUGS

During drilling operations at the Cove Fort-Sulphurdale Unit Well 42-7, drilling fluids were intermittently lost to the formation while drilling through fractures and/or void spaces. Attempts were made to seal off these voids and fractures while drilling from the surface to a depth of 3448' in order to effectively cement casing strings and to circulate formation cuttings to the surface. The slurries used to fill these voids and fractures are described below.

Lost circulation first occurred after drilling 17-1/2" hole to 1494'. O.E.D.P. was hung at 1457' and 198 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour, 3% Gel, 0.5% CFR-2 and 0.3% HR-7 was pumped through it (plug #1). The wellbore was filled with 300 barrels of mud. The top of the cement plug was located at 1445' which was 77' below the theoretical fill. This indicated a loss of 82 ft^3 of cement to the formation.

The fluid was squeezed into the formation with a surface pressure of 100 psig. O.E.D.P. was hung at 1353' and 200 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour, 3% Gel, 0.5% CFR-2 and 0.3% HR-7 was pumped into the hole (plug #2). The wellbore was filled with 75 barrels of mud and a surface pressure of 100 psig was applied with no fluid loss. The top of the cement was located at 1335'. This was ten feet below the theoretical fill indicating a small loss of cement to the formation.

A 12-1/4" hole was drilled to 2244' before again losing circulation. O.E.D.P. was hung at 2202' and 250 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel was pumped into the hole (plug #3). The top of the cement was found at 2119' which was 180' below the theoretical fill. This indicated a loss of 147 ft^3 of cement to the formation.

The wellbore was filled with 300 barrels of mud and O.E.D.P. was hung at 2046'. One hundred and twenty cubic feet of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel was pumped into the hole (plug #4). Found top of plug #4 at 2119', same as top of plug #3, indicating a total loss of plug #4 to the formation.

Left O.E.D.P. at 2046' and pumped 250 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel (plug #5). Found top of cement at 2084', 270' below theoretical fill. This indicated a loss of approximately 220 ft^3 of cement to the formation.

Filled the wellbore with 250 barrels of mud. Pumped 150 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel through O.E.D.P. hung at 2060' (plug #6). Found top of firm cement at 1990', 90' below theoretical fill, indicating a loss of approximately 75 ft^3 of cement to the formation.

Cleaned out cement to 2214' and lost full returns. Pumped 396 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel through O.E.D.P. hung at 2172' (plug #7). Filled the wellbore with mud and squeezed away fluid with 200 psig surface pressure. Found top of cement at 1940', 210' below theoretical fill. Approximately 170 ft^3 of cement was lost to the formation.

Cleaned out cement to 2244' and lost returns. Continued drilling 12-1/4" hole to 2250'. Hung O.E.D.P. at 2205' and pumped 142 ft^3 of "Thix-Set" cement with 13% Gilsonite and 1/2# Flocele per sack of cement (plug #8). Unable to fill the wellbore with 450 barrels of mud. Located top of cement at 2222' and cleaned out to 2230'. Top of cement was 145' below theoretical fill which indicates a loss of approximately 120 ft^3 of cement to the formation.

Hung O.E.D.P. at 1829' and pumped 142 ft^3 of cement premixed with 13% Gilsonite and 1/2# Flocele per sack of cement (plug #9). Unable to fill the wellbore with 200 barrels of mud. Found top of cement at 2230' indicating a 100% loss of plug #9 to the formation.

Hung O.E.D.P. at 1860' and pumped 240 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel (plug #10). Again, located top of cement at 2230' indicating a 100% loss of plug #10 to the formation.

Hung O.E.D.P. at 2209' and pumped 120 ft^3 of class "B" cement premixed 1:1 with Perlite and 3% Gel (plug #11). Found top of cement at 2230' indicating plug #11 was 100% lost to the formation.

Hung O.E.D.P. at 2169' and pumped 193 ft^3 of class "B" cement premixed 2:1 with Perlite, 40% Silica Flour and 3% Gel (plug #12). Ran in the hole to top of cement at 2230', indicating that 100% of plug #12 was lost to the formation.

Hung O.E.D.P. at 2170' and pumped 180 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel (plug #13).

Located top of cement at 1953', 60' above theoretical fill. This indicates a bridge, fill, or backflow of approximately 50 ft^3 of cement into the wellbore. Filled the wellbore with 325 barrels of mud and lost returns after circulating for two hours.

Hung O.E.D.P. at 1946' and pumped 100 ft^3 of "Thix-Set" cement premixed with 19% Gilsonite, 0.5% Flocele and 0.1% Tuff-Plug (plug #14). Filled the wellbore with 75 barrels of mud and found top of firm cement at 1861'. This was 30' below theoretical fill, indicating a loss of 25 ft^3 of cement to the formation.

Cleaned out cement to 2250' and drilled 12-1/4" hole to 2342'. Drilled without returns from 2275' to 2342'.

Hung O.E.D.P. at 2201' and pumped 112 ft^3 H_2O, 112 ft^3 of 6% $CaCl_2$ water with 400# of plaster sand, 28 ft^3 H_2O and 128 ft3 $NaSi_2$ mixed 1:1 with H_2O followed by 223 ft^3 of "Thix-Set" cement premixed with 25# Gilsonite, 1-1/4# Flocele and 1/8# Tuff-Fiber per sack of cement (plug #15). Found top of cement at 2242', 172 ft^3 below theoretical fill, indicating a loss of approximately 140 ft^3 of cement to the formation. Unable to fill the wellbore with 400 barrels of mud.

Hung O.E.D.P. at 2232' and pumped 112 ft^3 gel water with WG-11, CL-11 with 1680# of Unibeads, 400# Gilsonite, and 420# TLC-80 followed by 59 ft^3 of class "B" cement with 2% $CaCl_2$ and 100# Flocele (plug #16). Found top of cement at 2242', indicating that all of plug #16 was lost to the formation.

Left O.E.D.P. at 2232' and pumped 112 ft^3 of gel water with WG-11, CL-11 with 1680# Unibeads, 420# Gilsonite and 420# TLC-80 followed by 118 ft^3 of class "B" cement premixed with 2% $CaCl_2$ and 200# Flocele (plug #17). Found top of cement at 2139', 40' below theoretical fill, indicating that approximately 30 ft^3 of cement was lost to the formation. Filled the wellbore with 310 barrels of mud.

Cleaned out cement to 2244'. Hung O.E.D.P. at 2201' and pumped 56 ft^3 Frac Gel with WG-11, CL-11, 840# Unibeads, 210# Gilsonite, and 210# TLC-80 followed by 210 ft^3 of class "B" cement with 2% $CaCl_2$ and 75# Flocele (plug #18). Filled the wellbore with 170 barrels of mud. Found top of cement at 2184', 200' below theoretical fill, indicating a loss of approximately 165 ft^3 of cement to the formation.

Cleaned out cement to 2244'. Hung O.E.D.P. at 2232' and pumped 56 ft^3 Frac Gel with 25# WG-11 and 7# CL-11, 112 ft^3 of 3% $CaCl_2$ water, 56 ft^3 water, 258 ft^3 $NaSi_2$ mixed 1:1 with water, 56 ft^3 water and 136 ft^3 of class "B" cement premixed with 2% $CaCl_2$ and 1/2# Flocele per sack (plug #19). Ran in the hole to 2239' with no trace of plug #19.

Hung O.E.D.P. at 2239' and pumped 112 ft^3 of Frac-Gel with 500# Gilsonite, 500# Unibeads, 350# mothballs, 50# WG-11 and 15# CL-11 followed by 136 ft^3 of class "B" cement with 2% $CaCl_2$ and 1/2# of Flocele per sack of cement (plug #20). Ran in the hole to 2240' with no trace of plug #20.

Hung O.E.D.P. at 2232' and pumped 112 ft^3 of 3% $CaCl_2$ water, 56 ft^3 water and 134 ft^3 $NaSi_2$ followed by 98 ft^3 of class "B" cement with 2% $CaCl_2$, 6% Gilsonite and 1/2# of Flocele per sack of cement (plug #21). Found top of cement at 2187', approximately 60' below theoretical fill. This indicates a loss of approximately 50 ft^3 of cement to the formation.

Cleaned out cement to 2280' and hung O.E.D.P. at 2263'. Pumped 112 ft^3 of water, 112 ft^3 of $CaCl_2$ water, 67 ft^3 of water and 67 ft^3 $NaSi_2$. Pulled pipe to 2232' and pumped 88 ft^3 of class "B" cement premixed with 2% $CaCl_2$, 12% Gilsonite and 1/2# of Flocele per sack of cement (plug #22). Found top of plug #22 at 2240', approximately 70' below theoretical fill, indicating a loss of 60 ft^3 of cement to the formation. Unable to fill the wellbore with water.

Hung O.E.D.P. at 2233' and pumped 88 ft^3 of class "B" cement premixed with 2% $CaCl_2$, 8# Gilsonite and 1/2# Flocele per sack of cement (plug #23). Found top of cement at 2240' indicating that all of plug #23 was lost to the formation.

Hung O.E.D.P. at 2232' and pumped 112 ft^3 of Frac-Gel with 500# Unibeads, 150# Flocele, 150# Gilsonite, 150# mothballs, 75# WG-11 and 15# CL-11 followed by 161 ft^3 of class "B" cement premixed 2:1 with Perlite, 40% Silica Flour and 3% Gel, followed by 98 ft^3 of class "B" cement with 2% $CaCl_2$, 1/2# Flocele and 8# Gilsonite per sack of cement (plug #24). Found top of cement at 2240' indicating that all of plug #24 was lost to the formation.

With O.E.D.P. hung at 2232', pumped 112 ft^3 of water, 112 ft^3 of 3% $CaCl_2$ water, 28 ft^3 water and 67 ft^3 $NaSi_2$. Pulled drill pipe to 2201' and pumped 161 ft^3 of class "B" cement premixed 2:1 with Perlite, 40% Silica Flour, 3% Gel and 3% $CaCl_2$ (plug #25). Found top of cement at 2215', 170' below theoretical fill. This indicates a loss of approximately 140 ft^3 of cement to the formation. Unable to fill the wellbore with 300 barrels of mud.

Hung O.E.D.P. at 2201' and pumped 112 ft^3 of Frac-Gel with 75# Flocele, 100# Unibeads, and 300# LCM followed by 353 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour, 3% Gel and 3% $CaCl_2$ (plug #26). Filled the wellbore with 30 barrels of water. Located top of hard cement at 1842', 60' below theoretical fill. This shows a loss of approximately 50 ft^3 of cement to the formation.

Cleaned out cement to 2342' and continued drilling 12-1/4" hole to 2606'with intermittent returns.

Hung O.E.D.P. at 2575' and pumped 174 ft^3 of "Thix-Set" cement with 2% $CaCl_2$ and 10# of Gilsonite per sack of cement (plug #27). Found top of cement at 2468', 75' below theoretical fill. Sixty cubic feet of cement was lost to the formation.

Hung O.E.D.P. at 2448' and pumped 175 ft^3 of "Thix-Set" cement premixed with 2% $CaCl_2$ and 10# Gilsonite per sack of cement (plug #28). Located top of cement at 2449', 195' below theoretical fill. Lost 160 ft^3 of plug #28 to the formation.

Pumped 247 ft^3 of class "B" cement premixed 2:1 with Perlite, 5% Gel and 2% $CaCl_2$ through O.E.D.P. at 2418' (plug #29). Located top of cement at 2248', 100' below theoretical fill. Eighty cubic feet of plug #29 was lost to the formation.

Pumped 367 ft^3 of class "B" cement premixed 2:1 with Perlite, 5% Gel and 2% $CaCl_2$ (plug #30). Located top of firm cement at 2089', 290' below theoretical fill, indicating a loss of approximately 240 ft^3 of cement to the formation. Unable to fill the wellbore.

Cleaned out cement to 2165' and hung O.E.D.P. at 2139'. Mixed and pumped 215 ft^3 of class "B" cement premixed 1:1 with Perlite, 4% Gel and 2% $CaCl_2$ (plug #31). Located top of cement at 2077', 175' below theoretical fill. Approximately 145 ft^3 of plug #31 was lost to the formation.

Hung O.E.D.P. at 2046' and pumped 250 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel (plug #32). Unable to fill the wellbore with 500 barrels of water. Ran in the hole and located top of cement at 1885', 115' below theoretical fill. Approximately 95 ft^3 of cement was lost to the formation.

Hung O.E.D.P. at 1860' and pumped 250 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel (plug #33). Found top of cement at 1697', approximately 120' below theoretical fill. One hundred cubic feet of plug #33 was lost to the formation.

Hung O.E.D.P. at 1675' and pumped 250 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel (plug #33).

Found top of cement at 1697', approximately 120' below theoretical fill. One hundred cubic feet of plug #33 was lost to the formation.

Hung O.E.D.P. at 1675' and pumped 250 ft^3 of class "B" cement premixed 1:1 with Perlite with 40% Silica Flour, 3% Gel and 2% $CaCl_2$ (plug #34). Filled the wellbore with 125 barrels of water. Found top of cement at 1553', 160' below theoretical fill, indicating a loss of 130 ft^3 of cement to the formation.

Squeezed away 168 ft^3 of fluid at a surface pressure of 250 psig. Hung O.E.D.P. at 1490' and pumped 250 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel (plug #35).

Squeezed away 14 ft^3 of cement at 900 psig surface pressure. Ran in the hole and located top of cement at 1368' indicating a total loss of approximately 100 ft^3 of cement to the formation.

Cleaned out cement to 2606' with good returns and drilled 12-1/4" hole from 2606' to 2804' using aerated fluid and pumping water without returns. Hung O.E.D.P. at 2765' and pumped 312 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour, 0.5% CFR-2 and 3% Gel (plug #36). Located top of cement at 2754', indicating a loss of 270 ft^3 of cement to the formation.

Hung O.E.D.P. at 2731' and pumped 312 ft^3 of class "B" cement premixed 1:1 with Perlite, 40% Silica Flour and 3% Gel (plug #37). Located top of plug #37 at 2543', 170' below theoretical fill. Approximately 140 ft^3 of cement was lost to the formation.

Cleaned out cement and drilled 12-1/4" hole to 3448'. Ran and cemented 9-5/8" casing with shoe at 3357'. Continued drilling 8-3/4" hole to total depth with aerated fluid and by injecting water without returns.

COVE FORT SULPHURDALE UNIT WELL 42-7

CASING CEMENTATION

SUMMARY

In the following section, a general description of the cement slurries used for casing is given. A detailed description with volumes used, well depth, and casing depth can be found in the enclosed cement detail.

The 20" casing was landed in 26" hole at 251' with a hole depth at 255'. The cement slurry was composed of 649 ft^3 of class "B" cement with 2% $CaCl_2$ as an accelerator. It was displaced with 464 ft^3 of water, displacing 175 ft^3 of excess cement to the surface.

The 13-3/8" casing was cemented in one stage with a retarded, light weight slurry, followed by a more dense, unretarded slurry, for placement at the casing shoe. The casing shoe was set at 1552' with the baffle at 1513'. The light slurry was run ahead of the heavy slurry in an effort to reduce the hydrostatic head and thereby the pressure exerted on the weaker formations. It consisted of class "B" cement with 40% Silica Flour mixed in a one to one ratio with Perlite and 3% Gel. The Perlite and Gel are both additives to reduce the specific gravity of the slurry. The slurry was retarded to a desired temperature to allow sufficient placement time.

The more dense slurry was class "B" cement with 40% Silica Flour. Its application was primarily to provide a well cemented shoe with hard set cement of high compressive strength. Both slurries were displaced with water and good fluid returns were obtained at the surface.

The 9-5/8" casing was set with the shoe at 3357', the baffle at 3278', a Lynes ECP packer at 2014' with a Halliburton F.O. cementer at 2004', and a Burns hanger at 1345'. A two stage cementation process was applied because of the height of the cement column and the resulting high pressures that would occur in a one stage process. The first stage consisted of a light weight slurry followed by a heavier slurry. Again the light slurry was run first to reduce the hydrostatic head to reduce break down of the weaker formations. It consisted of class "B" cement with 40% Silica Flour mixed in a one to one ratio with Perlite and 3% Gel. As in cementing the 13-3/8" casing, it was retarded so that it would allow sufficient pumping time due to the elevated hole temperatures. The light weight slurry was followed by the more dense slurry of class "B" cement with 40% Silica Flour to place extremely dense cement around the shoe.

There was difficulty in inflating the Lynes packer, but it was inflated with 1500 psi surface pressure. An unretarded light weight slurry consisting of class "B" cement with 40% Silica Flour, mixed in a one to one ratio with Perlite and 3% Gel, was pumped through the F.O. ports at 2004'. The cement was allowed to set and the liner lap was tested to a gradient of 0.86 psi/ft and held for 22 minutes without a loss of pressure indicating a satisfactory liner lap test.

Prior to completion of CFSU 42-7, a cold water entry immediately below the 9-5/8" casing shoe was indicated from temperature surveys. It was necessary, then, to seal off the cold water entry from the hot production water. A 7" combination perforated and blank liner was run after drilling the well to total depth. The liner was landed with the shoe at 7615', a baffle plate at 4053', a Lynes E.C. packer at 3999', a cement collar at 3997' and the liner hanger at 3084'. The blank section of the liner was positioned on top of the perforated section, across from the cold water entry, making it possible to pump cement into the annulus around the blank portion of the liner and thereby eliminating the possibility of communication between hot and cold waters.

In order to perform this operation, the Lynes E.C. inflatable packer was installed between the blank and slotted liners with two B & W metal expanding cement baskets installed just below the packer. Both the baskets and packer were used to seal the annulus below the blank liner to prevent the cement slurry from falling down the annulus and plugging the perforated liner slots. The drillable baffle seal plate was placed inside the 7" casing below the packer to keep the cement slurry from going down the inside of the liner. A hydraulically activated cement port collar was placed above the Lynes E.C. packer.

Pressure, built up in the pipe from cement pumped down the liner against the baffle plate, inflated the Lynes packer against the hole wall. Application of additional pressure from the cement pumps opened the ports in the cement collar allowing cement to flow into the annulus and up past the water entry and liner lap.

It was found that insufficient cement was pumped in the first stage to seal off the weak zone. It was necessary to squeeze cement downward around the 7" casing liner hanger into that zone. In all, six squeeze jobs were necessary. The squeeze jobs were performed by setting a Halliburton RTTS packer in the 9-5/8" casing and pumping cement below it. A total of 3572 ft^3 cement was required to seal the water entry and liner lap.

The first stage of the cement job consisted of class "B" cement with 40% Silica Flour mixed in a one to one ratio with Perlite followed by a heavier slurry of "B" cement with 40% Silica Flour. Again the heavier slurry was applied for competency. The cement ports were closed with 800 psi and preparations were made to squeeze the liner lap. The exact mixture and volume of each slurry can be found in the cement detail. In general, the various slurries were squeezed around the casing and liner hanger in an attempt to place good cement from the Lynes packer at 3999' to the liner hanger at 3084'. All of the slurries applied contained class "B" cement mixed with 40% Silica Flour. Most of the slurries also contained Perlite, for it was felt that a lighter slurry would not be lost to the formation as easily. However, more dense slurry in the first squeeze job and the entire slurry in the second squeeze job were mixed without Perlite. The lap was tested twice without success. After the sixth squeeze job was completed, the cement, cement collar, and baffle plate were drilled out, establishing a competent cement bond from the liner top of the 7" liner to the Lynes packer and exposure of uncemented perforated liner from the shoe at 7615' to the Lynes packer at 3999'.

COVE FORT SULPHURDALE UNIT WELL 42-7

CONCLUSION: LOST CIRCULATION CEMENTING, CASING CEMENTING

The basic reasons behind placement of the many cement plugs to eliminate loss of fluid in both the 17-1/2" and 12-1/4" wellbore was primarily to allow the placement of a competent column of cement around the 13-3/8" casing string and 9-5/8" liner, casing string.

The cement slurry, in a fluid state, weighing in excess of the mud employed to drill the hole, would have readily escaped to the weak formations and/or voids, never reaching the surface in the case of the 13-3/8" string, or the liner top in the case of the 9-5/8" string.

In order to establish a competent column of cement surrounding a desired casing string, any loss of circulation to the formation must be reduced to a minimal amount. In the case of CFSU 42-7, all of the losses could be considered severe deterring proper cementing practices until the losses were corrected by cementing and proper slurry design.

It should be understood that cementing was the single most costly service in drilling Cove Fort Sulphurdale 42-7. Huge amounts of cement were used for both loss circulation plugs and casing. Loss circulation plugs alone required 7412 ft^3 with casing requiring an additional 8950 ft^3. The total amount of cement used was 16,362 ft^3.

CEMENT DETAIL FOR LOST CIRCULATION PLUGS

DATE	WELL DEPTH	OEDP DEPTH	HOLE DIA.	PLUG	SLURRY VOLUME	PLUG COMPOSITION	RESULTS
12/16/77	1494	1457	17 1/2"	1	198 ft^3	Class "B" cement, perlite 1-1, 40% Silica flour, 3% gel, 0.5% CFR-2 and 0.3% HR-7.	Filled the wellbore with 300 barrels. Found top of cement at 1445'. Squeezed fluid into the formation with 100 psig surface pressure.
12/16/77	1494	1353	17 1/2"	2	200 ft^3	Class "B" cement, perlite 1-1, 40% Silica flour, 3% gel, 0.5% CFR-2 and 0.3% HR-7.	Filled the wellbore with 75 barrels of mud. Pressured wellbore to 100 psig surface pressure with no fluid loss. Found top of cement at 1335'.
12/26/77	2244	2202	12 1/4"	3	250 ft^3	Class "B" cement, perlite 1-1, 40% Silica flour and 3% gel.	Found top of cement at 2119'. Unable to fill wellbore with 300 barrels of mud.
12/27/77	2244	2046	12 1/4"	4	120 ft^3	Class "B" cement, perlite 1-1, 40% Silica flour and 3% gel.	Found top of cement at 2119', same as plug #3. Apparently plug #4 was completely lost to formation.
12/27/77	2244	2046	12 1/4"	5	250 ft^3	Class "B" cement, perlite 1-1, 40% Silica flour, and 3% gel.	Found top of cement at 2084'. Unable to fill the wellbore with 250 barrels of mud.
12/27/77	2244	2060	12 1/4"	6	150 ft^3	Class "B" cement, perlite 1-1, 40% Silica flour, and 3% gel.	Found top of firm cement at 1990'. Lost partial returns from 2184' to 2214' and lost full returns at 2214'.
12/28/77	2244	2172	12 1/4"	7	396 ft^3	Class "B" cement, perlite 2-1, 40% Silica flour and 3% gel.	Filled wellbore and squeezed away cement with 200 psig surface pressure. Found firm cement at 1940'. Cleaned cement and lost returns.

DATE	WELL DEPTH	OEDP DEPTH	HOLE DIA.	PLUG	SLURRY VOLUME	PLUG COMPOSITION	RESULTS
12/29/77	2250	2205	12 1/4"	8	142 ft^3	Thix-set cement, 13% Gilsonite, 1/2 lb. Flocele/sack of cement.	Unable to fill the wellbore with 450 barrels of mud. Found top of cement at 2222'. Drilled cement to 2230'.
12/30/77	2250	1829	12 1/4"	9	142 ft^3	Thix-set cement, 13% Gilsonite, 1/2 lb. Flocele/sack of cement.	Unable to fill wellbore with 200 barrels of mud. Found top of cement at 2230'.
12/31/77	2250	1860	12 1/4"	10	240 ft^3	Class "B" cement, perlite 1-1, 40% Silica flour, and 3% gel.	Ran in the hole to 2230' without finding plug #10.
12/31/77	2250	2209	12 1/4"	11	120 ft^3	Class "B" cement, perlite 1-1, and 3% gel.	Ran in the hole to 2230' without finding plug #11.
1/7/78	2250	2169	12 1/4"	12	193 ft^3	Class "B" cement, perlite 2-1, 40% Silica flour and 3% gel.	Ran in the hole to 2230' without finding plug #12.
1/1/78	2250	2170	12 1/4"	13	180 ft^3	Class "B" cement, perlite 1-1, 40% Silica flour, and 3% gel.	Found top of cement at 1953'. Filled the wellbore with 325 barrels of mud. Lost returns after circulating for two hours.
1/2/78	2250	1946	12 1/4"	14	100 ft^3	Thix-set cement, 19% Gilsonite, 0.1% Flocele and 0.1% Tuff-Plug.	Filled the wellbore with 75 barrels of mud. Found top of firm cement at 1861. C.O. cement to 2250'. Lost returns after drilling to 2275'.
1/4/78	2342	2201	12 1/4"	15		112 ft^3 H_2O, 112 ft^3 6% $CaCl_2$ H_2O w/400# plaster sand, 28 ft^3 $NaSL_2$ mixed 1-1 with H_2O	Found top of cement at 2242'. Unable to fill wellbore with 400 barrels of mud.
					223 ft^3	Thix-set cement, 25# Gilsonite, 1 1/4# Flocele and 1/8# Tuff fiber per sack of cement.	

DATE	WELL DEPTH	OEDP DEPTH	HOLE DIA.	PLUG	SLURRY VOLUME	PLUG COMPOSITION	RESULTS
1/5/78	2342	2232	12 1/4"	16		112 ft^3 gel water with WG-11, CL-11 with 1680 lbs. of unibeads, 420 lbs. Gilsonite and 420 lbs. TLC-80.	Found top of cement at 2242'. Apparently all of plug #16 entered the formation.
					59 ft^3	Class "B" cement with 2% $CaCl_2$, and 100 lbs. Flocele.	
1/5/78	2342	2232	12 1/4"	17		112 ft^3 gel water with WG-11, CL-11 with 1680 lbs. of unibeads, 420 lbs. Gilsonite and 420 lbs. TLC-80.	Found top of cement at 2139'. Filled wellbore with 310 barrels of mud. Cleaned out cement to 2244'. Started losing mud.
					118 ft^3	Class "B" cement, 2% $CaCl_2$ & 200 lbs. Flocele.	
1/6/78	2342	2201	12 1/4"	18	56 ft^3	FracGel, WG-11, CL-11, 840 lbs. unibeads, 210 lbs. Gilsonite, and 210 lbs. TLC #80.	Filled wellbore with 170 barrels of mud. Found cement at 2184'. C.O. to 2244'.
					210 ft^3	Class "B" cement with 2% $CaCl_2$ and 75 lbs. Flocele.	
1/7/78	2342	2232	12 1/4"	19	56 ft^3	Frac-Gel, 25# WG-11 & 7 # CL-11.	Ran in the hole to 2239' with no trace of plug #19.
					112 ft^3	3% $CaCl_2$ H_2O.	
					56 ft^3	H_2O.	
					258 ft^3	$NaSi_2$ mixed 1-1 with H_2O.	
					56 ft^3	H_2O.	
					136 ft^3	Class "B" cement with 2% $CaCl_2$ & 1/2 lb/sk Flocele.	
1/8/78	2342	2239	12 1/4"	20	112 ft^3	Frac Gel, 500 lbs. Gilsonite, 500 lbs. unibeads, 350 lbs. mothballs, 50 lbs. WG-11 and 15 lbs. CL-11.	Ran in the hole to 2240', with no trace of plug #20.
					136 ft^3	Class "B" cement, 2% $CaCl_2$ and 1/2 lb. Flocele/sack.	

DATE	WELL DEPTH	OEDP DEPTH	DIA.	PLUG	VOLUME	PLUG COMPOSITION	RESULTS
1/8/78	2342	2232	12 1/4"	21	112 ft^3 56 ft^3 134 ft^3	3% $CaCl_2$ water. H_2O. $NaSi_2$.	Found top of cement at 2187'. Cleaned out cement to 2280'.
		2201			98 ft^3	Class "B" cement, 6% Gilsonite, 1/2 lb. Flocele and 2% $CaCL_2$.	
1/9/78	2342	2263	12 1/4"	22	112 ft^3 112 ft^3 67 ft^3 67 ft^3	H_2O. $CaCl_2$ water. H_2O. $NaSi_2$.	Found top of cement plug at 2240'. Unable to fill the wellbore with H_2O.
		2232			88 ft^3	Class "B" cement, 2% $CaCl_2$, 12% Gilsonite and 1/2 lb. Flocele per sack.	
1/10/78	2342	2233	12 1/4"	23	88 ft^3	Class "B" cement, 8 lbs. Gilsonite, 2% $CaCl_2$ and 1/2 lb. Flocele/sack.	Found top of cement at 2240'. No trace of plug #23.
1/10/78	2342	2232	12 1/4"	24	112 ft^3	Frac Gel, 500 lbs. unibeads, 150 lbs. Flocele, 150 lbs. Gilsonite, 150 lbs. moth balls, 75 lbs. WG-11 and 15 lbs. CL-11.	Found top of cement at 2240'. No trace of plug #24.
					161 ft^3	Class "B" cement, perlite 2-1, 40% Silica flour and 3% gel.	
					98 ft^3	Class "B" cement, 2% $CaCl_2$, 1/2 lb. Flocele and 8 lbs. Gilsonite per sack.	
1/10/78	2342	2232	12 1/4"	25	112 ft^3 112 ft^3 28 ft^3 67 ft^3	H_2O. 3% $CaCl_2$ water. H_2O. $NaSi_2$.	Found top of cement at 2215'. Unable to fill the wellbore with 300 barrels of mud.
		2201			161 ft^3	Class "B" cement, perlite 2-1, 40% Silica flour, 3% gel and 3% $CaCl_2$.	

DATE	WELL DEPTH	OEDP DEPTH	DIA.	PLUG	VOLUME	PLUG COMPOSITION	RESULTS
1/11/78	2342	2201	12 1/4"	26	112 ft^3	600 lbs. gel, 75 lbs. Flocele, 100 lbs. unibeads and 300 lbs. LCM.	Filled wellbore with 30 bbls. of water. Found top of solid cement at 1842'.
					353 ft^3	Class "B" cement, Perlite 1-1 40% Silica flour, 3% gel and 3% $CalC_2$.	
1/19/78	2606	2575	12 1/4"	27	174 ft^3	Thix-set cement, 10# Gilsonite per sack and 2% $CaCl_2$.	Found top of cement at 2468'.
˙/19/78	2606	2443	12 1/4"	28	175 ft^3	Thix-set cement, 10# Gilsonite per sack and 2% $CaCl_2$.	Located top of cement at 2449'.
1/19/78	2606	2418	12 1/4"	29	247 ft^3	Class "B" cement, Perlite 2-1, 5% gel and 2% $CaCl_2$.	Located top of cement at 2248'.
1/20/78	2606	----	12 1/4"	30	367 ft^3	Class "B" cement, Perlite 1-2, 5% gel and 2% $CaCl_2$.	Located top of firm cement at 2089'. Unable to fill the wellbore. C.O. to 2165'.
1/21/78	2606	2139	12 1/4"	31	215 ft^3	Class "B" cement, Perlite 1-1, 4% gel, and 2% $CaCl_2$.	Located top of cement at 2077'.
1/22/78	2606	2046	12 1/4"	32	250 ft^3	Class "B" cement, Perlite 1-1, 40% Silica flour and 3% gel.	Unable to fill the wellbore with 500 barrels of water. Found top of cement at 1885'.
1/22/78	2606	1860	12 1/4"	33	250 ft^3	Class "B" cement, Perlite 1-1, 40% Silica flour and 3% gel.	Found top of cement at 1697'.
1/22/78	2606	1675	12 1/4"	34	250 ft^3	Class "B" cement, Perlite 1-1, 40% Silica flour, 3% gel, 2% $CaCl_2$.	Filled wellbore with 125 barrels of water. Found top of cement at 1553'. Squeezed away 168 ft^3 of H_2O at a surface pressure of 250 psig.
_/22/78	2606	1490	12 1/4"	35	250 ft^3	Class "B" cement, Perlite 1-1, 40% Silica Flour, 0.5% CFR-2, 3% gel.	Squeezed away 14 ft^3 at 900 psig surface pressure. Found top of cement at 1368'

DATE	DEPTH	DEPTH	DIA.	PLUG	VOLUME	PLUG COMPOSITION	RESULTS
1/28/78	2804	2765	12 1/4"	36	312 ft^3	Class "B" cement, Perlite 1-1 40% Silica flour, 0,5% CFR-2, 3% gel.	Found top of cement at 2754'.
1/28/78	2804	2731	12 1/4"	37	312 ft^3	Class "B" cement, Perlite 1-1, 40% Silica flour, 3% gel.	Found top of cement at 2543'

CEMENT DETAIL

DATE	WELL DEPTH	OEDP DEPTH	HOLE DIA.	PLUG	SLURRY VOLUME	PLUG COMPOSITION	RESULTS
9/10/77 30"	30' G.L.		36"		5 1/2 Cu. Yd.	Ready mix cement	Rigged up Dale Martin rathole service. Drilled 36" hole to 30'. Ran & cmtd 30" conductor at 30' with ready mix cement.
12/2/77 20"	255'		26"		649 ft^3	Class "B" cmt. w/2% $CaCl_2$	Ran 6JTS 20" 94# H-40 Buttress csg to 251. Pumped cement through open ended csg. Rec'd. 175 ft^3 excess, cmt. to sump. Found TOC at 233'.
12/19/77 13 3/8"	1557'		17 1/2"		2071 ft^3	Class "B" cmt. w/ 1-1 Perlite 40% Silica flour, 3% gel, .5% CFR2, .3% HR7.	Ran 40 JTS of 13 3/8" 54.5# K-55 Buttress csg w/shoe at 1552' and baffle at 1513', had good returns to surface throughout job. Bumped plug o.k.
					184 ft^3	Class "B" cmt. w/40% Silica flour and .5% CFR-2.	
2/3/78 9 5/8" liner	3448' (P.B.-3360)		12 1/4"		1250 ft^3	1st stage Class "B" cmt. premixed 1:1 perlite, 40% Silica flour, 3% gel, 0.5% CFR-2, 0.4% HR-7.	Ran 51 JTS 9 5/8" 40# K-55 Buttress. Shoe at 3357'. Baffle collar at 3278'. Lynes ECP PKR at 2014'. HOWCO F.O. cementer at 2004'. Burns 13 3/8" x 9 5/8" single slipline hanger at 1345.
					326 ft^3	Class "B" cmt. premixed w/40% Silica flour, 0.75% CFR-2, and .2% HR-7.	1st stage-seated latch in plug o.k. w/1500 psi. *After "1st stage" attempted unsuccessfully w/isolation PKR to set Lynes PKR. Therefore ran in hole and set 9 5/8 RTTS at 1918'. Inflated Lynes PKR w/ 1500 psi. Opened F.O. cementer. POH & layed down RTTS. Picked up EZSV at set at 1805'.

DATE	WELL DEPTH	OEDP DEPTH	HOLE DIA.	PLUG	SLURRY VOLUME	PLUG COMPOSITION	RESULTS
2/4/78 9 5/8" liner (con't.)	3448' (B.P.-3360)		12 1/4"		750 ft^3	2nd stage Class "B" cement premixed 1-1 perlite, 40% Silica flour, 3% gel, .5% CFR-2.	Cemented through F.O. ports at 2004' and EZSV at 1801'. Displaced w/185 ft^3 of water. Pressure built up during last half of job. Maximum pump pressure was 800 psi. Pulled out of stinger & POH. Picked up 8 3/4" BHA. Drilled cmt. stringers from 1345' to 1805'. Tested liner lap to .86 psi/ft held o.k. Drilled retainer. Drilled cmt. from 1810' to 2007'. Fell thru to 3065'. Drilled cmt. from 3065' to 3278'. Drilled baffle collar at 3278'. Drilled cmt. to 3357'; csg shoe. Drilled cmt. from shoe to 3448'. After running 7" liner and not being able to release from hanger, the 7" liner was POH. The Burns hgr was replaced with a Midway hgr. Ran 72 JTS of 7" 26# K-55 LT&C blank csg. 36 JTS 7"-26" K-55 LT&C perforated csg. HOWCO cmt guide shoe at 7615. Baker Baffle plate at 4053'. Lynes EC. packer at 3999'. Cmt. collar at 3997'. Midway liner hanger at 3084'.
3/6/78	7735		8 3/4"		187 ft^3	1st stage Class "B" cmt. pre-mised w/1-1 perlite, 40% Silica Flour, 3% gel, .05% CFR-2, .04% HR-7.	Displaced w/49 ft^3 of water. Closed cement port with 800 psi. POH. Laid down liner setting and cementing tools. Picked up RTTS tool and set at 3034'.
					81 ft^3	Tail-end-class B 40% Silica flour.	

DATE	WELL DEPTH	OEDP DEPTH	HOLE DIA.	PLUG	SLURRY VOLUME	PLUG COMPOSITION	RESULTS
3/7/78	7615 shoe liner		8 3/4"		187 ft^3	2nd stage Squeeze #1 Class B premixed w/1-1 perlite, 40% S.F., 3% gel, .5% CFR-2.	Displaced with 330 ft^3 water. No pressure buildup.
					81 ft^3	Class "B" premixed w/40% Silica flour.	
3/9/78	7615 shoe of 7" liner		8 3/4"		244 ft^3	2nd stage Squeeze #2 Class B cmt. Pre-mixed w/40% Silica flour, .5% CFR-2.	Set HOWCO RTTS at 3034'. PKR started leaking during cmt. job. Released same & POH.
					1000 ft^3	2nd stage Squeeze #3 Class B cmt. premixed 1-1 perlite, 40% Silica flour, 3% gel, .5% CFR-2.	Set RTTS PKR at 2921'. Displaced w/336 ft^3 of water. Pressure built to 900 psi then broke back to 400 psi. POH w/ RTTS. Picked up 6 1/8" bit. Hit obstruction at 3137'. Cleaned out cmt. & rubber from 3137' to 3140' w/ full circulation. POH. Attempted to run and set 7" RTTS at 3100'. PKR failed. POH. Picked up 9 5/8" RTTS, set at 3010'.
3/10/78	7615 shoe of 7" liner		8 3/4"		675 ft^3	2nd stage Squeeze #4 Class B premixed 1:1 perlite, 3% gel, 40% Silica flour, .5% CFR-2.	Set RTTS at 3010'. Attempted to pressure test liner to 400 psi and hole went on vacuum. Pulled & reset RTTS at 2915'.

DATE	WELL DEPTH	O.E.D.P. DEPTH	HOLE DIA.	PLUG	SLURRY VOLUME	PLUG COMPOSITION	RESULTS
3/10/78 (cont'd.)					200 ft^3	Class B 1:1 Perlite, 3% Gel, 40% Silica Flour, .5% CFR-2 w/2% $CaCl_2$	Displaced w/319 ft^3 water. P.O.H. Cleaned out cement from 2927' to 3084'. P.O.H. Picked up 6-1/8" bit and R.I.H. to 3243'. Pushed obstruction to 3990'. P.O.H. Picked up 9-5/8" RTTS packer.
3/11/78	7615' shoe of 7" liner		8-3/4"		750 ft^3	Second stage Squeeze #5 Class B premixed 1:1 Perlite, 40% Silica Flour, 3% Gel	Set RTTS at 3040'. Cemented. Displaced with 360 ft^3 H_2O. No significant pressure build-up. P.O.H. Picked up 8-3/4" bit. R.I.H. to 3084' - no cement to top of liner. P.O.H
					167 ft^3	Second stage Squeeze #6 Class "B" premixed 1:1 Perlite, 40% Silica Flour, 3% Gel, 2% $CaCl_2$	R.I.H. with O.E.D.P. to 3080'. Displaced with 263 ft^3 water. P.O.H. Picked up 8-3/4" bit. Tagged cement at 2920'. Drilled cement to top of liner at 3084'. P.O.H. Picked up 6-1/8" bit. Drilled port collar. Drilled baffle collar and lost returns.

Well Analysis and Summarization
Union Geothermal
Well #42 - 7
Sec. 7 - 26S - 6W
Beaver County, Utah

May 8, 1978

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Table of Contents

Appendix

Covefort Sulphurdale Unit

Well #42-7

Drilling Mud History

Introduction:

In September 1977, NL Baroid Petroleum Services submitted to Union Oil Company of California, Geothermal Division, a suggested mud program for drilling in the Covefort Sulphurdale Unit. The proposed program, geological information furnished by Mr. Steve O. Maione, and recommendations made by Mr. Steve Pye and Mr. Paul Fischer, were reviewed and modified by Mr. V. K. Varma in August 1977. A copy of NL Baroid's proposed program is included in the appendix on pages 1 and 2. A copy of the modified program is included in the appendix on pages 3 - 6. This paper will analyze the proposed program, the accepted program, and the actual program used. It will also attempt to explain any deviations and the reasons therefore. This analysis should also help to explain any cost variances. Suggested mud parameters and general instructions, along with variances are listed by hole size intervals.

The First Interval (0' to 300')

Baroid suggested the use of a spud mud consisting of Quick Gel or Aquagel and Lime to drill the 26" surface hole. This was modified to include Caustic Soda instead of lime, with pill treatments of LCM to be used to combat lost circulation. Cement plugs were to be used in the event of severe lost circulation. The mud system was continuously monitored for H_2S intrusion. This modified mud program was successfully used. No severe drilling hazards were encountered in this interval.

The Second Interval (300' to 1500')

Baroid suggested a DAPP (diammonium phosphate) mud system to drill the 17½" conductor hole. The DAPP system was developed as a nonpollutant circulating medium suitable for use on federal land. The modified mud program suggested the use of a fresh water gel fluid with caustic for pH, lignite thinners for rheological control, and WL 100 for filtration control. The treatment for lost circulation was to be LCM sweeps and cement squeezes as necessary. It was recommended that Zinc Carbonate and Sodium Sulfite be used as corrosion control agents. The actual drilling was accomplished using the modified mud program. Moderate to severe lost circulation was encountered between 1300' and 1500'.

The Third Interval (1500' to 2250')

Baroid recommended the use of the DAPP system through this interval. The revised mud program called for the same program as that used in the second interval. The revised mud program was used. Due to severe lost circulation throughout this interval, completion was accomplished only through the use of repeated cement squeezes. A copy of the daily operations summary can be found in the appendix on pages 19 through 28.

The Fourth Interval (2250' to 3200')

Baroid recommended the use of a DAPP system through this zone. The revised mud program called for the same program as used in the previous two intervals, with the addition of sepiolite as necessitated by hole conditions. Lost circulation through this zone became so severe that it was necessary to convert to an aerated system. Aerated mud was tried unsuccessfully followed by foam drilling techniques. The success of these two systems was limited due to extreme water intrusion into the well bore. The method finally implemented was that of using aerated, treated water alternately pumping reserve pit water into the hole with complete lost returns. This method was necessitated because the hole was making a large volume of water (600 barrels per hour) and there was no way to dispose of it other than pumping it back into the hole. Corrosion became a severe problem in this interval due to the aerated drilling fluid environment and the temperatures involved. Although several methods of corrosion treatment were attempted, none of those used were as successful as desired; however, a limited amount of reduction was observed. A copy of corrosion ring records is included in the appendix pages 29 and 30. A copy of a drill pipe scale analysis is included in the appendix on page 31. The third and fourth intervals were part of the same casing interval.

The Fifth Interval (3200' to 7735')

Baroid recommended a DAPP circulating medium through this zone. In the revised program, a Polymer and Calcium Carbonate system was recommended. An attempt was made to go back to a fresh water, dispersed gel system. Due to severe lost circulation and continuous water intrusion, it became necessary to revert to the same system used in the previous interval; the same problems were encountered concerning corrosion. Although additional methods of corrosion control were attempted in this interval, none of those tried were successful in bringing the corrosion rate within acceptable limits.

Summary:

Primary problems encountered in drilling this well were:

1. Both moderate and severe lost circulation.

   Approximate cost $34,097 - a cost analysis is included in the appendix on pages 14 through 17 with a breakdown on page 13.

2. Corrosion problems associated with the aerated drilling system and the high temperature of the well bore.

   Cost - $91,792 - refer to cost summary, appendix page 13.

3. High volume of water encountered at 2500'.

   A. Made it impossible to drill with air.

   B. Increased corrosion control costs considerably.

Conclusions:

Although we feel that either the Baroid or the revised program would have been adequate under normal conditions, the severity of lost returns dictated the actual well site mud system used.

Corrosion problems accounted for $91,792 or 50% of the actual mud bill. Most of this expense was incurred while drilling with an aerated system. Although many alternative corrosion control methods were tried, none were successful. For this reason, Baroid would suggest that a Baroid corrosion control laboratory and technician be utilized on the next project of this type.

APPENDIX

BAROID DIVISION
N L Industries, Inc.
RECOMMENDED MUD PROGRAM

Company: Union Geothermal   Date: September 10, 1977

Well Name and Number: Covefort Sulphurdale Unit Well #42-7   Proposed Depth: 10,000'

Location: Sec 7 - 26S - 6W   County: Beaver   State: Utah

Casing: Surf. 20" @ 300' / 13-3/8" @ 1600'   Inter. 9-5/8" @ 3500'   Prod. 7" @ T.D.

RECOMMENDED MUD PROPERTIES / TREATMENT

DEPTH FEET	WEIGHT LB/GAL	VISCOSITY SEC.	FILTRATE ml	TREATMENT
0 to 300'	8.4 to 8.9	45 to 50	N.C.	Spud mud consisting of QUIK GEL or AQUAGEL and LIME to set surface casing.
300' to T.D.	8.4 to 8.6	26 to 38	15 to 20cc	Diammonium Phosphate system using pre-hydrated AQUAGEL for viscosity and WL-100 for filtration control as required by hole conditions. Should a higher density fluid be required, CARBONOX/ Q-BROXIN and AKTAFLO-S are recommended for control of rheological properties.

Remarks: Recommend 400 bbl of saltwater be maintained in storage to quench well during trips.

Recommend use of a Baroid Mud Cleaner and Baroid Double Deck Shaker for solids control.

Recommend COAT-777 for corrosion control and additions of AMMONIUM HYDROXIDE if H_2S is encountered.

Please refer to Detailed Mud Plan and Contingency Section for specifics on D.A.P. systems, lost circulation and the above recommendations.

Estimated cost for mud materials: 80,000 with moderate lost circulation

Recommended Program Based Upon: 65 - 70 days drilling time including moderate lost circulation problems.

BR-1007-2A

DETAILED MUD PLAN

0 to 300'

AQUAGEL and LIME are recommended to maintain a 45 to 50 sec/qt funnel viscosity and a 10+ pH. Mud density should be maintained at 8.9 ppg or less. Previous operations in the area have encountered loose unconsolidated gravel bed while drilling conductor hole. For this reason, setting conductor pipe as quickly as possible and control of potential problems created by loose gravel are essential to reduce drilling time, lost circulation and overall costs.

300' to T.D.

A Diammonium Phosphate system is recommended for this interval. Diammonium Phosphate (D.A.P.) exhibits thermal stability, positive corrosion control and reduces wetting of water sensitive formations. Since volcanic formations encountered are of the acid extrusive type, the common oil field practice of maintaining a high pH is futile, expensive and, in the case of a D.A.P. system, unnecessary. Furthermore, the lower the pH and the higher the temperature, the greater the solubility of ammonia. D.A.P. will not create ammonia handling or safety problems for rig personnel if a pH of 7.2 to 8.3 is maintained.

Formations encountered below 600' are usually Dyrite and produce "gun barrel" well bores until production zones are encountered. Since unnecessarily high viscosities could damage production zones it is recommended that they be maintained no higher than necessary to achieve good hole cleaning as dictated by hole conditions.

UNION 76

August 31, 1977

TO: Mr. Del Pyle/Mr. Don Ash

FM: V. K. Varma

On the basis of geological information furnished by Steve Maione and recommendations made by Steve Pye and Paul Fischer on August 11, 1977, the mud programme for Cove Fort Fed. #42-7, Utah, has been modified and revised.

Suggested mud parameters and general instructions are listed by hole size intervals.

I. Conductor Hole 66cm (26")

Depth	Exp. Lithology	Weight	Viscosity	Filterate Loss	Ph
0-250'	Alluvium, Andesites	8.4-9.0ppg	As Required	N. A.	10.5-11.0

Remarks

Drill conductor interval with gel, caustic and water with sufficient viscosity and yield point to clean hole.

In the event of loss of returns, pill Treatments with LCM to be pumped in to regain circulation. Cement plug(s) be placed in case of severe losses.

To ensure that maximum safety conditions are met, the mud system will be monitored continually for H_2S.

II. Surface Hole 44.4cm (17-1/2")

Depth	Exp. Lithology	Weight	Viscosity	Filterate Loss	Ph
250'-1500'	Andesite (Volcanics)	8.8-10ppg 66-75pcf	45-55	8-12cc	10.5-11.5m

Material

Quebracho	P. V. as per AFD (Annular Flow Dynamics)
Bentonite	Gels 2/6
Tannathin	Y.P. as per AFD
Caustic Soda	Solids 4-12%
Cypan	Bentonite 18-22 #/Bbl
Barite (if needed)	

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Commencing with this interval, the desander and desilter should be utilized to maintain minimum mud weights for maximum penetration rates. Adjust mud rheology and/or rig hydraulics to maintain laminar flow in the annulus for maximum hole cleaning and minimum hole erosion.

If lost circulation occurs, sweep treatments of one or more of the following: Cotton seed hulls, mica, nut plug and Kwik-Seal are recommended to regain returns. If lost circulation persists, a "Diaseal-M" or cement squeeze may be required to regain circulation.

Corrosion and hydrogen sulfide protection should be initiated through this interval and continued to total depth with additions of Zinc Carbonate, Sodium Sulfide, Unisteam and a water soluble organic phosphate scale inhibitor.

Ratio: Zinc Carbonate - 2#/Bbl (and as conditions dictate).
Sodium Sulfite (catalyzed) - Sufficient to maintain 100-300 ppm at flow line.
SI-1000 (organic phosphate) - In conjunction with Sodium Sulfite to maintain 10-20 ppm at flow line.

III. Intermediate Hole 31.1cm (12-1/4")

The mud(s) type to be used in this hole section will largely depend upon lighology and temperatures. Depths set below are tentative and mud systems may have to be changed as and when warranted by encountered formations and temperatures.

System No. 1 (Gel-Liqnite)

Depth	Exp. Lithology	Weight	Viscosity	Filterate	Ph
1500'-2250'(?)	Conglomeratic Ss, Shale, Siltstone	8.8-10ppg 66-75pcf	45-55	8-10cc	10.5-11.5m

Materials

Bentonite	P.V. as per AFD
Quebracho	Yp as per AFD
Tannathin	Gels 2/6
Caustic Soda	Solids 4-12%
Cypan	Bentonite 18-22#/Bbl
Barite (if needed)	

Lost circulation and corrosion to be controlled as described for the 44.4cm (17-1/2") hole.

Should the well bore temperatures become detrimental to mud parameters, causing excessive gelation, flocculation and mud instability, the system will be changed over to a sepiolite base system.

System No. 2 (Sepiolite)

Depth	Exp. Lithology	Weight	Viscosity	Filterate	Ph
2250'?-3200'?	Red beds, Siltstone, ss., Sh, Thin Silty Limestone	9.0-9.3ppg 67-69.5pcf	40-45	8-10cc	10.5-11.5m

Materials

Sepiolite (Geo-Gel)	P.V. as per AFD
Bentonite	Yp as per AFD
Cypan	Gels 1/2
Caustic Soda	Solids 6%

Resinex/WL-100 - Avoid usage unless essential
Bentonite 4lb/Bbl

System No. 3 (Consolidation Treatment) 'Special'

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IV. Production Hole 22.2cm (8-3/4")

As recommended in memo E & pp 77-108 M, a Polymer and Calcium Carbonate mud system will be used to drill carbonate rocks.

Depth	Expl. Lithology	Weight	Viscosity	Filterate	Ph
3200'?-10,000'±	Limestone, Dolomite (Carbonate rocks)	8.5-9ppg 63.5-67pcf	28-35 (low)	>12cc (high)	<12

Material

Calcium Carbonate

Polymer & Additives) to be advised by Union Research

Yp/Pv - As necessary for good hole cleaning

Gels - 0/2

Solids - 6%

General Instructions

1. A minimum of 1000 sacks of Barite will be readily available at all times during drilling operations.

2. Pre-treatments for hydrogen sulfide will begin at spud @ 2#/Bbl Zinc Carbonate and adjusted as conditions dictate. A "HACH" test for hydrogen sulfide in the mud system will be run on a routine basis.

3. Corrosion coupons will be installed in the kelly saver sub and the first joint above the drill collars. These coupons will be changed at 100± hour intervals and monitored for type and severity of corrosion. Precision weight measurements will have to be made for accuracy of results.

4. For maximum corrosion protection, a catalyzed sodium sulfite oxygen scavanger will be injected into the pump suction in quantities sufficient to maintain concentrations of sulfite at 100-300 ppm at the flowline. SI-1000, a water soluble organic phosphate scale inhibitor may be used in conjuntion with sodium sulphite to prevent scale build-up on tubular goods. SI-1000 concentrations should be maintained at 10-20 ppm at the flowline.

   In addition, Magco Inhibitor 202, a water soluble filming amine, will be used, if conditions warrant, to coat the drill string on trips.

   Inhibitors may change from time to time as a result of continuing research.

Equipment

1. Three station (Shakers, cellar and rig floor) hydrogen sulfide gas detectors (0-100 ppm) with audio warning device will be in continuous operation during drilling operations.

2. Drager multi gas detectors (hand operated) will be available for spot checks.

3. Degasser, desilter and desander.

4. High-low level mud pit indicator complete with visual and audio warning device.

5. Temperature recorder with chart for continuous monitoring of flowline and suction temperatures.

cc: Steve Pyc
Paul Fischer
Steve Maione

EQUIPMENT

1. Three station H_2S gas detectors with audio warning device.
2. Drager multi gas detectors (hand operated) for spot checks.
3. Degasser.
4. Double deck shaker.
5. Mud cleaner.
6. Mud cooling tower.
7. High-low level mud pit indicator.
8. Temperature recorder.
9. Two 2500 CFM Air Compressors.

BAROID DIVISION
N L Industries, Inc.

DRILLING MUD RECORD

COMPANY Union Oil of California Geothermal Div STATE Utah

WELL Cove Fort Federal Unit 42-7 COUNTY Beaver

CONTRACTOR Loffland Brothers Drilling Rig #184 LOCATION Wildcat SEC 7 TWP 26S RNG 6W

STOCKPOINT Milford, Utah DATE 3-22-78 BAROID ENGINEER Jim Goldsby/Randy Rhodes/Ron Peterson

CASING PROGRAM: 20 inch at 251 ft.
13-3/8 inch at 1552 ft.
9-5/8 inch at 3357 ft.
7 inch @ 7500

TOTAL DEPTH 7735 ft.

DATE	DEPTH feet	WEIGHT lb/gal	VISCOSITY Sec API @ °F	VISCOSITY PV @ °F	Yp	GELS 10 sec/10 min	pH Strip ☐ Meter ☐	FILTRATION ml API	FILTRATION HTHP @ °F	FILTRATION Cake 32nds	FILTRATE ANALYSIS Pf	FILTRATE ANALYSIS Mf	FILTRATE ANALYSIS Cl ppm	FILTRATE ANALYSIS Ca ppm	SAND %	RETORT Solids %	RETORT Oil %	RETORT Water %	CEC	REMARKS AND TREATMENT
11-28	-0-	8.7	57				8.5	NC					400							Spud Mud
11-28	144	8.8	58	30	40	5/20	9	20		3			450		0	10	0	90		Vis-45 to 50 Wt-8.6 to 8.9
11-30		9.2	50	30	40	8/20	9	22		3			450			10	0	90		Reaming Hole to 26"
12-1-77		9.2	46	25	35	5/20	8.5	20		3			450			12	0	88		Circ. for 20" casing
12-2		9.2	50	30	40	8/20	8.5	22		3			450			12	0	88		Setting 20" casing & Nippling
																				up BOP
12-3		9.2	50	30	40	8/20	8.5	22		3			450			12	0	88		Testing BOP
12-4	Tight	8.8	40	20	35	6/12	11.5	18		2			400	200		8	0	92		Drilling Cement
12-5	Tight	8.8	41	10	20	4/10	11	15		2	1.4	2.0	750	40	0	4	0	96		Dirlling Ahead
12-6	Tight	8.8	46	15	30	5/10	11.5	15		2	1.3	2.0	500	80	0	5	0	95		Drilling Ahead
12-7	600	9	39	12	3	2/8	11	14		2	.3	.7	1500	60	0	3	0	97		Drilling Ahead
12-8	746	9.3	39	16	14	4/10	10.5	14		2	.3	.6	600	80	0	8	0	92		Trip for fish 1 drill collar& bi
12-9	815	9.2	41	25	9	3/10	10.5	13		2	.3	.6	600	70	0	10	0	90		Drilling Ahead
12-10	897	9.2	43	23	6	4/15	10.5	14		2	.3	.8	400	60		12	0	88		Drilling Ahead
12-11	1086	9.3	43	32	12	4/12	10.5	8		2	.3	.8	300	90		12	0	88		Drilling Ahead
12-12	1221	9.4	36	20	10	4/8	10	9		2	.3	.8	350	80		12	0	88		Tripping for plugged jet
12-13	1301	9.3	43	25	12	4/8	10.5	9		2	.4	.7	350	70	0	9	0	91		$NaSO_2$ 70 ppm H_2S 0 Drilling
12-14	1388	9.2	49	40	25	10/30	10	19		3	.3	.8	300	60	0	8	0	92		$NaSO_2$ 60 H_2SO Lost Returns
12-15	1452	9.2	43	32	20	8/15	10	15		2	.4	.7	300	70	0	7	0	93	LCM 5%	$NaSO_2$ 60 H_2SO Fishing for Collar
12-16	1494	9.2	40	25	15	4/10	10	14		2	.4	.9	300	80		8	0	92		$NaSO_2$ 80 H_2SO Cementing
12-17	1494	9	37	26	12	4/10	10.5	14		2	.3	.8	300	90		8	0	92		$NaSO_2$ 80 H_2SO Waiting on Cement
12-18	1537	9.1	41	30	20	8/20	11	15		2	.3	1.0	400	150	0	8	0	92		$NaSO_2$ 80 H_2SO Trip to run 13-3/8 casings
12-20	1557	8.9	34	9	2	0/10	12	12		2	1.5	3.1	100	280	0	4	0	96		$NaSO_2$ 25 H_2SO Nipple up 13-3/8cs
12-22	1557	8.6	28	2	1	0/0	12	20		1	2.3	4.0	150	440	0	2	0	98		$NaSO_2$ 25 H_2SO Drlg Cement
12-22	1557	9	44	22	13	2/8	10.5	12		2	.48	1.4	150	440	Tr	5	0	95	13%	$NaSO_2$ 25 H_2SO No Returns
12-22	1559	9	44	22	13	2/8	10.5	12		2	.5	1.4	150	440	Tr	5	0	95	13%	$NaSO_2$ 25 H_2SO Recovered returns
12-23	1603	8.9	39	14	3	0/2	10.5	8		1	.45	1.1	200	528	Tr	4	0	96	10%	$NaSO_2$ 25 H_2SO Tripping
12-24	1815	8.7	38	12	3	0/4	12	12.8		2	1.5	2.4	140	400	0	2	0	98	10%	$NaSO_2$ 25 H_2SO Lost Returns
12-24	1818	8.8	33	6	3	0/5	10.5	11.6		2	1.0	1.9	170	468	Tr	4	0	96	8%	$NaSO_2$ 25 H_2SO Partial Returns
12-25	2045	8.9	41	12	8	2/9	11	9.6		2	1.0	1.9	150	40	1/4	4	0	96	5%	$NaSO_2$ 25 H_2SO Drilling
12-26	2218	8.6	34	10	4	0/3	9	16		2	.2	.45	150	120	0	2	0	98	10%	Coat 45 0 H_2SO $NaSO_2$ 0 Lost Retu
12-27	2244		40																10%	Waiting on Cement
12-28	2244	8.7	58	18	15	14/29	12.5	12.8		2	1.4	2.4	150	120	Tr	3	0	97	12%	$NaSO_2$ 0 H_2SO Circ to Drl Cement
12-28	2244	8.8	36	8	4	2/11	12.5	15.2		2	5	8.2	150	40	1/4	3	0	97	6%	$NaSO_2$ 0 H_2SO Drilling Cement
12-29	2244	8.9	41	14	4	1/40	12.5	16.8		2	6.3	11	150	0	Tr	4	0	96	12%	$NaSO_2$ 0 H_2SO Drilling Cement

BAROID DIVISION
N L Industries, Inc.

DRILLING MUD RECORD

COMPANY Union Oil of Californis Geothermal Div. STATE Utah CASING PROGRAM: 20 inch at 251 ft

WELL Cove Fort Federal Unit 42-7 COUNTY Beaver 13-3/8 inch at 1552 ft

CONTRACTOR Loffland Brothers Drilling Rig #184 LOCATION Wildcat SEC 7 TWP 26S RNG 6W 9-5/8 inch at 3357 ft

STOCKPOINT Milford, Utah DATE 3-22-78 BAROID ENGINEER Jim Goldsby/Randy Rhodes/Ron Peterson TOTAL DEPTH 7" @ 7500 / 7735 ft

DATE	DEPTH feet	WEIGHT lb/gal	VISCOSITY Sec API @ °F	VISCOSITY PV @ °F	Yp	GELS 10 sec/10 min	pH Strip ☐ Meter ☐	FILTRATION ml API	FILTRATION HTHP @ °F	FILTRATION Cake 32nds	FILTRATE ANALYSIS Pf	FILTRATE ANALYSIS Mf	FILTRATE ANALYSIS Cl ppm	FILTRATE ANALYSIS Ca ppm	SAND %	RETORT Solids %	RETORT Oil %	RETORT Water %	CEC LCM	REMARKS AND TREATMENT
12-30	2250	8.6	30	3	2	0/3	7.2	NC		2	0	.3	150	80	Tr	2	0	98	5%	$NaSO_2$ 0 H_2SO Waiting on Cement
12-31	2250	8.6	30	3	2	0/3	7.2	NC		2	0	.3	150	80	Tr	2	0	98	10%	$NaSO_2$ 0 H_2SO Tripping
1-1-78	2248	8.6	40	12	5	1/8	7.6	NC		2	0	.3	150	40	0	2	0	98		Cementing
1-3	2248	8.8	51	16	11	5/48	12.5	13.2		4	2.4	3.9	150	0	Tr	4	0	96	10%	$NaSO_2$ 0 H_2SO Drilling cement
1-4	2311	8.8	32	6	2	0/3	7.2	NC		NC	0	.2	150	40	Tr	4	0	96	10%	$NaSO_2$ 0 H_2SO Drilling No Proplem
1-5	2344	8.8	30				7.2	NC			0	.3	150	40	0	4	0	96	10%	Pm-0 $NaSO_2$ 0 H_2SO Drlg no returns
1-6	2345	8.8	40	12	6	2/8	7.2	NC			0	.3	150	20	TR	4	0	96	10%	Pm-0 $NaSO_2$ 0 H_2SO Cementing
1-7	2345	8.8	44	13	7	2/10	7.8	NC			0	.4	150	40	0	4	0	96	8%	$NaSO_2$ 0 H_2SO Waiting on Cement
1-8	2345																			No mud in pits
1-9	2345	8.8	42	12	4	1/8	7.8	NC			0	.3	150	20	0	4	0	96	8%	Pm 0 Waiting on cement
1-10	2345	8.8	40	10	4	1/8	7.8	NC			0	.4	150	40	0	4	0	96	4%	Pm 0 Waiting on Cement
1-11	2345	8.8	40	10	4	1/8	7.8	NC			0	.4	150	40	0	4	0	96	8%	Pm 0 Waiting on Cement
1-12	2345																			Waiting to drill with air.
1-13	2345																			Nippling up for air drilling
1-14	2345																			Nippling up for air drilling
1-15	2345	8.6	30	3	1	0/0	9.5	NC			.5	1.1	150	0	0	2	0	98		Tripping in
1-16	2368	8.3	46	7	4	3/5	12.	NC		3	1.3	1.8	80	44	1/4	3	0	97		Drilling with air
1-17	2406	8.4	28	1	2	0/0	11.5	NC		NC	.74	.99	60	14	TR	1	0	99		Drilling with foam
1-18	2600	8.4	28	1	2	0/0	11.5	NC		NC	.44	.99	60	14	TR	1	0	99		Drilling with foam
1-21	2600	8.4	28	1	2	0/9	11	NC					200	40						Drilling with foam
1-25	2600	8.4	35	2	4	0/0	11.5	NC			2.0	3.5	150	100		1	0	99		Drilling Cement
1-26	2600	8.4	28	1	2	0/0	11	NC			.8	1.1		40						Air Drilling Cement
1-27	2741	8.4	28	1	2	0/0	9.5	NC		Nc	.25	.63	250	100		1	0	99		Drilling
1-28	2804	8.4	28	0	1	0/0	9	NC		NC	.20	.58	250	100		1	0	99		Waiting on Cement
1-29	2808	8.4	28	0	1	0/0	9.5	NC		NC	.42	.54	186	36	Tr	1	0	99		Drilling with air
1-30	3169	8.4	28	0	1	0/0	9.2	NC		NC	.36	.68	215	32	Tr	1	0	99		Drilling with air
1-31	3326	8.4	28	0	1	0/0	11.5	NC		NC	1.5	2.0	220	40	Tr	1	0	99		Drilling with air
2-1	3448	8.4	28	0	1	0/0	10	NC		NC	.48	.86	188	40	Tr	1	0	99		Drilling with air
2-7	3448	8.8	45	10	7	3/6	12	16.8		4	1.9	2.6	186	0	3	4	0	96		Drilling cement
2-8	3678	814	28	0	1	0/0	12.5	NC		NC	2.5	3.5	220	0	Tr	1	0	99		Drilling with air
2-8	4036	8.4	28	2	1	0/0	11	NC		NC	.45	1.7	218	0	Tr	1	0	99		Drilling with air
2-9	4414	8.4	28	2	1	0/0	11.5	NC		NC	1.3	1.8	2200	0	Tr	1	0	99		Drilling with air/ Discovered bad bottle Silver Ni
2-10	4789	8.4	28	2	1	0/0	10.5	NC		NC	1.1	1.2	2100	60	Tr	1	0	99		Drilling with air
2-11	5146	8.5	28	3	1	0/0	11.5	NC		NC	1.3	1.8	2200	58	0	1	0	99		Drilling with air
2-12	5404	8.5	28	2	1	0/0	11	NC		NC	.95	1.7	2500	64	Tr	1	0	99		Drilling with air

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Baroid Petroleum Services

COMPANY Union Oil of California Geothermal Div. STATE Utah

WELL Cove Fort Federal Unit 42-7 COUNTY Beaver

CONTRACTOR Loffland Brothers Drilling Rig 184 LOCATION Wildcat SEC 7 TWP 26S RNG 6W

STOCKPOINT Milford, Utah DATE 3-22-78 BAROID ENGINEER Jim Goldsby/Randy Rhodes/Ron Peterson

CASING PROGRAM: 20 inch at 251 ft.
13-3/8 inch at 1552 ft.
9-5/8 inch at 3357 ft.
7" @ 7500
TOTAL DEPTH 7735 ft.

DATE	DEPTH feet	WEIGHT lb/gal	VISCOSITY Sec API @ °F	PV @ °F	Yp	GELS 10 sec/10 min	pH Strip / Meter	FILTRATION ml API	HTHP @ °F	Cake 32nds	Pf	Mf	FILTRATE ANALYSIS Cl ppm	Ca ppm	SAND %	RETORT Solids %	Oil %	Water %	CEC	REMARKS AND TREATMENT
2-13	5656	8.5	28	1	1	0/0	10	NC		NC	.37	1.3	2400	100	0	1	0	99		PO4 605 ppm Drilling with air
2-14	5822	8.5	28	1	1	0/0	11.5	NC		NC	1.3	1.8	2470	28	0	1	0	99		Drilling with air
2-15	6264	8.5	28	1	1	0/0	11.5	NC		NC	1.2	1.6	2500	0	0	1	0	99		Drilling with air
2-16	6444	8.4	28	1	1	0/0	10.5	NC		NC	.73	1.4	2200	24	0	1	0	99		H_2SO Drilling with air
2-17	6654	8.4	28	1	1	0/0	11	NC		NC	1.0	1.6	1960	29	0	1	0	99		H_2SO Drilling with air
2-18	6838	8.4	28	1	1	0/0	12	NC		NC	2.7	4.6	1920	32	0	1	0	99		H_2SO NO_2 4000 Drilling with air
2-19	7003	8.4	28	1	1	0/0	10.5	NC		NC	1.1	2.2	1840	20	0	1	0	99		H_2SO NO_2 1000 Drilling with air
2-20	7240	8.4	28	1	1	0/0	10	NC		NC	.68	2.2	1850	15	0	1	0	99		H_2SO NO_2 1000 Drilling with air
2-21	7510	8.4	28	1	1	0/0	10.5	NC		NC	.16	2.4	1800	8	0	1	0	99		H_2SO NO_2 1200 PO_4 42 Drlg w/air
2-22	7512	8.4	28	1	1	0/0	11.5	NC		NC	1.5	2.3	1820	16	0	1	0	99		H_2SO NO_2 1000 Drilling with air
2-23	7530	8.3+	28	1	1	0/0	12.5	NC		NC	2.8	3.3	380	60	0	0	0	100		H_2SO NO_2 0 Drilling w/fresh water
2-24	7542	8.4	28	1	1	0/0	10.5	NC		NC	.95	1.5	1480	62	0	1	0	99		H_2SO NO_2 0 Drilling with air
2-25	7633	8.4	28	1	1	0/0	10.5	NC		NC	.88	1.4	1560	20	0	1	0	99	$SO_3$10	H_2SO NO_2 50 Drilling with air
2-26	7735	8.4	28	1	1	0/0	11	NC		NC	1.3	1.7	1820	40	0	1	0	99	$SO_3$0	H_2SO NO_2 25 $PO_4$15 Tripping
2-28	7735	8.4	28	1	1	0/0	11.5	NC		NC	1.8	2.2	1860	68	0	1	0	99	$SO_3$0	H_2SO NO_2 5 $PO_4$500 Clearing hole
3-1	7735	8.4	28	1	1	0/0	10	NC		NC	.64	1.4	1850	64	0	1	0	99	$SO_3$0	H_2SO $NO_2$25 $PO_4$500 Logging
3-2	7735	8.4	28	1	1	0/0	9.5	NC		NC	.4	2.4	1940	68	0	1	0	99	$SO_3$0	H_2SO $NO_2$25 $PO_4$500 Preparing to set casing

Baroid Petroleum Services

MUD MATERIALS Used (Total)

DRILLING MUD RECORD

MATERIAL	AMOUNT	COST $	MATERIAL	AMOUNT	COST $	MATERIAL	AMOUNT	COST $
Aquagel	3353	17,720.90	Carbonox	180	1,978.20	Surflo H35	33	13,874.85
Caustic Soda	1816	46,326.16	Q Broxin	4	107.76	Coat 45	50	3,675.00
D A P 50#	21	426.72	Lime	3	15,33	Nickle Chl.	5	1,250.00
WL100	17	1,787.89	Cedar Fi	105	1,283.10	SurfloW300	6	233.10
Baroid	2	13.02	Pluggit	55	658.90	Coat 415	7	1,886.50
Fibertex	548	6,696.56	Quick Foam	83	4,638.87	Surflo H351	20	5,181.00
Soda Ash	105	2,522.10	Quick Gel	100	473.00	Sub Total		165,672.53
Ctnseed Hls.	164	2,163.16	Benex	10	138.90	Drayage		9,340.50
Micatex	78	819.00	Sodium Nitr.	222	26,531.22	Sales Tax		7,876.12
Kwikseal	602	12,461.40	P 80#	59	1,918.09			
Bicarb/Soda	280	7,492.80	Coat 888	142	3,399.00			TOTAL COST $182,889.15

Baroid

BIT AND DRILL STRING RECORD

Bit No.	Size, Inch	Make and Type		Nozzle No.	Nozzle Size, inch	Depth Out, Feet	Depth In, Feet	Footage	Rotating Time, Hr	Drill String Collars No.	Collars OD	Collars ID	Drill Pipe Type	Drill Pipe OD	Drill Pipe ID
1 768956	12¼	Sec	S42J	3	15/32	Drilled Mouse and rathole					8		IF	5	
2 625936	17½	Reed	473J	3	14/32	133	55	78	11½		8		IF	5	
3 315305	17½	Reed	473J	3	13/32	255	133	122	12		8		IF	5	
HO#1 68674	26	Sec	H O	3	20/32	255	55	200	27½		8		IF	5	
RR3 315305	17½	Reed	473J	3	12/32	288	255	33	10		8		IF	5	
4 BB439	17½	STC	4JS	3	16/32	892	288	604	104		8		IF	5	
5 711851	17½	Sec	S84	3	16/32	1257	892	365	48		8		IF	5	
RR4 BB439	17½	STC	4JS	3	16/32	1452	1257	195	40¼		8		IF	5	
RR5 711851	17½	Sec	S84	3	16/32	1494	1452	42	10½		8		IF	5	
RR5 711851	17½	Sec	S84	3	16/32	1557	1494	63	26 3/4		8		IF	5	
RR1 768956	12¼	Sec	S42J	3	15/32	1559	1557	2	1		8		IF	5	
6 403948	12¼	Reed	S21J	3	15/32	1613	1559	54	3½		8		IF	5	
7 257YL	12½	HTC	J33	3	15/32	2400	1613	787	56¼		8		IF	5	
8 129LP	12¼	STC	3JS	--	---	2606	2400	206	25¼		8		IF	5	
9 984JZ	12¼	STC	7JA	--	---	2804	2606	198	18½		8		IF	5	
10 763636	12¼	Sec	H7SG	--	---	2804	Used to clean cement				8		IF	5	
11 688BJ	12¼	STC	7JA	--	---	3304	2804	500	25 3/4		8		IF	5	
12 333653	12¼	Reed	S62J	--	---	3448	3304	144	7½		8		IF	5	

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Baroid

BIT AND DRILL STRING RECORD

Bit No.	Size, Inch	Make and Type	Nozzle No.	Nozzle Size, inch	Depth Out, Feet	Depth In, Feet	Footage	Rotating Time, Hr	Drill String Collars No.	Collars OD	Collars ID	Drill Pipe Type	Drill Pipe OD	Drill Pipe ID
13 133Ft	8 3/4	STC T2H	Damaged when made up							8		IF	5	
14 HJ217	8 3/4	HTC HH44	3	16/32	Cleaned out Cement					8		IF	5	
15 163052	8 3/4	Reed 4-13T	3	16/32	3453	3448	5	½		8		IF	5	
RR14 HJ217	3 3/4	HTC HH44	3	16/32	3629	3453	176	9¼		8		IF	5	
16 404432	8 3/4	Reed FP62J	--	---	3975	3629	346	17½		8		IF	5	
17 HJ222	8 3/4	HTC HH44	--	---	4414	3975	439	22½		8		IF	5	
18 837MJ	8 3/4	STC F5	--	---	4789	4414	375	15½		8		IF	5	
19 753240	8 3/4	Sec M84E	--	---	5216	4789	427	23¼		8		IF	5	
20 721NE	8 3/4	STC F5	--	---	5619	5216	403	24 3/4		8		IF	5	
21 625516	8 3/4	Reed FP52	--	---	6168	5619	549	24 3/4		8		IF	5	
22 656MF	8 3/4	STC F57	--	---	6489	6168	321	21½		8		IF	5	
23 722MJ	8 3/4	STC F5	--	---	6835	6489	346	24½		8		IF	5	
24 972LL	8 3/4	STC F5	--	---	7003	6835	168	18¼		8		IF	5	
25 416KE	8 3/4	STC F6	--	---	7323	7003	320	22		8		IF	5	
26 639886	8 3/4	Sec M89TF	--	---	7512	7323	189	7 3/4		8		IF	5	
27 690394	8 3/4	Sec M89TF	--	---	7615	7512	103	11½		8		IF	5	
28 797LZ	8 3/4	STC F6	--	---	7735	7615	120	8		8		IF	5	

FL-36

Union Geothermal

Union Oil Company of California
Cove Fort Sulphurdale Unit
Federal #42-7

Drilling Fluid Cost Breakdown and Analysis

Normal Mud Maintenance Costs	$ 57,000	$ 57,000	
Lost Circulation:			
Lost Circulation Material	26,604		
Bicarbonate of Soda for drilling cement squeeze	7,493		
Total cost of Lost Circulation		$ 34,097	
Sub Total Well Costs			$ 91,097
Corrosion Control:			
Caustic Soda to maintain pH (less $12,676 for normal maintenance)	$ 33,650		
Sodium Nitrite	26,531		
DAPP 50	427		
DAPP 80	1,918		
Coat 888	3,399		
Surflo H35	13,874		
Nickle Chloride	1,250		
Coat 415	1,887		
Surflo H351	5,181		
Coat 45	3,675		
Total cost of Corrosion Control		$ 91,792	
TOTAL WELL COST			$ 182,889

MUD COST ANALYSIS

A. Mud Type: Low Solids Non-Dispersed
Aquagel-water

B. Typical Mud properties at beginning of Interval: 0 - 250'

Mud Weight	8.7	pH	9.0
Viscosity	57	Solids	10
Pv/Yp	30/40	Oil	0
Gels	5/20	Water	90
Filtrate API	20	HPHT	

C. Typical Mud properties at bottom of Interval:

Mud Weight	9.2	pH	8.5
Viscosity	50	Solids	12
Pv/Yp	30/40	Oil	0
Gels	8/20	Water	88
Filtrate API	22	HPHT	

Mud cost at bottom of interval:	$ 1180
Mud cost at top of interval:	$ -0-
Interval mud cost:	$ 1180
Mud cost per day:	$ 169
Mud cost per foot:	$ 4.65
Mud cost per barrel per day:	$ .35
Maintenance cost:*	$ 1180
Average daily maintenance cost:*	$ 169
Trouble cost:	$ -0-

* Maintenance costs as used in this summary include maintenance and alteration of mud properties.

MUD COST ANALYSIS

A. Mud Type: Dispersed Fresh Water Gel
Aquagel, Lignite thinners, WL100 water loss control

B. Typical Mud properties at beginning of Interval: 250' - 1552'

Mud Weight	8.8	pH	11
Viscosity	40	Solids	8
Pv/Yp	20/35	Oil	0
Gels	6/12	Water	92
Filtrate API	18	HPHT	

C. Typical Mud properties at bottom of Interval:

Mud Weight	8.9	pH	11
Viscosity	34	Solids	8
Pv/Yp	9/2	Oil	0
Gels	0/10	Water	92
Filtrate API	15	HPHT	0

Mud cost at bottom of interval:	$ 11604
Mud cost at top of interval:	$ 1180
Interval mud cost:	$ 10424
Mud cost per day:	$ 580
Mud cost per foot:	$ 8
Mud cost per barrel per day:	$ 1.20
Maintenance cost:*	$ 7300
Average daily maintenance cost:*	$ 406
Trouble cost:	$ 3100

* Maintenance costs as used in this summary include maintenance and alteration of mud properties.

MUD COST ANALYSIS

A. Mud Type: Dispersed Fresh Water Gel at top of Interval
Aerated treated water and foam at bottom of Interval

B. Typical Mud properties at beginning of Interval: 1552' - 3357'

Mud Weight	8.9	pH	10.5
Viscosity	39	Solids	4
Pv/Yp	14/3	Oil	0
Gels	0/2	Water	96
Filtrate API	12	HPHT	

C. Typical Mud properties at bottom of Interval:

Mud Weight	8.4	pH	11.5
Viscosity	28	Solids	1
Pv/Yp	0/1	Oil	0
Gels	0/0	Water	99
Filtrate API	NC	HPHT	

Mud cost at bottom of interval:	$ 68000
Mud cost at top of interval:	$ 11604
Interval mud cost:	$ 56396
Mud cost per day:	$ 1200
Mud cost per foot:	$ 31.25
Mud cost per barrel per day:	$ 1.32
Maintenance cost:* projected	$ 19200
Average daily maintenance cost:*	$ 109
Trouble cost:	$ 37196

* Maintenance costs as used in this summary include maintenance and alteration of mud properties.

MUD COST ANALYSIS

A. Mud Type: Dispersed Fresh Water Gel was tried but due to formation fracture condition, it became necessary to revert back to Aerated treated water.

B. Typical Mud properties at beginning of Interval: 3357' - 7735'

Mud Weight	8.8	pH	12
Viscosity	45	Solids	4
Pv/Yp	10/7	Oil	0
Gels	3/6	Water	0
Filtrate API	16.8	HPHT	

C. Typical Mud properties at bottom of Interval:

Mud Weight	8.4	pH	11.5
Viscosity	28	Solids	1
Pv/Yp	1/1	Oil	0
Gels	0/0	Water	99
Filtrate API	NC	HPHT	

Mud cost at bottom of interval:	$ 182890
Mud cost at top of interval:	$ 68000
Interval mud cost:	$ 114890
Mud cost per day:	$ 3282
Mud cost per foot:	$ 26.25
Mud cost per barrel per day: Including sump @ approximately 12000 bbls	$ .35
Maintenance cost:* Projected	$ 29320
Average daily maintenance cost:*	$ 714
Trouble cost:	$ 85603

* Maintenance costs as used in this summary include maintenance and alteration of mud properties.

COMMENTS & DRILLING HAZARDS | FORMATION | DEPTH

NL Baroid GRAPHIC RECORD

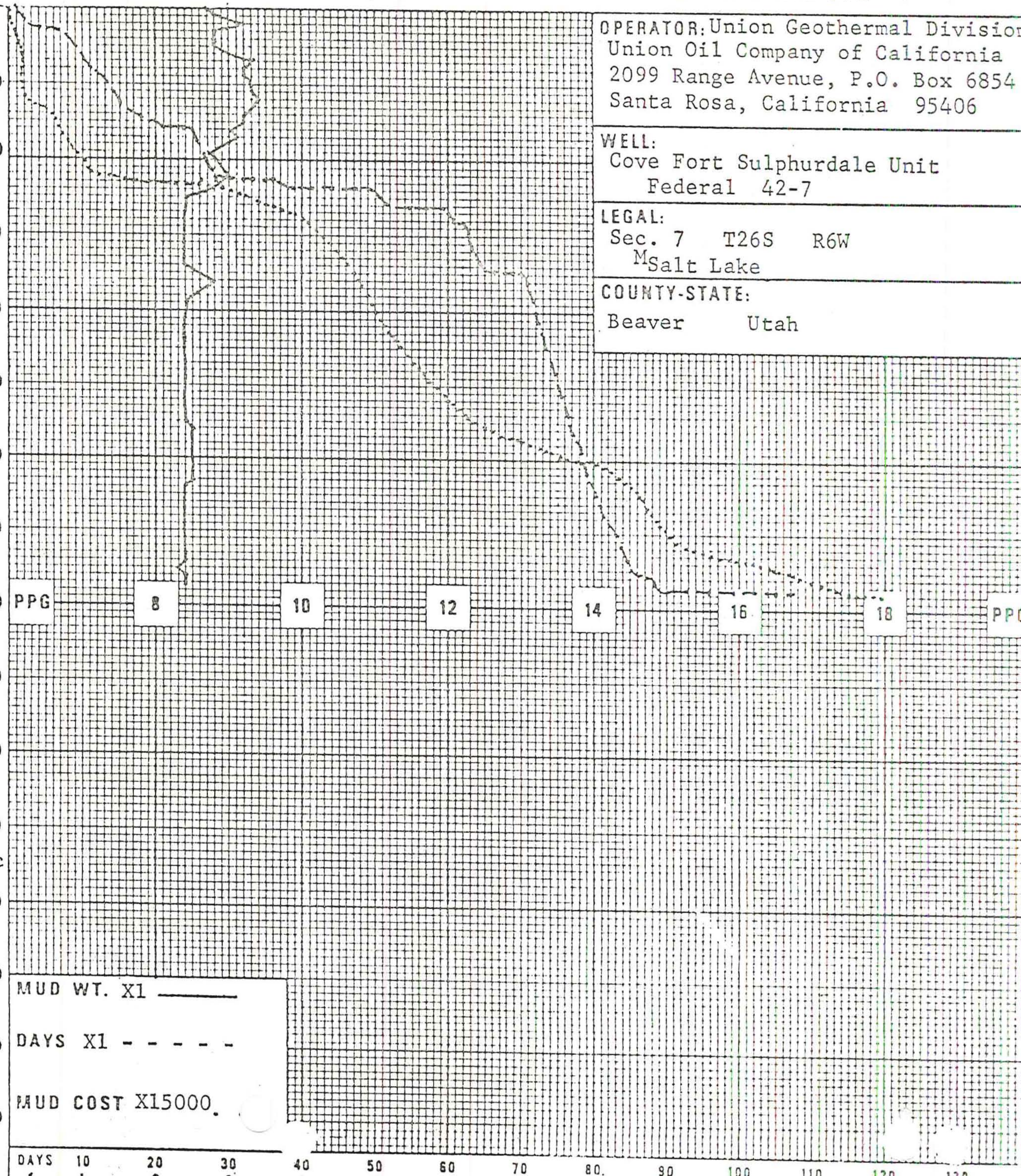
OPERATOR: Union Geothermal Division
Union Oil Company of California
2099 Range Avenue, P.O. Box 6854
Santa Rosa, California 95406

WELL: Cove Fort Sulphurdale Unit
Federal 42-7

LEGAL: Sec. 7 T26S R6W
MSalt Lake

COUNTY-STATE: Beaver Utah

COMMENTS & DRILLING HAZARDS	FORMATION
Lost 1388 Circulation Cementing	0 - 2055 Bullion Canyon Volcanics Mid Tertiary Andesite
2244 Severe Lost Circulation Problems	Upper Oligocene possibly miocene
2342 Aerated drlg	2055-2800 Coconino Sand Permian lots of uniform temperature water
Corrision 3448 control problems	
Continued Aerated drlg	2800-3380 Pakoon Limestone
Hole making water	
Lost circulation environment	3380-3980 Oquirrh Pennsylvanian
	3980-7735 Contact Metamorphics in Paleozoic section Marbles
	No recognizable tops
	Few sedimentary beds
	Zone from 7100 to 7735 was metamorphic Serpentine Marble that kept sloughing into the hole.



BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
9-10-77				Drilled and set 30" conductor pipe to a depth of 30'
11-28-77				Installed mouse and rat hole and rigged up to spud hole
11-29-77		157'		Spudded hole - commenced drilling operations
11-30-77		255'		Drilled 17½" hole to 255' rigged up to open hole to 26"
12-1-77		255'		Opened hole to 26"
12-2-77		255'		Ran, Set, and cemented 20" surface casing. Installed
				flanged and nippled up blowout preventers
12-3-77		255'		Finished installing and attempted testing of BOPE
12-4-77		259'		Completed tests of BOPE and commenced drilling of 17½" ho
12-5-77		347'		Continued drilling 17½" hole
6-77		492'		Continued drilling 17½" hole
12-7-77		611'		POH to change shock sub. RIH and continued drilling
				17½" hole
12-8-77		746'		Continued drilling until pin parted on bottom stabilizer
				leaving one 9" drill collar, reamer and bit in hole
12-9-77		819'		Engaged fish and P.O.H. Inspected drilling assembly and
				R.I.H. to bottom. Continued drilling
12-10-77		905'		Continued drilling
12-11-77		1096'		Continued drilling
12-12-77		1221'		Continued drilling until bit plugged POH to unplug bit
				then RIH
12-13-77		1313'		Continued drilling to 1257' lost pump pressure. POH to
				check drill string. Bit washed out around two jet nozzle
				changed bit, RIH and continued drilling.
12-14-77		1388'		Continued drilling to 1388' lost circulation. Began

BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
12-14-77		1388' (Cont.)		mixing mud and LCM to regain circulation. Lost 650 bbls
				mud to the hole.
12-15-77		1452'		Regained circulation. Continued drilling to 1452' twisted
				pin off top stabilizer. Left two 8" drill collars, shock
				sub, 8" drill collar, reamer and bit in hole. RIH with
				over shot and caught fish.
12-16-77		1494'		POH with fish and changed tools. RIH and continued
				drilling to 1494'. Lost circulation. Mixed and pumped
				cement to regain circulation.
12-17-77		1494'		Continued cementing operations until hole would not take
				fluid under 100 psi at surface. RIH with 17½" drilling
				assembly.
12-18-77		1557'		Continued drilling to 1557'. POH and laid down tools
12-19-77		1557'		Ran, set, and cemented 13 3/8" casing. WOC and rigged
				down BOPE.
12-20-77		1557'		Rerigged BOPE
12-21-77		1557'		Completed installation and testing of BOPE
12-22-77		1576'		RIH with 12¼" drilling assembly. Commenced drilling 12¼"
				hole to 1559'. Lost circulation. Mixed more mud, lost
				350 bbls mud to hole. POH and found bit locked. Changed
				bottom hole assembly. RIH continued drilling 12¼" hole to
				1576'
12-23-77		1806'		Continued drilling.
12-24-77		1970'		Continued drilling to 1836'. Lost 650 bbls mud to hole.
				Pulled bit off bottom and mixed mud and LCM. Regained

BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
12-24-77		1970' (Cont.)		circulation. Continued drilling to 1850'. Lost circulation. Pulled bit to 1550' to mix mud & LCM. Regained circulation after a loss of 150 bbls mud. Continu[ed] drilling to 1970' with loss of another 50 bbls mud.
12-25-77		2218'		Continued drilling to 2123'. Lost 650 bbls mud to hole. Pulled bit off bottom to mix mud and LCM to regain circulation, lost an additional 475 bbls. Regained circulati[on]. Continued drilling to 2175'. Lost 450 bbls mud to hole. pulled bit off bottom. Mixed mud and LCM. Regained circulation. Continued drilling to 2218'. Lost 450 bbls mud to hole, pulled bit off bottom to mix mud and LCM.
12-26-77		2244'		Continued drilling to 2238' without returns, losing anoth[er] 400 bbls mud. Pulled bit off bottom to mix mud and LCM Continued drilling to 2244' without returns losing anothe[r] 400 bbls mud. POH to mix and pump cement to regain circulation. WOC
12-27-77		2244'		Mixing and pumping cement to regain circulation. RIH and commenced cleaning hole. Plugged bit while cleaning stringer at 1636'.
12-28-77		2244'		P.O.H. and cleaned bit. RIH and continued cleaning hole. Lost all returns (700 bbls mud) at 2214'. POH Mixed and pumped cement to regain circulation. WOC
12-29-77		2244'		RIH and began cleaning cement stringers at 1760'. Lost circulation at 2244' continued to drill to 2250' without returns. Lost 450 bbls mud to hole. POH to mix and pum[p]

BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
12-29-77		2244' (Cont.)		cement WOC
12-30-77		2250'		Lost 450 bbls mud to hole. POH mixed mud and LCM. RIH
				lost another 200 bbls mud to hole
12-31-77		2250'		POH mixed and pumped 100 bbl LCM plug mixed and pumped
				cement to regain circulation WOC
1-1-78		2250'		Continued cementing operations WOC
1-2-78		2250'		RIH to circulate, lost 325 bbls to hole. POH mixed and
				pumped cement. RIH and commenced cleaning cement
				stringers at 1535'.
1-3-78		2307'		Continued cleaning cement. Drilled to 2252' lost
				circulation. Continued drilling without returns.
				Pulled bit off bottom to mix mud. Mixed mud. RIH Con-
				tinued drilling without returns. Lost 500 bbls mud to
				formation. Pulled off bottom mixed mud and LCM. RIH
				continued drilling without returns.
1-4-78		2342'		Continued drilling without returns. Pulled off bottom
				mixed mud and LCM. RIH, continued drilling without
				returns. POH Mixed and pumped cement. WOC
1-5-78		2342'		RIH Started pumping mud, lost 400 bbls mud to hole. POH
				mixed and pumped cement. WOC
1-6-78		2342'		Filled hole with mud. Lost approximately 400 bbls to
				hole. Continued cementing operations.
1-7-78		2342'		Started cleaning cement to 2244' where lost circulation
				was again encountered. Lost full returns while cleaning
				hole at 2242' losing approximately 400 bbls mud. POH an

BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
1-7-78		2342' (Cont.)		continued cementing operations.
1-8-78		2342'		Continued cementing operations; WOC
1-9-78		2342'		RIH and cleaned hole to 2250' with full returns. Lost circulation and drilled without returns to 2280' losing approximately 350 bbls mud. POH to mix mud. RIH and encountered fill at 2260'. Attempted to wash out fill and couldn't. Continued drilling without returns losin an additional 400 bbls mud. POH and continued cementing operations.
1-10-78		2342'		Continued cementing operations.
11-78		2342'		Continued cementing operations then POH to repair rig drawworks.
1-12-78		2342'		Began rigging up to drill with aerated mud.
1-13-78		2342'		Continued rigging up for drilling with aerated mud.
1-14-78		2342'		Continued rigging up for aerated circulating system.
1-15-78		2342'		RIH and began cleaning hole with mud as circulating medium to 2090'. Commenced using aerated mud at 2090'. Continued cleaning hole to 2245'.
1-16-78		2400'		Continued cleaning hole and began drilling new hole. Lc circulation. POH to rig up for foam drilling. Started run in hole.
1-17-78		2543'		RIH. Commenced drilling with foam. Hole began making water at the rate of 600 bbls per hour. Filled sump then shut of air and emptied sump by pumping same water into hole without returns while drilling.

BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
1-18-78		2606'		Continued drilling while pumping sump water without
				returns. Pulled off bottom to replace rotating rubber,
				encountered 34 ft fill while returning to bottom. POH
1-19-78		2606'		RIH with OEDP to run temp survey. POH Commenced cement-
				ing operations.
1-20-78		2606'		Continued cementing operations.
1-21-78		2606'		RIH and commenced cleaning hole with foam and aerated m
				as circulating medium. Hole started making water again
				POH and pumped 1680 bbls water into hole with no fill.
				Commenced cementing operations.
22-78		2606'		Continued cementing operations.
1-23-78		2606'		Continued cementing operations. Had to shut down opera-
				tions due to blizzard.
1-24-78		2606'		Opened road to rig and relieved crews. Commenced clean-
				ing hole using mud as circulating medium with full
				returns to 1750'.
1-25-78		2606'		Continued cleaning hole to 2006'. POH and rigged up fo
				aerated drilling. RIH and continued cleaning hole to
				2300' with full returns.
1-26-78		2681'		Finished cleaning hole and began drilling new hole. Hole
				commenced making 300 bbls water per hour. Continued
				drilling using aerated fluid.
1-27-78		2804'		Continued drilling with aerated system until sump fille
				Emptied sump by pumping fluid through bit without retur
				while drilling Approximately 7000 bbls.

NL BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
1-28-78		2804'		Continued pumping sump water for a total of 9000 bbls.
				POH Commenced cementing operations.
1-29-78		3029'		Cleaned hole and commenced drilling to 3029' with
				aerated mud.
1-30-78		3304'		Continued drilling to 3304'. POH to run surveys and
				temp readings.
1-31-78		3448'		Relocated jet subs. RIH Continued drilling to 3448'.
				POH to run logs.
2-1-78		3448'		Ran Logs. Commenced cementing operations to condition
				hole for casing.
·2-78		3448'		Cleaned hole to run casing. POH ran and set 9 5/8"
				casing.
2-3-78		3448'		Commenced cementing operations on 9 5/8" casing.
2-4-78		3448'		Continued cementing and testing casing. Began cleaning
				cement.
2-5-78		3448'		Continued cleaning cement and ran cement bond logs.
2-6-78		3629'		Rigged down logging equipment and commenced cleaning
				hole. Drilled with full returns to 3495' where total
				returns were lost due to the presence of a 4' void.
				Continued drilling while pumping water through bit
				without returns to 3629'.
2-7-78		3975'		POH and replaced jet subs. RIH and drilled to 3800'
				with aerated water. Drilled to 3975' with no returns
				while pumping water through bit.
2-8-78		4336'		Drilled with aerated water to 4135'. Drilled with wate

NL BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
2-8-78		4336' (Cont.)		and no returns to 4325'. Drilled with aerated water
				to 4336'.
2-9-78		4690'		Drilled with aerated water to 4550'. Drilled to 4690'
				while injecting water with no returns.
2-10-78		5023'		Drilled to 4789' injecting water with no returns. Drill
				to 5018' injecting water with no returns. Drilled to
				5023' with aerated water.
2-11-78		5291'		Continued drilling operations alternating circulating
				medium as necessary.
2-12-78		5619'		Continued drilling operations alternating circulating
				medium as necessary.
2-13-78		5740'		Drilled to 5710' with aerated water, pumped sump down
				while repairing spline on compound shaft. Drilled to
				5740' with aerated water.
2-14-78		6159'		Continued drilling alternating circulating mediums.
2-15-78		6329'		Continued drilling while alternating circulating medium
2-16-78		6555'		Continued drilling while alternating circulating medium
2-17-78		6835'		Continued drilling while alternating circulating medium
2-18-78		6973'		Continued drilling while alternating circulating medium
				Had to shut down rig to repair pump suction at 6875'.
2-19-78		7125'		Continued drilling while alternating circulating medium
				ran temperature survey.
2-20-78		7386'		Continued drilling while alternating circulating medium
				POH at 7323' and laid down two joints split drill pipe.
				RIH continued drilling.

NL BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
2-21-78		7512'		Continued drilling with aerated water. Bit plugged then opened up again. Pipe stuck, worked stuck pipe free. POH to check drill string. Relocated jet subs. RIH still couldn't circulate. POH and laid down one joint split pipe.
2-22-78		7530'		RIH cleaned fill out of hole. Continued drilling to 7530' then pumped 12,000 bbls sump water into hole.
2-23-78		7542'		POH checked bit. RIH to clean hole for logging. Commence running logs.
2-24-78		7615'		Rigged down dia-log equipment. RIH Washed and reamed hole. Continued drilling to 7615', tripped for bit and pumped sump water into hole.
2-25-78		7735'		Continued drilling, washing, and reaming, pipe stuck while drilling. Worked free after two hours.
2-26-78		7735'		POH Pumped sump water into hole while rigging logging equipment. Commenced logging operations with Go International Spinner Survey. Tool failed.
2-27-78		7735'		Attempted to rerun spinner survey. Tool failed. Completed Go International logs, rigged down equipment.
2-28-78		7735'		Washed and reamed hole. Rigged up Schumberger Equipment.
3-1-78		7735'		Ran Schumberger logs. POH to run casing.
3-2-78		7735'		Ran casing.
3-3-78		7735'		Couldn't get tools to release from liner hanger.
3 -78		7735'		P.O.H. with casing.
3-5-78		7735'		RIH with drill string to circulate and clean hole.

NL BAROID

DAILY OPERATIONS SUMMARY

Date	Tour	Depth	Hours	Operation
3-6-78		7735'		POH and rigged up to rerun liner. Cemented liner.
3-7-78		7735'		POH and laid down liner hanging tools. Recemented liner.
3-8-78		7735'		POH and RIH to set packer. Were unsuccessful. Pumped
				water to cool hole.
3-9-78		7735'		Continued completion operations.
3-10-78		7735'		Continued completion operations.
3-11-78		7735'		Continued completion operations.
3-12-78		7735'		Continued completion operations.
3-13-78		7735'		Continued completion operations.
3-14-77		7735'		Finished completion operations.

Corrosion in $lbs/ft^2/year$

Dates	Coupon #'s	Air Time	Total Time	Treatment used
2/7-2/8	21434	28	12.9	pH 11-12(NaOH) Unisteam .45 gpm Ammonia .45 gpm
2/8-2/9	21378	30	12	pH 11-12 (NaOH) Unisteam .45 gpm ½ time Ammonia .45 gpm Unisteam .45 gpm Ammonia .45 gpm ½ time H 35 .63 gpm pH 11-12 (NaOH)
2/9-2/11	21417	20	9.3	Unisteam .45 gpm Ammonia .45 gpm ½ time H35 .63 gpm pH 11-12 (NaOH) Ammonia .45 gpm H35 .63 gpm ½ time pH 11-12 (NaOH) Na_2SO_3 on water only
2/10-2/11	21353	13.8	8.0	Ammonia .45 gpm H35 .63 gpm pH 11-12 (NaOH) Na_2SO_3 on water only Unisteam residual present
2/11-2/13	21379	22.7	12.1	Ammonia .45 gpm H35 .63 gpm pH 11-12 (NaOH)
	21359	19.0	10.1	Na_2SO_3 on water only
2/13-2/15	21362	15.6	7.1	Unisteam .45 gpm Ammonia .45 gpm pH 11-12 (NaOH)
	10753A	16.4	7.6	Na_2SO_3 on water only H35 residual present
2/15-2/16	21356	46.6	16	Unisteam .45 gpm
2/16-2/18	21398	33	11.4	Ammonia .45 gpm pH 11-12 (NaOH)
2/15-2/18	21360	30	10.5	Na_2SO_3 on water only
2/18-2/19	21342	17	9.7	
2/19-2/20	21220	23	9.9	Unisteam .45 gpm
2/18-2/20	6889A	20.2	8.2	Ammonia .45 gpm
2/20-2/21	21397	40.2	13.4	pH 11-12 (NaOH)
2/21-2/22	21373	42.2	14.1	6# min on water

Corrosion in lbs/ft^2/year

2/21-2/23	21495	27.2	7.8	On air Unisteam .45 gpm Ammonia .45 gpm UW58 .05 gpm H35 .14 gpm pH 11-12 (NaOH)
2/21-2/23	21342	27.8	7.8	On water Ammonia .45 gpm H35 .14 gpm Na_2SO_3 500 ppm pH 11-12 (NaOH)
2/22-2/23	21377	29.1	12.5	On air Unisteam .45 gpm Ammonia .45 gpm UW58 .05 gpm H35 .14 gpm pH 11-12 (NaOH)
2/22-2/23	21490	23.6	10.1	On fresh water Ammonia .45 gpm H35 .14 gpm Na_2SO_3 500 ppm pH 11-12 (NaOH)
2/24-2/26	21420		7.2	On Air Unisteam .45 gpm Ammonia .45 gpm UW58 .05 gpm H35 .14 gpm pH 11-12 (NaOH)
2/24-2/26	21306		7.1	On produced water Ammonia .45 gpm H35 .14 gpm Na_2SO_3 500 ppm pH 11-12 (NaOH)
2/27-2/28	21305	34	22.8	Dapp @ approx 2 lbs/bbl pH 11-12 (NaOH)
2/27-2/28	21355	30	19.5	H35 .14 gpm

Union Geothermal
Union Oil Company
Cove Fort Sulphurdale Unit
Federal #42-7

Beaver County, Utah
Loffland Rig #184

Analysis of deposit removed from the outside surface of drill pipe

Date	Stand #	Xray analysis	per cent
2-25-78	21	Calcium Carbonate	75%
		Magnetite	25%
2-25-78	42	Calcium Carbonate	46%
		Magnetite	54%
2-28-78	4,5,6	Calcium Carbonate	75%
		Magnetite	25%
2-28-78	21	Calcium Carbonate	67%
		Magnetite	33%

Technical Memorandum
Research Department
Union Oil Company of California
Union Research Center, Brea, California

UNION 76

To:	Mr. G. W. Hendricks	Memo:	E&PP 78-51M
From:	D. S. Pye	Date:	March 15, 1978
Division:	Exploration & Production Research	Project:	638-18810
Subject:	CORROSION PROBLEMS WHILE DRILLING COVE FORT SULFURDALE UNIT 42-7	Supervisor:	R. F. Krueger

DON L. ASH
MAY 22 1978

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Patent
W. C. Allen
D. L. Ash, Santa Rosa
P. W. Fischer
C. Otte, UOC
D. E. Pyle, UOC

During late January and February I was asked to investigate severe drill pipe corrosion being experienced during the drilling of exploratory geothermal well Sulfurdale 42-7 at Cove Fort, Utah. This report is a summary of the problems and the attempted remedies.

CORROSION RATES BECAME SEVERE WHEN AERATED WATER WAS USED AS THE DRILLING FLUID

Due to severe lost circulation problems and the costs associated with maintaining circulation under these adverse conditions, the drilling fluid was changed over from mud to aerated water. The aerated water reduced the wellbore pressure below formation pressure, which allowed the drilling fluid to circulate, but it also resulted in the production of formation fluids.

Two problems resulted from this change in the drilling method. The first was the produced fluids. The increased volume of fluid could only be disposed of in the well, so when the surface storage was full, the water was reinjected into well. Most of the time drilling was continued while the water was being injected (drilling "blind" with no fluid returns to the surface), but due to hole problems, drilling was halted during the water injection after February.

The second problem is the subject of this report. This problem was the increase in the corrosion rates that were experienced when oxygen containing air was injected with the water.

CHEMICAL TREATMENTS REDUCED, BUT DID NOT SOLVE THE CORROSION PROBLEM

Various chemicals were used in an effort to bring the corrosion under control, but none worked satisfactorily. The best results were obtained with a combination of water soluble amine (Unisteam), organic phosphonate (H-35 or H-351), ammonium hydroxide and pH control (with caustic). This combination reduced the corrosion rate from over 30 $lbs/ft^2/yr$ to between 7 and 8 $lbs/ft^2/yr$ on average. However, this is far from our desired maximum of 2 $lbs/ft^2/yr$. These high corrosion rates were reflected in severe damage to the drill pipe. There were 218 joints of premium grade drill pipe (#1) in the hole. Only 101 joints remained grade #1. 82 joints were downgraded to #2 pipe, 28 joints were downgraded to #3 pipe, and 7 joints went to junk. These adverse corrosion rates can also be seen in the casing caliper log on the 9-5/8-inch casing, although the damage is not as severe as that experienced by the drill pipe. The maximum corrosion rates occurred at the bottom of the drill string, and there was no casing in the hole at this point, which is why the casing did not show as severe a damage as the drill pipe.

DISCUSSION OF THE CORROSION CONTROL METHODS THAT WERE ATTEMPTED, THEIR APPLICATION, AND RELATIVE SUCCESS

When the corrosion problem was first recognized, we began to combat it using a method which had been successful in the past. This method utilized a water soluble amine, ammonium hydroxide, and pH control with caustic. It took about five days to set up the equipment and line up the supplies required to properly implement this treatment. This delay was dictated by the drilling method which required continuous treatment. Since formation water was produced, the total returns were placed in the sump, and then fluid was withdrawn from the sump and used as the drilling fluid. This fluid was basically untreated, so the total fluid going downhole had to be treated continuously. Since drilling rigs are set-up to treat a circulating fluid to maintain given concentrations rather than to continuously treat all the fluid, extensive modifications had to be made on the rig treating system. These modifications are shown schematically in FIGURE 1. The large quantities involved in continuous treatment also created supply problems which required a few days to straighten out, primarily because of adverse weather conditions at the time.

TABLE 1 summarizes the corrosion control chemicals used and their effectiveness. This table lists the chemicals used, their rate of injectiion (TABLE 2 lists the measured concentrations, and pH of the injected and returning fluids), the dates over which they were used, and the measured corrosion rates. The measured corrosion rates are calculated in two different ways. The first calculation assumes that all the corrosion took place while air was being injected, and calculates the rate during this time. The second calculation assumes that the corrosion took place uniformly during the time the coupon was in the drill string, and this represents the average corrosion rate on the drill pipe. For the purpose of the following discussion, I will use the corrosion rates in TABLE 1 based on the time that air was injected. All these corrosion rates are based on the weight loss experienced by corrosion rings placed in the drill string at the top of the drill collars. (TABLE 3 lists all the coupon results).

Initial treatments with caustic, ammonium hydroxide, and Unisteam (treatments 1 and 2) reduced the corrosion rates to 28#/ft^2/yr. Since this was still too high, we tried adding an organic phosphonate (H-35) to the mixture, (Mixture 3) but the rate stayed almost the same - 20-30#/ft^2/yr. We then tried a combination of organic phosphonate (H-35), ammonium hydroxide, and caustic during the air injection phase (basically eliminating the Unisteam), and added a catalyzed sodium sulfite oxygen scavenger during the period when air was not injected (Treatment 5). This combination reduced the corrosion rate to about 20#/ft^2/yr. However, we noted that during the transition time when a residual amount of Unisteam was present (Treatment 4), the rate was down to about 14#/ft^2/yr. Due to the cost and the ineffectiveness of H35 alone, we switched back to a Unisteam, ammonium hydroxide, caustic treatment, except that we also treated with sodium sulfite oxygen scavenger during the time that air was not being injected (Treatment 7). This resulted in corrosion rates of 30 to 40#/ft^2/yr. The increase in these rates over treatments 1 and 2 is probably due to the increasing depth of the well which increases the corrosion rate.

We noted again that the corrosion rate decreased during the interim period when the chemical change was made (treatment 6) where corrosion rates were only 16#/ft^2/yr.

The next test used an inhibitive salt, sodium nitrite. The initial results were not too bad 20#/ft^2/yr, but this rate did not hold, and rates of up to 40#/ft^2/yr were recorded, and this test was abandoned.

We switched back to a mixture which would approximate the interim mixtures which had appeared to give us the best results so far (Treatment 9). This gave corrosion rates of 27-28#/ft^2/yr. On the theory that the inhibiting nature of these chemicals was being defeated by the produced brines, a test was made using fresh water (treatment 11), but no significant improvement was noted. One last test was conducted using diammonium phosphate (Treatment 12), but it also proved negative, with corrosion rates of 30#/ft^2/yr.

TABLE 1 provides a brief overview of this discussion. This table is augmented by TABLE 4 which shows the time interval that each coupon was exposed, and the treating fluids used at that time. TABLE 2 lists the actual measured quantities of the treating materials that were in the fluids going down the hole and the fluids that were returning from the hole, and TABLE 3 lists all the test coupons that were run and their results.

OTHER METHODS WERE CONSIDERED

Two other methods of corrosion control were considered, but were not tried. The first was the use of chromates. This method was not used because of environmental problems. The second method was the elimination of oxygen by using an inert gas such as nitrogen. This method was not tried because of the excessive costs and long lead times which may have exceeded the remaining drilling time on the well.

Stephen Pye
Exploration & Production Research

DSP:ms
Att.

TABLE 1

SUMMARY OF THE CORROSION CONTROL CHEMICALS USED AND THEIR EFFECTIVENESS

	Compounds Used	$\#/ft^2/yr.$ Air Time	$\#/ft^2/yr.$ Total Time	Dates	Coupons
1)	Unisteam 0.45 gpm Ammonia 0.45 gpm NaOH pH 11-12	28	12.9	2/7-2/8	21434
2)	Unisteam 0.45 gpm Ammonia 0.45 gpm NaOH pH 11-12 (1/2 of coupon life)	30	12.0	2/7-2/9	21378
3)	Unisteam 0.45 gpm Ammonia 0.45 gpm H-35 0.63 gpm NaOH, pH 11-12 (Other 1/2 of coupon life)				
	1/2 exposed to treatment 3 and 1/2 to treatment 4	20	9.3	2/9-2/11	21417
4)	Ammonia 0.45 gpm H-35 0.63 gpm NaOH, pH 11-12, NO_2SO_3 on water, residual Unisteam	13.8	8.0	2/10-2/11	21353
5)	Ammonia 0.45 gpm H-35 0.63 gpm NaOH Na_2SO_3	22.7 19.0	12.1 10.1	2/11-2/13	21379 21359
6)	Unisteam 0.45 gpm Ammonia 0.45 gpm NaOH, pH 11-12 Na_2SO_3 on water H-35 residual present.	15.6 16.4	7.1 7.6	2/13-2/15	21362 10753A
7)	Unisteam 0.45 gpm Ammonia 0.45 gpm NaOH, pH 11-12 Na_2SO_3 added on water	46.6 33.0 30.0	16.0 11.4 10.5	2/15-2/16 2/16-2/18 2/15-2/18	21356 21398 21360
8)	Unisteam 0.45 gpm Ammonia 0.45 gpm $NaNO_2$ ~6#/min.	17.0 23.0 20.2 40.2 42.2	9.7 9.9 8.2 13.4 14.1	2/18-2/19 2/19-2/20 2/18-2/20 2/20-2/21 2/21-2/22	21342 21220 6889A 21397 21373

TABLE 1 (Cont'd.)

	Compounds Used	#/ft²/yr Air Time	Total Time	Dates	Coupon Nos.
9)	Unisteam 0.45 gpm Ammonia 0.45 gpm UW-58 0.05 gpm H-35 0.14 gpm (Above used during air Injection)	27.2 27.8	7.8 7.8	2/21-2/23 2/21-2/23	21495 21342
	Ammonia 0.45 gpm H-35 0.14 gpm Na_2SO_3 (500 ppm) (Above used when air was not injected.)				
10)	Same, except used fresh water	29.1 23.6	12.5 10.1	2/22-2/23 2/22-2/23	21377 21490
11)	Same, except used produced water		7.2 7.1	2/24-2/26 2/24-2/26	21420 21306
12)	DAP	34 30	22.8 19.5	2/27-2/28 2/27-2/28	

TABLE 2

MEASURED CONCENTRATIONS AND pH OF THE INJECTED AND RETURNING FLUIDS

Date	Time	pH Suc	pH RTN	H-35 Suc	H-35 Rtn	NO_2 Suc	NO_2 Rtn	SO_3 Resid.	Remarks
1/28	2400	12.0	10						Drilling Cement
1/29	0100	11.8	11.7						Upped caustic to 1 sk/hr
	0200	10.2	8.4						(13 gal unisteam, 10 gal NH_4,
	0330	10.3	10.6						2-1/2 gal Quick foam 19.5 bbls, pump 6 gpm)
	0400	9.4	11.2						Caustic tank empty
	0430	10.8	7.9						First returns on surge
	0440		11.1						Avg. caustic 6 sk/5 hrs.
	0450	10.9							
	0740	9.1							Pit sample while tripping
	1230								Deleted Foamer and Increased Caustic to 2 sk/hr.
	1545	10.4	9.1						Derrick man says he can't keep pH above 10 with 2 sks/hr
	1600	10.5	9.3						
	1630	9.2	8.2						
	1700	10.1	7.8						
	1730	9.7	8.0						Made connection
	1800	9.9	8.0						limiting caustic addition to
	2100	8.9	9.4						100#/hr until new supplies arrive.
	2130	9.5							
	2145								Increased caustic to 4 sk/hr
	2200	10.4	10.2						
	2230	10.9	9.0						
	2300	11.0	10.9						
	2330	9.4	11.3						
1/30	0630	9.7							Communication gap with derric
	0830	9.8	9.5						man, dropped back to 2 sk/hr
	0900	9.8	8.3						for 6 hrs, back to 4 sk/hr no
	1035	10.3	10.0						Caustic Supplies have arrived Start trying for higher pH.
	1100	10.4	8.5						
	1130	10.4	9.1						Returns still foamy.
	1136		10.8						Single unload
	1140		10.4						
	1200	10.8							
	1230	10.5	8.7						
	1300	10.4	9.1						All 1 head
	1310		9.0						Sump pH = 9.3
	1313		11.5						
	1316		8.8						
	1330	11.3							
	1630	11.7	10.5						Sump pH = 9.6 Trip to measure BHT-288

Table 2 - Cont'd.

Date	Time	pH Suc	pH Rtn	H-35 Suc	H-35 Rtn	NO_2 Suc	NO_2 Rtn	SO_3 Resid	Remarks
1/31	0745	12.1							
	1100	11.3	8.0						8.8 pH sump
	1300	10.6	8.7						8.5 pH sump
	1330	9.4	8.8						
	1400	9.3	7.9						
	1430	8.9	8.3						
	1500	11.0	7.8						
	1630	10.0							Caustic pump started
2/6	1500								Trip for log, casing lost returns, drilling without returns, bit dropped 3 ft., had been drilling with mud pH 11.5 since 0800
	1715	11.8							
	1805	12.4							Pumping pit away
	1915	12.3							Reduced caustic addition sump 9.5 pH
	2015	12.0							
	2115	12.2							
2/7	0140								Trip - pipe looked good. No magnetite nodules.
	0745	10.6	8.4						
	0805	11.6							
	0830	11.6	8.6						sump pH = 9.5
	0900								Increased Unisteam and Ammonia
	1045	11.7	8.9						30 gal unisteam, 30 gal ammonia/9.5 bbl-pump at 6 gpm
	1130	11.9	9.1						
	1500	11.1							Drilling w/o returns same additions
	1800	11.4							
2/8	0230								pH low, just started drilling, caustic tank empty
	0300	12							
	0330	12.1	9.0						
	0430	12.2	7.8						
	0530	11.8	9.0						
	1130	10.5							Injecting w/o returns, poor samples
	1200	10.5							Mixed up the pit
	1200	12.1							Start H-35 injection
	2300	12.0	10.7						
2/9	1130								30 gal US, 30 gal NH_4, 42 gal H-35 - in 9.5 bbl, inj 6 gpm.
	1700								Ran out of H-35, continued injecting without
	1800								
	2400								Started injecting H-35 again, no air injection during the time H-35 was not used.

TABLE 2 - Cont'd.

Date	Time	pH Suc	pH Rtn	H-35 Suc	H-35 Rtn	NO_2 Suc	NO_2 Rtn	SO_3 Resid	Remarks
2/10	0430								Tripped bit 4780
	1130								Back on bottom
	1230								End of Unisteam addition
	1300				1280				
	1400				350				
	1500				570				
	2300								Sump 306 ppm H-35
	2300				1388			20	First Returns
2/12	0800				1050				Sump 1139 ppm H-35
	1430				1993				
	1600								Sump 1139 ppm H-35
2/13	0315								Changed to Unisteam Ammonia, Na_2 SO_3
	2300		9.7						
2/14	0100		10.2						
	0300		9.4						
2/18	0300								Started $NaNO_2$
	0430		9.2				250		Unisteam, ammonia, $NaNO_2$, NaOH
	0500	11.7	9.2			1400	230		
	0600					4000			
	1100					2000	500		
	1600					2000			
	2000					1000			
2/19	0600					1000			
	1700					1000			
2/20						1000			Started picking up CO_2 while on air about 7200
2/21	1300								Stopped Na NO_2
									30 gal US; 30 gal NH_4; 3 gal UW 58; 9 gal H-35 — Mixed to 9-1/2 bbl, 6 gpm on ai
									30 gal NH_4; 9 gal H-35; 200# /hr Na_2SO_3 — 9-1/2 bbls 6 gpm On Water
2/22									Having trouble with Na_2SO_3 pump amount injected questionable.

TABLE 2 - Cont'd.

Date	Time	pH Suc	pH Rtn	Cl Suc	Cl Rtn	NO_2 Suc	NO_2 Rtn	H-35 Returns		Remarks
2/23	0600	13.0		380		0			Fresh Water	
	0630		8.7		1950		50			
	0730	12.5	10.6		1400	50	100			
	0800	12.5	10.0	490	1420	25	100			
	0830	12.7	10.5	350	1200	10	50	44		
	0900	12.4	9.9	270	1100	5	70			
	0930	12.6	10.4	190	950	1	70			
	1000	12.4	9.9	190	950	1	70	64		
	1040	12.2	10.0	180	750	1	70			
	1110	12.0	10.2	150	680	0	30	57		
	1140	11.9	8.9	250	1130	0	50			
	1210	11.9	8.8	150	1260	0	50	35		
	1215								Terminate Test	

Time	PO_4 Conc. Suct.	PO_4 Conc. Rtn.	DAP Test
0200	3500		
0400	3250		
0630	3400		256 in sump
0730	2750		650 in sump

TABLE 3
RESULTS OF CORROSION COUPON TESTS

NOTE: All coupons were at the top of the drill collars except those followed by KSS which were in the kelley saver sub at the top of the drill string. The corrosion rings were for 4-1/2 IF tool joints, and had a K factor of 253

	Depth		In		Out		Weight		Total	
Coupon No.	In	Out	Date	Time	Date	Time	Original	Final	Hrs.	$\#/ft^2/yr.$
Unknown	-	2528	-	-	1/28	1800	79.4208	76.953	86	7.26
5127	2528	2758	1/28	1800	1/29	0900	80.5851	79.341	15	21.0
10783A	2777	3304	1/29	1200	1/30	1900	81.165	79.92	31	10.2
6695A	2777	3304	1/29	1200	1/30	1900	80.497	78.752	31	14.2
10910A	3304	3448	1/31	0030	2/1	0330	80.0203	78.36	27	15.6
21328	3453		2/6	1130	2/7	0140	80.2645	80.08	14	3.3
21307	3453	3980	2/6	1130	2/7	2330	80.3381	79.05	36	9.1
21434	3629	4414	2/7	0140	2/9	0730	80.6539	77.92	54	12.9
21378	3975	4787	2/7	2330	2/10	0730	81.0735	78.42	56	12.0
21353	4787	5216	2/10	1700	2/11	1500	78.7073	77.70	32	8.0
21417	4414	5216	2/9	0700	2/11	1500	79.2884	77.22	56	9.3
21357 KSS	5216	5619	2/11	1600	2/13	0315	79.3599	79.23	35	0.9
21379	5216	5619	2/11	1600	2/13	0055	80.6510	79.08	33	12.1
21359	5216	5619	2/11	1600	2/13	0045	78.8140	77.51	33	10.1
21439 KSS	5619	6168	2/13	0315	2/15	0445	80.1146	79.83	49.5	1.4
10753A	5619	6168	2/13	0100	2/15	0430	82.0930	80.54	51	7.6
21362	5619	6168	2/13	0045	2/15	0430	79.6304	78.15	52	7.1
21356	6168	6489	2/15	0300	2/16	1530	78.8827	76.58	36.5	16.0
21398	6489	6835	2/16	1500	2/17	2200	79.4851	78.09	31	11.4
21360	6168	6835	2/15	0300	2/18	0000	78.0566	75.20	69	10.5
21337 KSS	6168	6835	2/15	0315	2/18	0230	80.3938	80.02	71.25	1.3
21342	6835	7003	2/18	0000	2/19	0830	78.2639	77.02	32.5	9.7
21220	7003	7323	2/19	0830	2/20	1320	80.3410	79.20	29	9.9
6889A	6835	7323	2/18	0000	2/20	1315	78.9159	76.92	61.25	8.2
10989A KSS	6835	7323	2/18	0230	2/20	1530	79.0156	78.93	61	0.4
21397	7323	7512	2/20	1320	2/21	1300	80.0125	78.74	24	13.4
21373	7323	7512	2/20	1315	2/21	1300	80.8633	79.53	24	14.1
21495	7512	7530	2/21	1300	2/22	2250	80.7664	79.69	35	7.8
21324	7512	7530	2/21	1300	2/23	0030	80.5405	79.44	35.5	7.8
21365 KSS	7323	7530	2/20	1530	2/23	0020	80.2124	80.10	57	0.5
21377	7530	7542	2/23	0100	2/23	1455	80.64	79.95	14	12.5
21490	7530	7542	2/23	0100	2/23	1455	80.44	79.88	14	10.1
21462 KSS	7530	7542	2/23	0800	2/23	1530	79.5048	79.43	7.5	0
21420	7542	7735	2/24	0100	2/26	0500	80.1468	78.67	52	7.2
21306	7542	7735	2/24	0100	2/26	0500	79.3884	77.92	52	7.1
21399 KSS	7542	7735	2/24	0100	2/26	0500	79.79	79.70	52	0.4
			2/27		2/28				10.5	22.8
			2/27		2/28				10.5	19.5

TABLE 4

COUPON RESULTS AS A FUNCTION OF TIME AND THE CORROSION CONTROL TREATMENT

KSS - Kelley Saver, ( ) air time only.

Date	Time	Coupons	Fluid
1/26	0000		
	0600		1100 SCFM
	1200		365-370 gpm or 700-800 gpm
	1800		
1/27	0000		0.15 gpm ammonia
		7.26 NH_4 QF	0.04 gpm quick foam
	0600		
	1200		
	1800		
1/28	0000		
	0600		
	1200		
	1800		
1/29	0000	21.0 US NH_4 QF	0.2 US 0.15 Ammonia 0.04 quick foam 1 sk/hr NaOH
	0600		
	1200	US NH_4	0.2 US 0.15 ammonia 2 sk/hr NaOH
	1800		4 sk/hr, Caustic limited by supply
1/30	0000		
	0600	10.2 14.2	
	1200		Started increasing caustic based on pH.
	1800		2200 SCFM
1/31	0000		365-370 gpm or 700-800 gpm
	0600		
	1200	15.6	
	1800		
2/6	0000		2200 SCFM 365-370 gpm or 700-800 gpm
	0600		
	1200	3.3	
	1800	[illegible].1	
2/7	0000		
	0600	12.9 (28)	Upped US NH_4 0.45 US 0.45 NH_4
	1200		
	1800		
2/8	0000		
	0600	12.0 (30)	
	1200		
	1800		

Date	Time	Coupons	Fluid
2/9	0000	12.9 (28)	
	0600		
	1200	(30) 12.0	0.45 US 0.45 NH_4 0.63 H-35
	1800		
2/10	0000		
	0600	(20) 9.3	0.45 NH_4 0.63 H-35 $NaSO_3$ on H_2O
	1200		
	1800		
2/11	0000	8.0 (14)	
	0600		
	1200		
	1800		
2/12	0000	0.93 KSS 12.1 (23) 10.1 (19)	
	0600		
	1200		
	1800		
2/13	0000		
	0600	1.45 KSS 7.6 (16) 7.1 (16)	.45 US .45 NH_4 $NaSO_3$ on water
	1200		
	1800		
2/14	0000		
	0600		
	1200		
	1800		
2/15	0000		
	0600		
	1200		
	1800	16.0 (47)	
2/10	0000		
	0600	10.5 (30)	
	1200		
	1800		
2/17	0000	11.4 (33)	
	0600		

TABLE 4 (Cont'd.)

Date	Time	Coupons		Fluid
2/17	0600	(33) 11.4	(30) 10.5	
	1200			
	1800		1.3 KSS	
2/18	0000			.45 US .45 NH_4 $NaNO_2$
	0600	(17) 9.7		
	1200		8.2 (20)	
	1800			
2/19	0000	0.4 KSS		
	0600			
	1200	(23) 9.9		
	1800			
2/20	0000			
	0600			
	1200			
	1800	(40)		
2/21	0000	13.4		
	0600	14.1 (42)		
	1200		0.5 KSS	Air .45 US .45 NH_4 .05 UW58 .14 H-35 Water .45 NH_3 .14 H-35 200#/hr $NaSO_3$
	1800			
2/22	0000	7.8 7.8 (27)		
	0600			
	1200			
	1800			
2/23	0000			
	0600	12.5 (29) 10.1 (24) 0KSS		As above but in fresh water.
	1200			
	1800			Delete fresh water
2/24	0000			
	0600			
	1200	7.2 7.1		
	1800	0.4 KSS		
2/25	0000			
	0600			
	1200			

Date	Time	Coupons	Fluid
2/25	1200	7.2 7.1 0.4 KSS	
	1800		
2/26	0000		
	0600		
	1200		
	1800		
2/27	0000	22.8 (34) 19.5 (30) 0.1 KSS	DAP
	0600		
	1200		
	1800		
2/28	0000		
	0600		
	1200		
	1800		
3/1	0000		
	0600		
	1200		
	1800		
3/2-	0000		
	0600		
	1200		
	1800		
3/3	0000		
	0600		
	1200		
	1800		
3/4	0000		

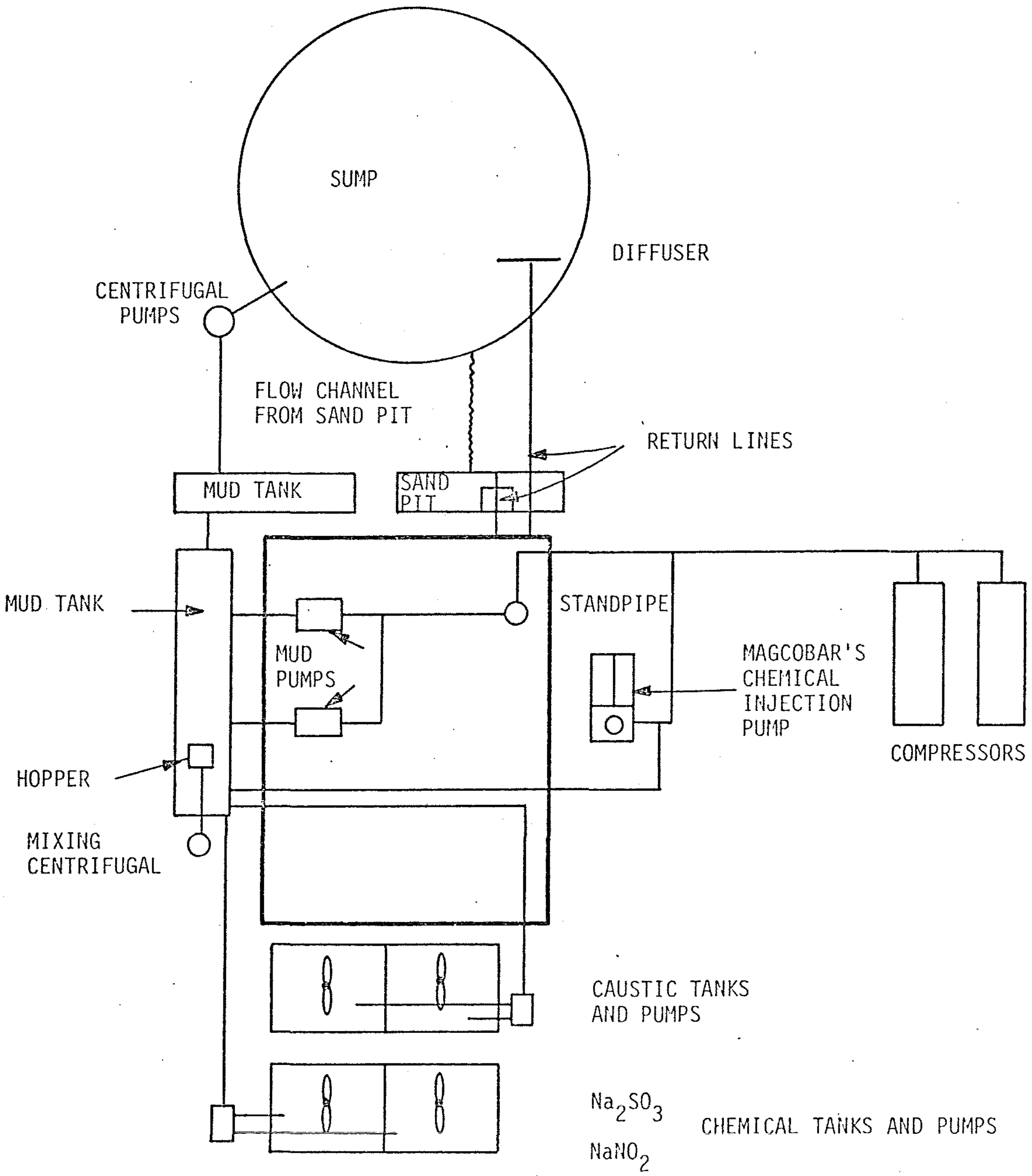


FIGURE 1

SCHEMATIC DIAGRAM OF THE CHEMICAL TREATMENT SYSTEM

COVE FORT SULPHURDALE UNIT WELL 42-7

H_2S SAFETY PROCEDURES

Protection of all people on and around the Cove Fort-Sulphurdale 42-7 location from possible H_2S gas poisoning was of the utmost importance to Union Oil Company of California.

With the help of Oilind Safety Engineering, Inc., Union Oil developed and implemented a state of the art safety program to ensure the safety of everyone. The safety equipment and personnel consisted of:

1) Safety trailer with 15 - 300 C.F. cylinder cascade air supply system.
2) Two thousand feet of low pressure air line hose with quick connects.
3) High pressure air compressor.
4) Five low pressure manifolds.
5) Fourteen air line masks with escape cylinders.
6) Thirteen 30 minute self contained oxygen units.
7) Two head-fixed H_2S monitor systems.
8) Warning sirens and revolving amber light.
9) Three wind socks.
10) First aid kit.
11) Two resuscitators with cylinders (oxygen powered).
12) Flare gun with shells.
13) Gas detector (pump type).
14) Safety supervisor.

One H_2S gas monitor was located on the rig floor, one under the rig floor at the flow nipple, and one at the mud shakers. The monitors were set to detect H_2S concentrations in excess of 10 ppm and automatically activate a warning siren and revolving amber light. In the event of a warning, the men on the rig floor were instructed to immediately put on air breathing apparatus with escape cylinders and alternate reserve air line. Air was supplied to the masks through manifolds from the cascade air supply system. If for some reason there was a malfunction in the air supply system, the masks were equipped with escape cylinders which would supply air for sufficient time to allow a person to leave the area.

After it was determined that everyone was wearing a mask, either a safety supervisor or drilling foreman would check the area for H_2S using a hand operated gas detector. One of the 30 minute self-contained units was worn by the foreman so that he could move safely around the location while making the check. If an H_2S concentration of over 10 ppm was found in or around the work area, the men were required to continue work wearing the masks. If less than 10 ppm H_2S was found, the men could continue work without the masks. Constant monitoring was continued until the gas dissipated.

Three wind socks were located strategically around the location. If the warning siren sounded when an employee was away from either a self-contained air unit or air line mask, he could observe the wind sock and move quickly up wind escaping the gas.

In addition to the above, two oxygen resuscitators and a flare gun were on location at all times. The resuscitators were to be employed to revive any individual overcome by H_2S. If it was determined that any H_2S leak was adequate to endanger human or animal life in an area adjacent to the location, use of the flare gun would be a last resort measure to ignite and eliminate the gas.

All presonnel required to be present or perform any type of service on or in the proximity of the CFSU 42-7 location were given instruction relating to safe operating procedures in the presence of H_2S gas. Safety instruction was conducted in all cases by a qualified representative of Oilind Inc.. In addition to instruction, an inspection for broken eardrums was made by an M.D. and all personnel were required to be cleanly shaven to ensure an airtight fit of the available breathing apparatus.

Many scheduled and unscheduled H_2S drills were conducted, exposing each person associated with the drilling operation to at least one drill. The drills were triggered by manual activation of the H_2S alarm system.

In actuality, no H_2S gas problems were encountered while drilling Cove Fort Sulphurdale 42-7. The warning alarm did sound several times, but a 10 ppm or greater H_2S concentration was never found during extensive area by area checks.

RESULTS OF HIGH TEMPERATURE PRODUCTION LOGGING ON CFSU 42-7 BEAVER COUNTY, UTAH

Brian Maassen
Union Oil Company of California
Santa Rosa

SUMMARY

Four continuous temperature surveys were run on the CFSU 42-7, in Beaver County, Utah, with Gearhart-Owen high temperature production logging equipment. The first three surveys were made with the well static from one to twenty-four hours after a thirty minute flow period. These surveys indicated maximum temperatures of 340°F at 2500' and 344°F at 7327' with a 2500 foot 290°F isothermal zone from ±3600' and ±6100'. Using a radio-active tracer tool, flow rates of 26,000 lb/hr and 34,000 lb/hr downward were measured at depths of 3515' and 3900' respectively. An injection temperature profile indicated that fluid was exiting the wellbore at 6100' which is the bottom of the isothermal zone.

OBJECTIVES

The CFSU 42-7 was the first well completed in the Cove Fort, Sulphurdale Unit located in Beaver County, Utah. Upon reaching a T.D. of 7735', the well was logged with Gearhart-Owen temperature and spinner tools built for high temperature conditions. The objectives of the logging program were:

1) To evaluate wellbore conditions with high temperature tools prior to cooling the hole for conventional electric logging.

2) To test these tools to determine their diagnostic capability.

3) To determine why the well would produce hot fluids while drilling with an air-water mixture immediately after injecting several throusand barrels of cold water.

4) To design the completion program based on the evaluation of the data from these surveys and other geologic information.

TOOL DESCRIPTION

The temperature log was a combination temperature and differential temperature survey. The output was in the form of two traces consisting of absolute temperature in degrees Fahrenheit and differential temperature (the rate of change in the absolute temperature). The differential temperature readings were a qualitative indicator which pointed out small changes in temperature which were not noticeable on the absolute temperature trace.

The temperature and differential temperature tool consists of a thermal couple temperature probe attached to some electronics kept cool in a Dewar flask. The Dewar flask is effective for 4 to 5 hours at 550°F. The tool sends only absolute temperature to the surface, then the temperature differential reading is calculated by comparing the present reading with a reading taken at a fixed time interval prior to the present reading. This comparison is made by electronics in the logging truck. The high temperature spinner tool is essentially similar to a standard spinner tool constructed with high temperature components good to 550°F. Both tools are run on a 2 conductor logging cable able to withstand temperatures up to 565°F.

PROCEDURE

Upon reaching total depth at 7735', the drilling assemply was pulled out of the hole. Open ended drill pipe was run to 3000' and the well was flowed on air assist for 30 minutes. The fluid temperatures measured at the pit were 203°F. Logging began one hour after the flow.

Static Surveys

The first log was a temperature and differential temperature run from 3450' to 7327'. All the surveys touched bottom at 7327'. At 4000' the tool worked erratically but indicated temperatures seemed to be accurate. Temperatures of 340°F were found at 7300' with an 298°F isothermal zone from 3500' to 6120'.

The isothermal zone seemed to indicate movement of fluid up or down the wellbore. A spinner survey was run while the well was static to verify this. The spinner tool found the fluid level at 1310'. The results of this survey were inconsistent and were disregarded because the tool bearings were found to be damaged when inspected after the run. Thirteen hours after the flow a second temperature survey was run from 300' to 7327'. The differential temperature was not run because the tool was still operating erratically. The fluid level was found at 1310'. The highest temperatures were 340°F at 2500' opposite the Coconino sandstone and 344°F at 7327' (T.D.). The 298°F isothermal zone was still present between 3600' and 6075'.

Twenty-four hours after the flow a third temperature survey was run. A new control panel which did not support the differential temperature function was used on this run in hopes of correcting the problem of erratic tool operation. The new panel read temperatures about 5°F lower. The well was logged from 300' to 7327' and produced the same characteristic profile as the previous two surveys. The fluid level was again detected at 1310'.

Following the third temperature survey, a conventional (normal temperature) R/A tracer and spinner tools were run. The R/A tracer tool indicated that there was no flow in the wellbore at 3450', 26,000 lb/hr downward flow at 3515', and 34,000 lb/hr downward flow at 3900'. More R/A shots were planned but the R/A and spinner tools failed due to overheating.

Injection Temperature Profile

It was planned to run an injection profile with the spinner tool. However, when the tool overheated during the prior R/A work, an injection temperature profile was run in its place. The injection rate was 553 gal per minute of 70°F water and the survey was started when 1 wellbore volume was displaced. Injection continued during the survey and a total of 3.25 wellbore volumes had been injected by the survey's completion. The temperatures above 6060' showed cooling of the wellbore and the temperatures below 6060' were unchanged. This indicated that a large portion of the fluid was exiting at 6060'. This depth also corresponds with the bottom of the isothermal zone.

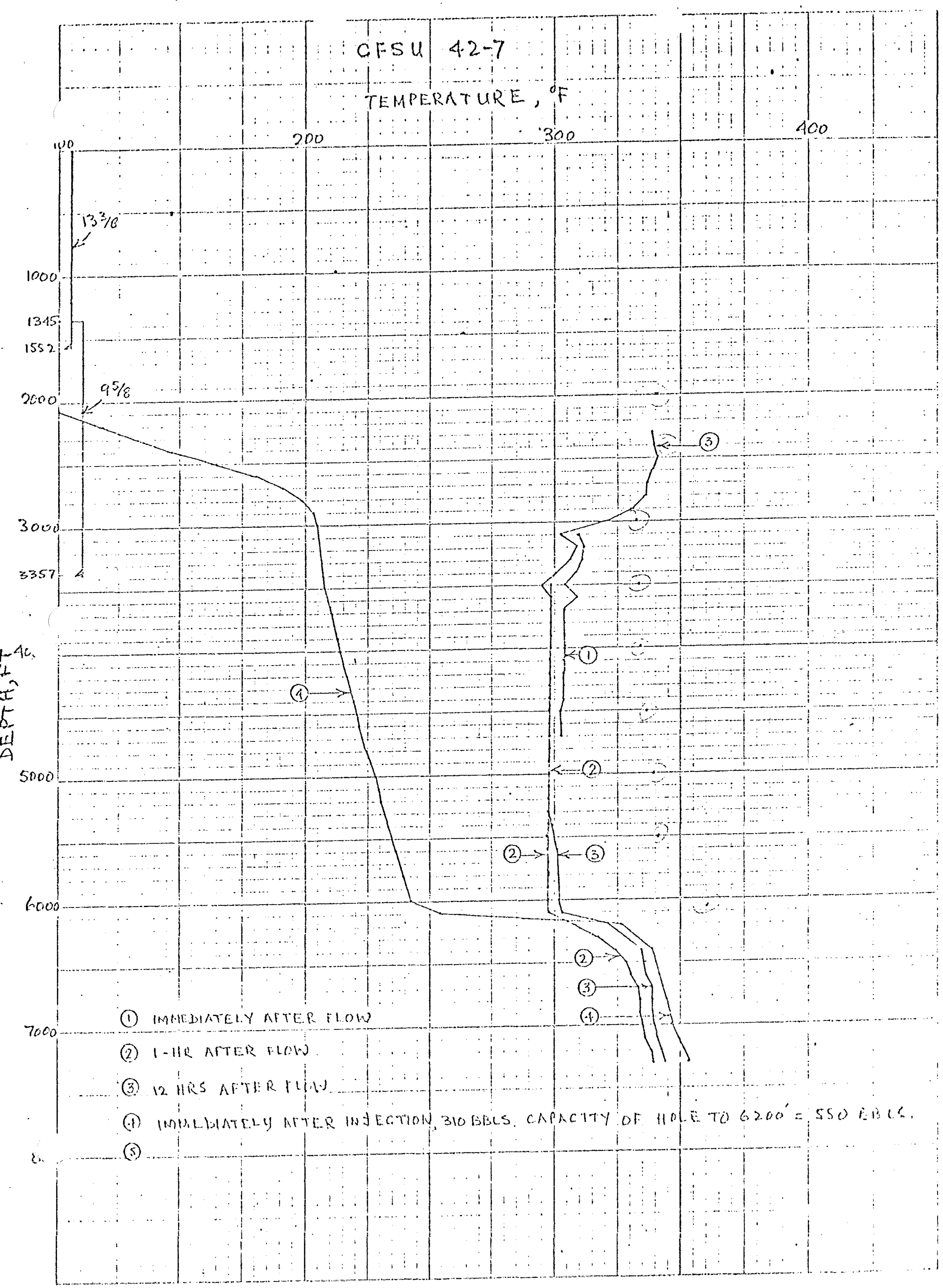
CONCLUSIONS

1) The maximum temperature recorded was 344°F at 7320'.

2) Fluid was entering the wellbore at ±3600' and exiting at ±6100' creating a 2500 foot 298°F isothermal zone. Whether this is due to natural conditions or is the result of disturbances created by drilling is yet to be determined.

3) The production logging equipment proved an effective method of determining what was going on in the wellbore. The high temperature spinner needs further improvements in its design.

3/30/78



GFSU 42-7
TEMPERATURE, °F
100
200
300
400
DEPTH, FT
1000
1345
1552
2000
3000
3357
4000
5000
6000
7000
13 3/8
9 5/8
① IMMEDIATELY AFTER FLOW
② 1-HR AFTER FLOW
③ 12 HRS AFTER FLOW
④ IMMEDIATELY AFTER INJECTION, 310 BBLS. CAPACITY OF HOLE TO 6200' = 550 BBLS.
⑤

FLOW TEST RESULTS AND ANALYSIS

The following data is not a complete summation of the information gained from the CFSU 42-7 flow test.

Water samples, now being analyzed, are necessary for a complete flow test conclusion.

Upon completion of the water analysis, the flow test summary will be forwarded with the Reservoir assessment report.

Union 76

May 23, 1978

TO: Mohinder Gulati

FM: Brian Maassen *B W Maassen*

RE: Preliminary Results of CFSU 42-7 Flow Test

Static Survey

A static temperature and differential survey was run on 5/15/78 prior to the flow test. The survey indicated a maximum temperature of 328°F at 6040' where a bridge was encountered. The 2500 foot isothermal zone from ±3600 to ±6100' found in surveys run prior to completion of the well was no longer present. A sensitive spinner tool was hung at several points in the zone and no flow was detected.

Flow Period

Open ended coiled tubing was run into the well on 5/16/78 at ±50 feet/min, circulating nitrogen at 1500 cubic feet per minute. An obstruction was encountered at 591 feet. When an attempt was made to back off 50', the tubing parted and 591 feet was lost down hole. Coiled tubing was again run into the well with a 3" washing jet on the end to act as a guide shoe. The tubing was run at the same speed and nitrogen rate as above, past the bridge at 6040', until it tagged bottom at 7211'. Several attempts were made to get past 7211' but all were unsuccessful. The well was lifted on nitrogen assist for 6 hours. At times, the well produced a small amount of black, sandy grit. Flow continued unassisted at a rate of ±48,000 lb/hr at 3 psig of wellhead pressure and decreased gradually over the next 7 hours to 43,000 lb/hr. The well was shut in at 7:00 a.m. on 5/17/78. Shortly after shut-in a 3" valve was opened on the wellhead, a noncondensible gas head was bled off and the wellhead pressure dropped to 0 psi.

Post Flow Survey

Twelve hours after shut-in a second temperature and differential temperature survey was run. This survey indicated a maximum temperature of 340°F at 6110' and a 336°F temperature at 6900'. The fluid level was at 1270'.

Injection Period

The produced fluid was injected into the well for 17 hours at an average rate of 53,000 lb/hr on a vacuum. A spinner survey was run but the results were inconclusive. The fluid level was found at 1370'. A radioactive tracer survey showed fluid leaving the wellbore at the following locations:

Slotted Interval	Percent
4353'-4473'	51
4860'-4989'	3
5112'-5319'	20
5534'-5660'	13
below 5800'	13

No tracer shots were made below 5800' due to temperature limitations on the tool. The injection flowing bottom hole pressure and pressure falloff were measured with Kuster tools, but the results are not yet available.

BWM/bls
cc: C. Otte
D. Pyle
N. Stefanides
V. Suter
S. Lipman
O. Whitescarver
D. Ash
R. Dondanville
F. Corbin
S. Maione

UNION 76

GEOTHERMAL DIVISION

SUBSURFACE SURVEY

Field Work Sheet

CFSU - 42-7 - S1 - PT, Trav

OWNER: Union Oil Company FIELD: Cove Fort WELL NAME: Sulpherdale 42-7

CASING: ELEV.: 6420 DATE: 4/5-6/78

LINER DESCRIPTION: 7" From 0 to 7615 ZERO POINT: Swab gate (+5')

tie back @ 3084 DEPTH: 7615 (KB + 20')

REMARKS: Fluid level ~ 1850 Ft

"Cold Water Entry" AT ± 2786

PURPOSE: Gradient Survey - traverse From 1500 to 6050 FT

ELEMENT: Press SERIAL NO.: 12833 CLOCK: 17454 TURN: STABILIZATION PERIOD:

temp 10172 17498

MAX. °F: 325 @ 6050

ENGAGE STYLUS: 1130 PST DISENGAGE STYLUS: 1724 PST COR. CSG. PRESS.: 250 #/G

PICKUP @: 6064

TIME ON BOTTOM: 1648 PST

WELL STATUS: TIME OFF BOTTOM: 1700 PST

SHUT IN: ✓ ON PRODUCTION: Open Swab Gate 1130 PST

Close Swab Gate 1720 PST

Pressure | Temperature

TIME	DEPTH	DEFL.	F—T	GRAD.	/D	TIME	DEPTH	DEFL.	F—T	GRAD.	/D	TIME	DEPTH	DEFL.	F—T	GRAD.	/D
	0		250				0		min				4700		301		
	500		253				500		106				4800		301		
	1000		253				1000		173				4900		301		
	1500		253				1500		227				5000		303		
	2500		471				2000		305				5100		303		
	3500		873				2100		308				5200		303		
	4500		1277				2200		309				5300		304		
	5500		1681				2300		309				5400		305		
	6050		1900				2400		310				5500		306		
							2500		310				5600		307		
							2600		310				5700		308		
							2700		310				5800		309		
							2800		310				5900		310		
							2900		304				6000		319		
							3000		293				6050		325		
							3100		297								
							3200		298								
							⟆		⟆								
							4000		298								
							4100		299								
							4200		299								
							4300		299								
							4400		300								
							4500		300								
							4600		301								

COMMENTS: Bridge @ 6064 - Tool sticking badly at This point

19050 FT wireline on drum

BY: timmons & morford

UNION 76

GEOTHERMAL DIVISION

SUBSURFACE TEMPERATURE SURVEY

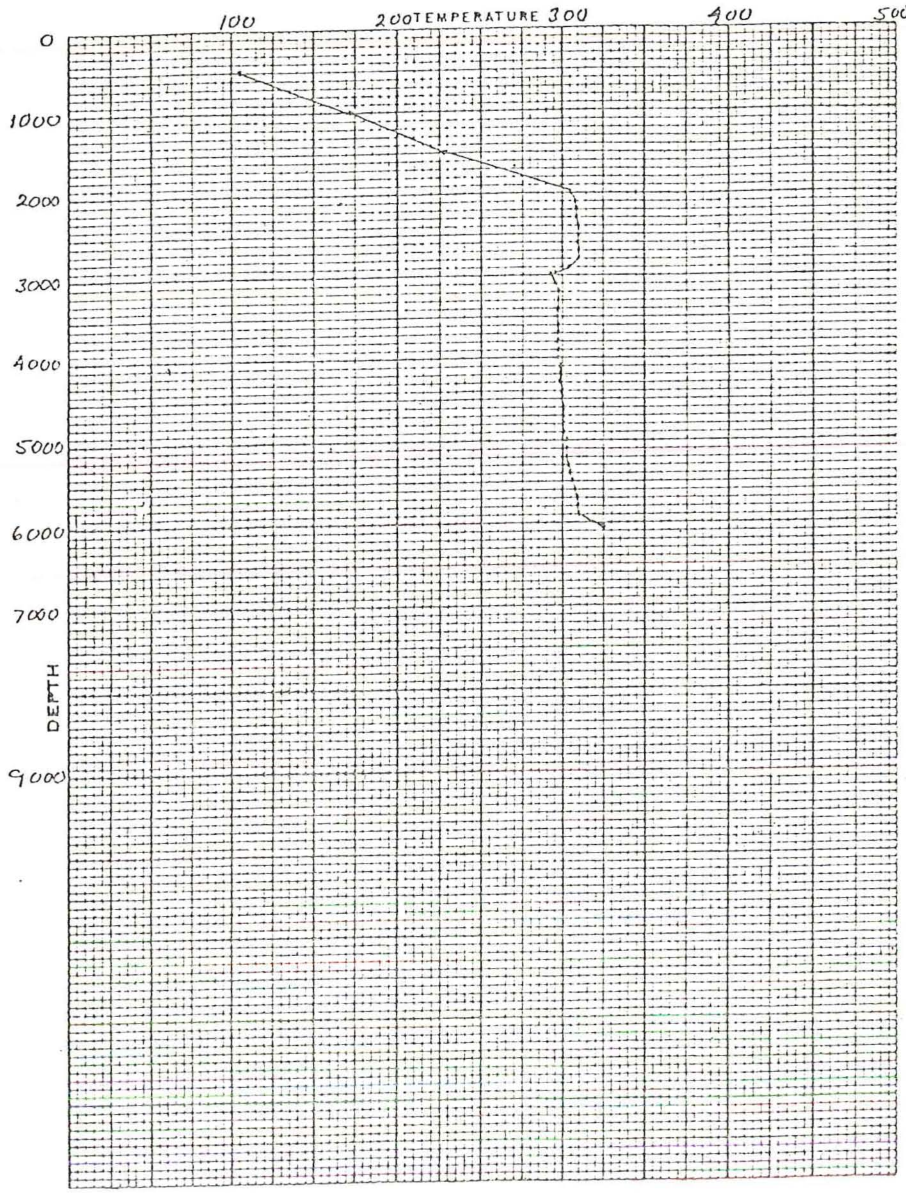
CFSU 12-7-S1-PT TRA

OWNER: Union Oil Company
FIELD: Cove Fort
ELEV: 6420
WELL NAME: Sulferdale 12-7
DATE: 4/5-6/78
CASING:
ZERO POINT: Swab Gate (+5 ft.
LINER DESCRIPTION: 7" From 0 - 7615
Tie back @ 3084
DEPTH: 7615

HOLE DESCRIPTION:

INSTRUMENT: 104 - 768 ° FAH
SERIAL NO: 10172

PURPOSE: Pressure / Temperature Gradient by Traverse
MAX TEMP: 325 °F @ 6050
REMARKS: Fluid level ~ 1850 FT.
STABLIZATION PERIOD:



PRESSURES.	GAUGE	BOMB
CASING PSI	250	250

DEPTH	TEMP.	DEPTH	TEMP
0	MIN	5300	304
500	106	5400	305
1000	173	5500	306
1500	227	5600	307
2000	305	5700	308
2100	308	5800	309
2200	309	5900	310
2300	309	6000	319
2400	310	6050	325
2500	310		
2600	310		
2700	310		
2800	310		
2900	304		
3000	293		
3100	297		
3200	298		
|	|		
4000	298		
4100	299		
4200	299		
4300	299		
4400	300		
4500	300		
4600	301		
4700	301		
4800	301		
4900	301		
5000	303		
5100	303		
5200	303		

BY: Timmons & Morford

UNION 76

GEOTHERMAL DIVISION

SUBSURFACE PRESSURE SURVEY

CFSU 42-7-51-PT TRAV

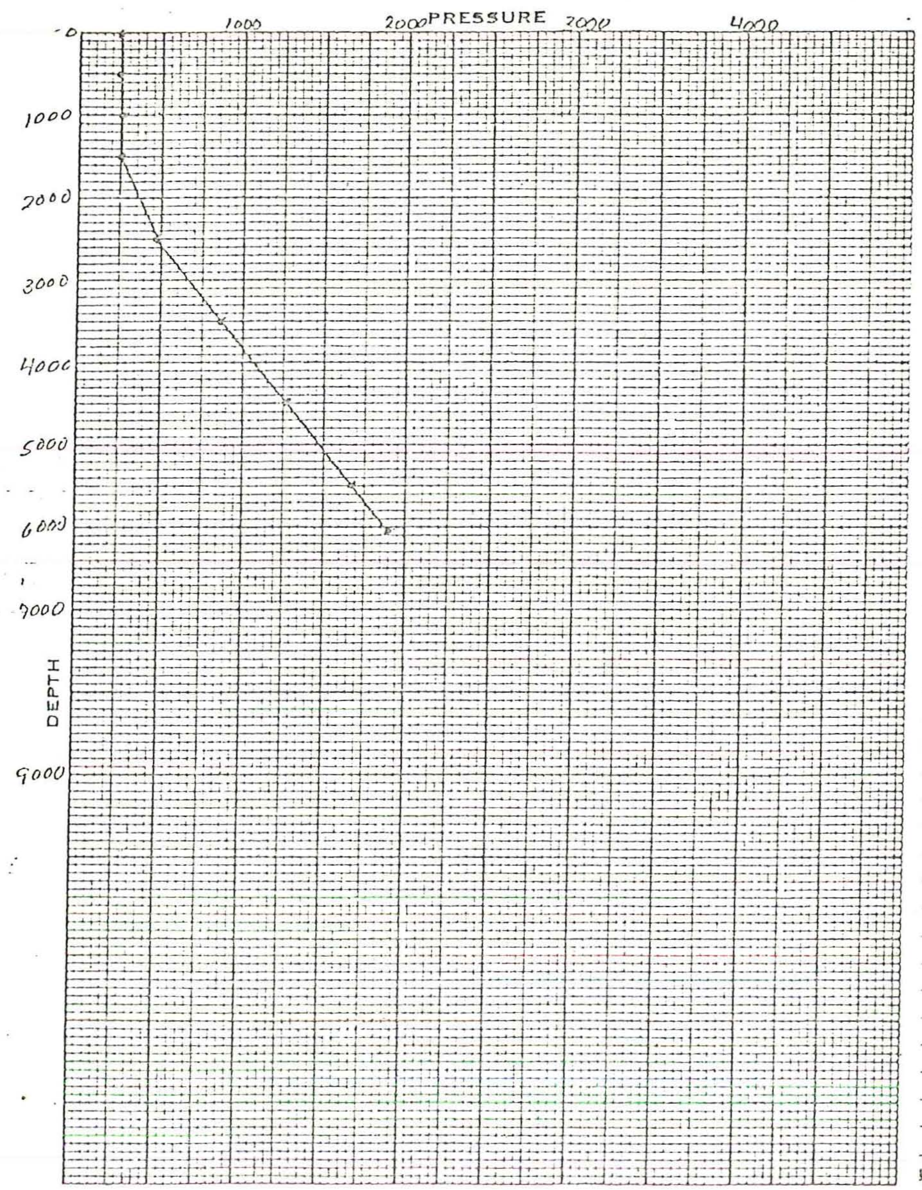
OWNER: Union oil Company
FIELD: Cove Fort
WELL NAME: Sulphurdale 42-7
CASING:
ELEV: 6420
DATE: 4/5-6/78
LINER DESCRIPTION: 7" from 0 to 7615, tie back @ 3084
ZERO POINT: Swab gate
DEPTH: 7615

HOLE DESCRIPTION:

INSTRUMENT: 0 – 4100 PSIG
SERIAL NO: 12833

PURPOSE: Gradient Survey – traverse from 1500"
MAX TEMP: 325 °F @ 6050
REMARKS: Fluid level @ ~1850 ft

STABLIZATION PERIOD:



PRESSURES	GAUGE	BOMB
CASING PSI	250	250

DEPTH	PRESSURE	GRADIENT
0	250	
500	253	
1000	253	
1500	253	
2500	471	
3500	873	
4500	1277	
5500	1681	
6050	1900	

BY: Timmons & Mumford

76

UNION 76

GEOTHERMAL DIVISION

SUBSURFACE SURVEY

Field Work Sheet

CFSU 42-7 - S2 - PT

OWNER Union Oil Company of California FIELD Cove Fort WELL NAME Sulphurdale 42-7

CASING ELEV. 6420 DATE: 5/9/78

LINER DESCRIPTION: 7" from 0 To 7615 ZERO POINT Swab Gate (+5')

Tie back @ 3084 DEPTH 7615 (KB @ + 20')

REMARKS: Fluid level 1760 ±

PURPOSE Gradient Survey

ELEMENT Press SERIAL NO. 12833 CLOCK 17454 TURN STABILIZATION PERIOD

Temp 10172 17499

MAX. °F 319

ENGAGE STYLUS 0948 DISENGAGE STYLUS - 1212 COR. CSG. PRESS. 188 T/G

PICKUP @ 6033

TIME ON BOTTOM 1125

WELL STATUS TIME OFF BOTTOM 1138

SHUT IN: ✓ ON PRODUCTION: Open Swab Gate 1006

Close Swab Gate 1200

TIME	DEPTH	DEFL.	°F (Temp)	GRAD.	/D	TIME	DEPTH	DEFL.	°F (Press)	GRAD.	/D	TIME	DEPTH	DEFL.	°F	GRAD.	/D
	0		MIN						199								
	1000		169						204								
	2000		302						291								
	3000		300						677								
	4000		301						1084								
	5000		305						1479								
	6000		316						1877								
	6030		319						1890								

COMMENTS:

BY: Sam Timmons

UNION 76

GEOTHERMAL DIVISION

SUBSURFACE TEMPERATURE SURVEY

CFSU 42-7-52-PT

OWNER: Union Oil Company | FIELD: Cove Fort | WELL NAME: Sulphurdale 42-7

CASING: | ELEV: 6420 | DATE: 5/9/78

LINER DESCRIPTION: 7" from 0 To 7615 | ZERO POINT: Swab Gate

Tie back @ 3084 | DEPTH: 7615

HOLE DESCRIPTION:

INSTRUMENT: 104-768 ° FAHR.

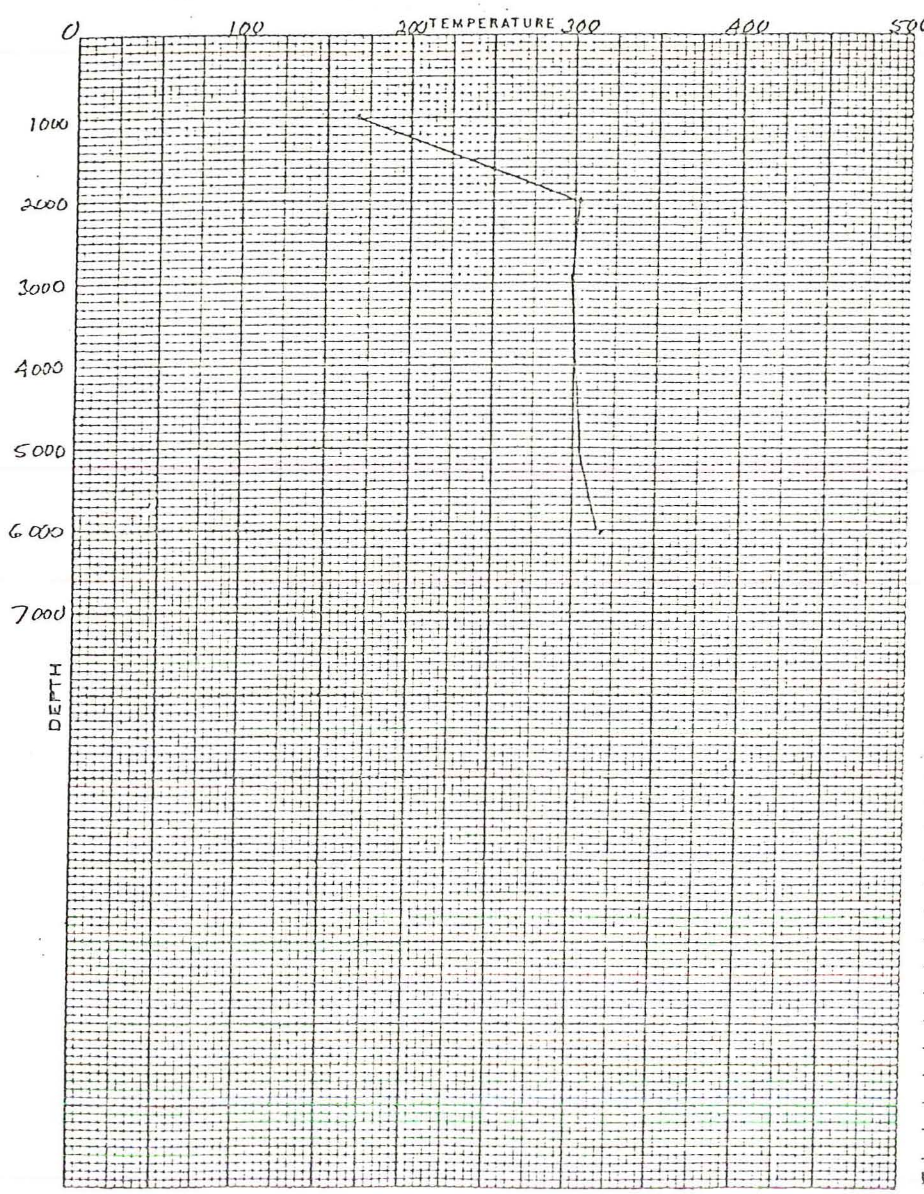
SERIAL NO: 10172

PURPOSE: Gradient Survey

MAX TEMP: 319 °F @ 6030

REMARKS: Fluid Level @ 1760 ±

STABLIZATION PERIOD



PRESSURES	GAUGE	BOMB
CASING PSI	188	199 N/C

DEPTH	TEMP.	DEPTH	TEMP.
0	MIN		
1000	169		
2000	302		
3000	300		
4000	301		
5000	305		
6000	316		
6030	319		

BY: Sam Timmons

UNION

GEOTHERMAL DIVISION

SUBSURFACE PRESSURE SURVEY

OWNER: Union Oil Company | FIELD: Cove Fort | WELL NAME: Sulphurdale 42-7

CASING: | ELEV: 6420 | DATE: 5/9/78

LINER DESCRIPTION: 7" from 0 - 7615 | ZERO POINT: Swab Gate

Tie back @ 3084 | DEPTH: 7615

HOLE DESCRIPTION:

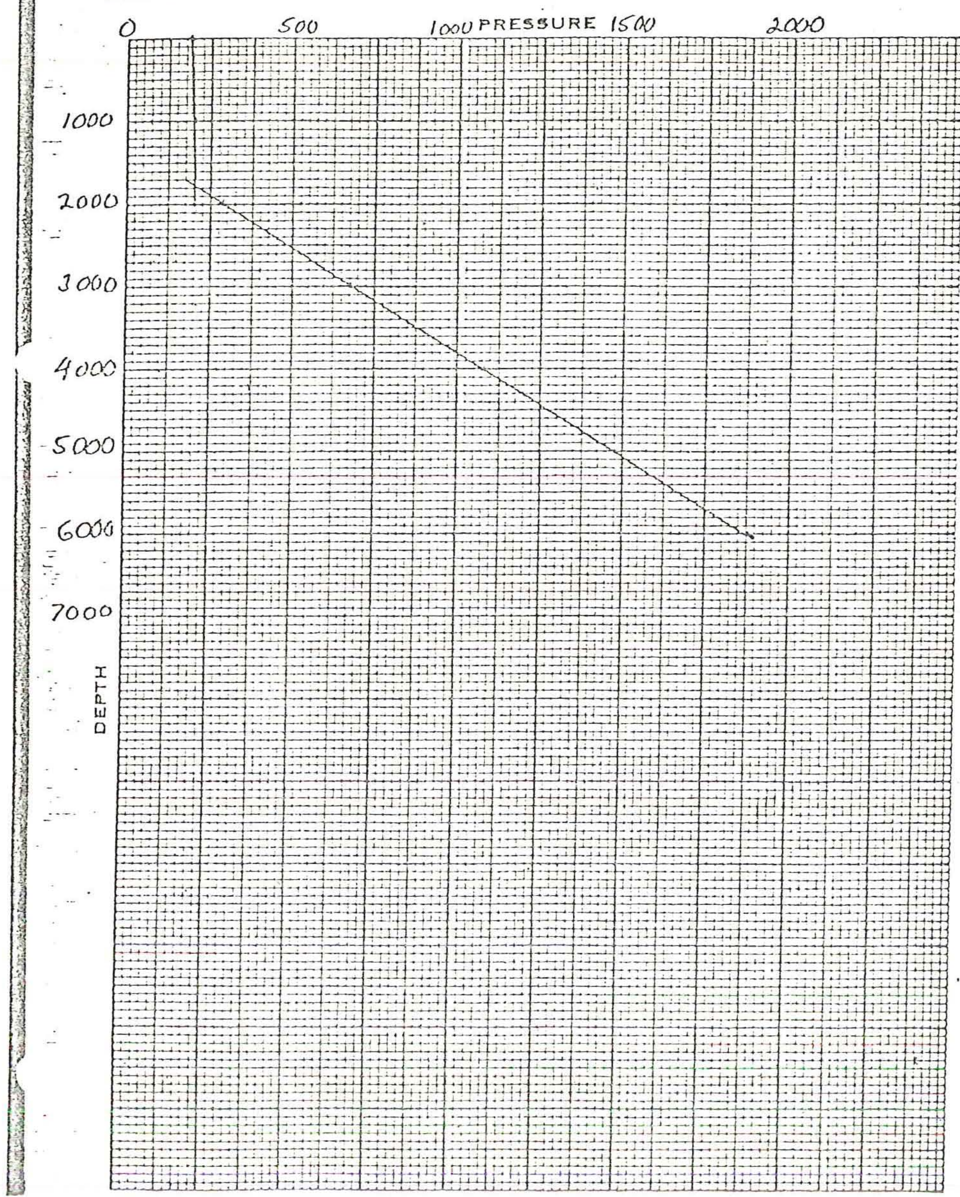
INSTRUMENT: 4100 PSIG

SERIAL NO: 12833

PURPOSE: Gradient Survey | MAX TEMP: 319 °F @ 6030

REMARKS:

STABLIZATION PERIOD:



PRESSURES	GAUGE	BOMB
CASING PSI		

DEPTH	PRESSURE	GRADIENT
0	199	
1000	204	
2000	291	
3000	677	
4000	1084	
5000	1479	
6000	1877	
6030	1890	

BY: Sam Timmons

UNION 76

GEOTHERMAL DIVISION

SUBSURFACE SURVEY

Field Work Sheet

CFSU 42-7 - S3 - T

OWNER Union Oil Company FIELD Cove Fort WELL NAME Sulphurdale 42-7

CASING ELEV: 6420 DATE: 5/17/78

LINER DESCRIPTION: 7" from 0 - 7615 ZERO POINT Swab Gate (+13')

DEPTH 7211 (KB)

REMARKS: Fluid level 1270 ±

PURPOSE To check accuracy of G.O. Temperature log

ELEMENT Temp SERIAL NO. 10172 CLOCK 17454 TURN STABILIZATION PERIOD

MAX. °F 332

ENGAGE STYLUS 1620 DISENGAGE STYLUS

COR. CSG. PRESS. —

PICKUP @

TIME ON BOTTOM —

TIME OFF BOTTOM —

WELL STATUS

SHUT IN: ✓ ON PRODUCTION:

Open Swab Gate —

Close Swab Gate —

TIME	DEPTH	DEFL.	F—T	GRAD.	/D	TIME	DEPTH	DEFL.	F—T	GRAD.	/D	TIME	DEPTH	DEFL.	F—T	GRAD.	/D
	0		—														
	1000		193														
	2000		306														
	3000		306														
	4000		321														
	5000		327														
	6000		332														
	6900		332														

COMMENTS:

BY: Sam Timmons

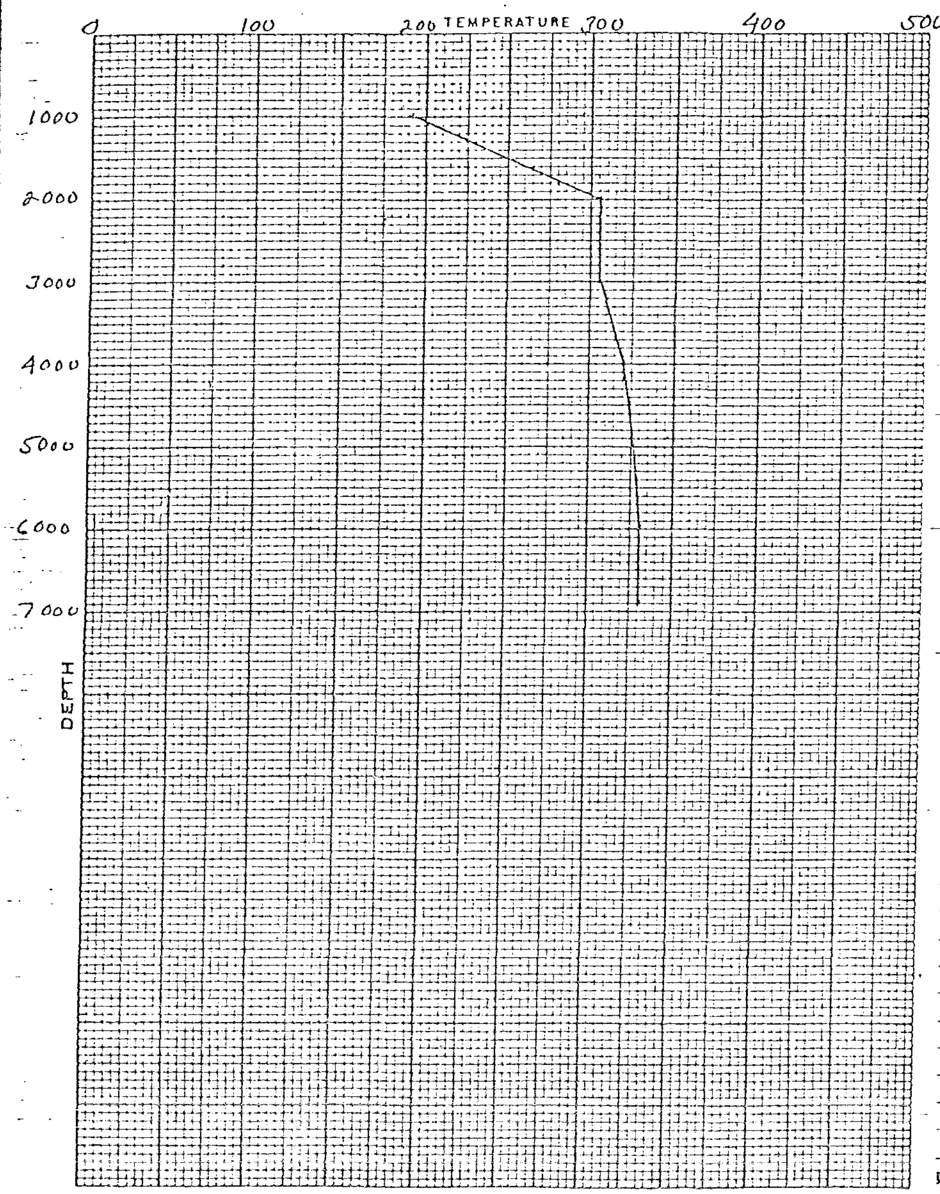
UNION 76

GEOTHERMAL DIVISION

SUBSURFACE TEMPERATURE SURVEY

CFSU 42-7-SJ-T

OWNER: Union Oil Company
FIELD: Cove Fort
WELL NAME: Sulphurdale 42-7
CASING:
ELEV: 6420
DATE: 5/17/78
LINER DESCRIPTION: 7" from 0-7615
ZERO POINT: Swab Gate
DEPTH: 7211
HOLE DESCRIPTION:
INSTRUMENT: 104-768 FAHR.
SERIAL NO: 10172
PURPOSE: G.O. Accuracy check
MAX TEMP: 332 °F @ 6000
REMARKS:
STABLIZATION PERIOD:



PRESSURES.	GAUGE	BOMB
CASING PSI		

DEPTH	TEMP.	DEPTH	TEMP.
1000	193		
2000	306		
3000	306		
4000	321		
5000	327		
6000	332		
6900	332		

BY: Sam Timmons

UNION 76

GEOTHERMAL DIVISION

SUBSURFACE SURVEY

Field Work Sheet

CFSU-42-7-S4-PPT
PFO

OWNER Union Oil Company FIELD Cove Fort WELL NAME Sulphurdale 42-7
CASING ELEV. 6420 DATE: 5/18/78
LINER DESCRIPTION: 7" To 7615 3084 ZERO POINT Swab Gate (+13')
Tie back @ 3084 DEPTH 7615 (KB)

REMARKS: Fluid level 1370 ±

PURPOSE Injection Gradient and pressure fall off

ELEMENT Temp SERIAL NO. 10172 CLOCK 17454 TURN STABILIZATION PERIOD 1hr
Press 12833 17498
press 12835 17499 MAX. °F
ENGAGE STYLUS 1830 (5/18) DISENGAGE STYLUS 0531 (5/19) COR. CSG. PRESS.
PICKUP @
TIME ON BOTTOM 1959
WELL STATUS Injecting TIME OFF BOTTOM 0903
SHUT IN: @ 2100 hours ON PRODUCTION: Open Swab Gate 1852
Close Swab Gate 0500

TIME	DEPTH	DEFL.	F—T	GRAD.	/D	TIME	DEPTH	DEFL.	F—T	GRAD.	/D	TIME	DEPTH	DEFL.	F—T	GRAD.	/D
			Press (12833)					Temp (10172)									
	0		min					min.									
	1000		min					min									
	2000		272					min									
	3000		679					231									
	4000		1092					240									
	5000		1500					249									
	6000		1906	*				267	* readings after 1 hr on bottom								
hang bombs @ 6000-ft — shut in @ 2100 hrs — Time in minutes																	
0			1906					267									
1			1909														
2			1902														
3			1900														
4			1900														
5			1900														
10			1898														
15			1898					267									
60			1895					268									
120			1894					270									
180			1892					273									
240			1890					277									
300			1888					281									
360			1888					285									
420			1888					288									
439			1888					289									

COMMENTS:

BY:

UNION

GEOTHERMAL DIVISION

SUBSURFACE PRESSURE SURVEY

CFSU 42-7 - S4 - PPT - PFO

OWNER: Union Oil Company FIELD: Cove Fort WELL NAME: Sulphurdale 42-7

CASING: ELEV: DATE: 5-18-78

LINER DESCRIPTION: 7" To 7615 ZERO POINT: Swab Gate

Tie back @ 3084 DEPTH: 7615 (KB)

HOLE DESCRIPTION:

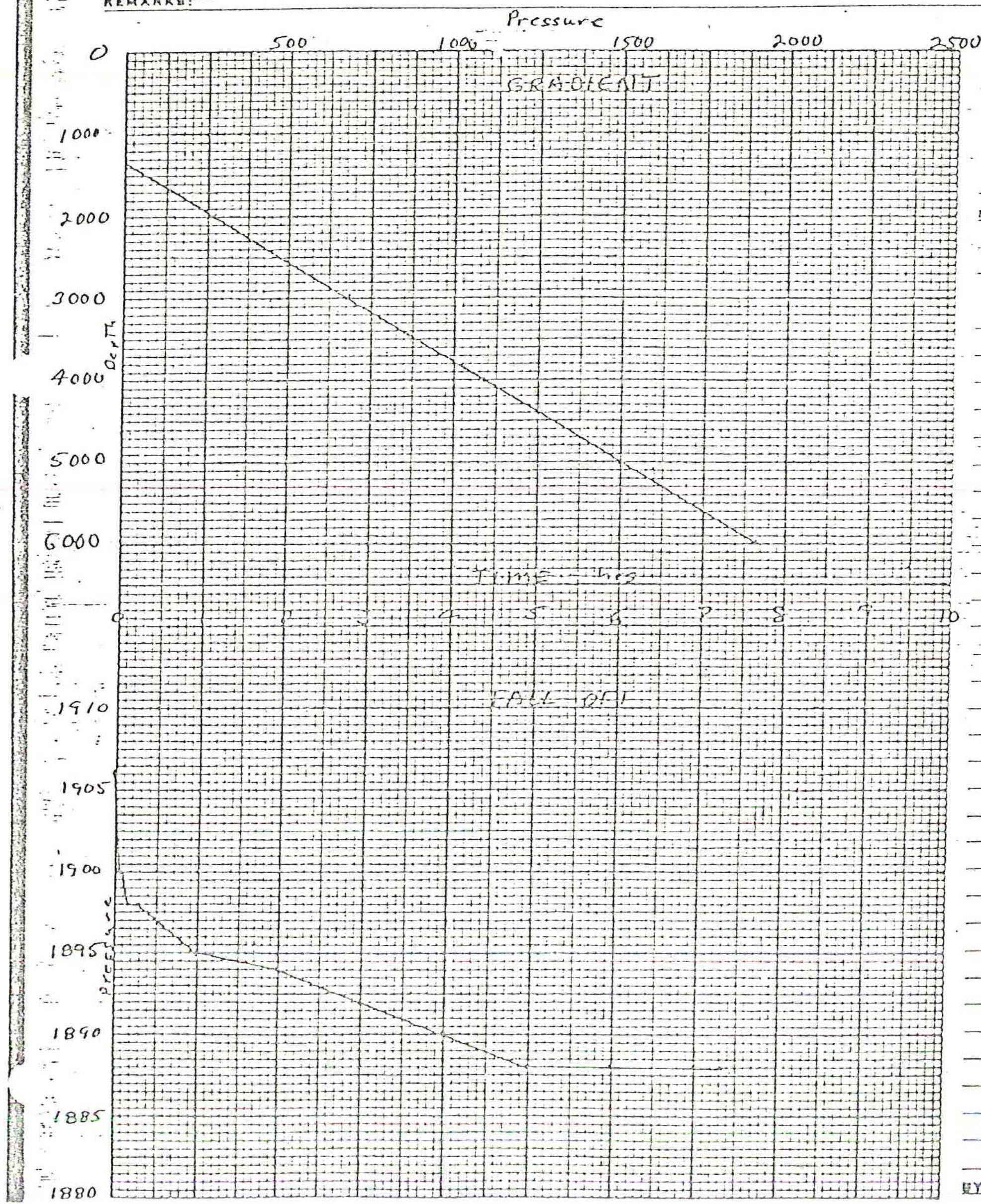
INSTRUMENT: 4100 PSIG

SERIAL NO: 128JJ

PURPOSE: GRADIENT - FALL OFF MAX TEMP: 289 °F @ 6000

REMARKS: AFTER 7hr 19min

STABLIZATION PERIOD



PRESSURES.	GAUGE	BOMB
CASING PSI		

DEPTH	PRESSURE	GRADIENT
1000	min	
2000	272	
3000	679	
4000	1092	
5000	1500	
6000	1906	

BY: Sam Timmons

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UNION

GEOTHERMAL DIVISION

SUBSURFACE PRESSURE SURVEY

CFSU 42-7 – S4 – PPT-PFO

OWNER Union Oil Company

FIELD Cove Fort

WELL NAME Sulphurdale 42-7

CASING

ELEV

DATE 5-18-78

LINER DESCRIPTION: 7" To 7615 Tie back @ 3084

ZERO POINT Swab Gate

DEPTH 7615 (KB)

HOLE DESCRIPTION: Temp inst # 10172 104° – 768°F

INSTRUMENT 4100 PSIG

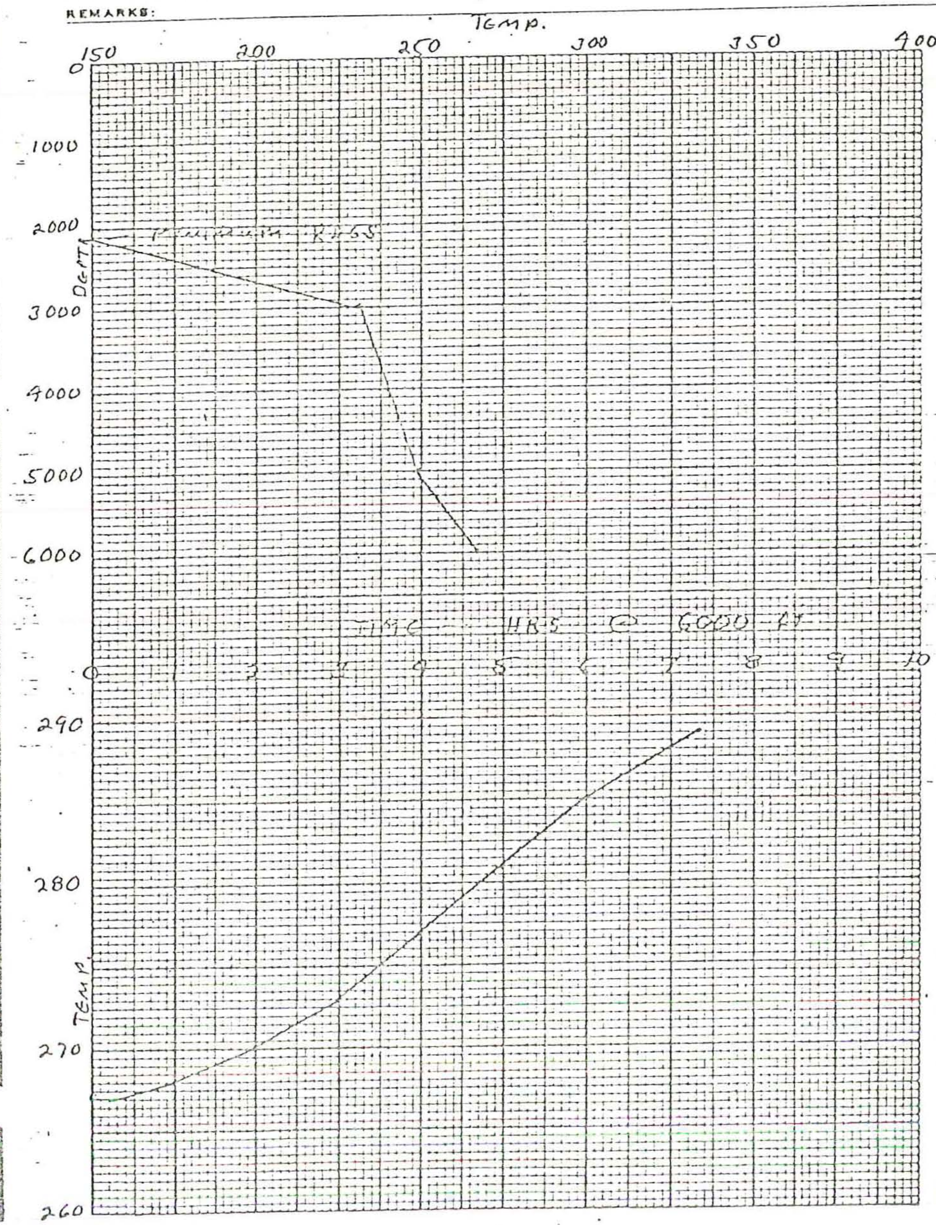
SERIAL NO 12833

PURPOSE GRADIENT – FALL OFF

MAX TEMP 289 °F @ 6000 AFTER 7hr 19min

REMARKS:

STABLIZATION PERIOD



PRESSURES	GAUGE	BOMB
CASING PSI		

DEPTH	GRADIENT
1000	min
2000	min
3000	231 °F
4000	240
5000	249
6000	267

BY: Sam Timmons

UNION 76

76

GEOTHERMAL DIVISION

SUBSURFACE SURVEY

Field Work Sheet

CFSU 42-7-SS-PT

OWNER Union Oil Company FIELD Cove Fort WELL NAME Sulphurdale 42-7

CASING ELEV. 6420 DATE: 5/19/78

LINER DESCRIPTION: 7" To 7615 ZERO POINT Swab Gate (+13)

Tie back @ 3084 DEPTH 7615 (KB)

REMARKS: fluid level 1325±

PURPOSE Gradient Survey

ELEMENT Temp SERIAL NO. 10172 CLOCK 17498 TURN STABILIZATION PERIOD

Press 12833 17454

MAX. °F 298 @ 6000

ENGAGE STYLUS 1021 DISENGAGE STYLUS 1312 COR. CSG. PRESS. Vacuum

PICKUP @ —

TIME ON BOTTOM

WELL STATUS TIME OFF BOTTOM 1243

SHUT IN: ✓ ON PRODUCTION:

Open Swab Gate

Close Swab Gate

Temp / Press

TIME	DEPTH	DEFL.	F-T	GRAD.	/D	TIME	DEPTH	DEFL.	F-T	GRAD.	/D	TIME	DEPTH	DEFL.	F-T	GRAD.	/D
	1000		171						min								
	2000		280						279								
	3000		285						677								
	4000		292						1072								
	5000		295						1477								
	6000		298						1881								

COMMENTS: Removed 1100 feet of wireline from drum and disposed. Corrosion pitting problem - loss of wire ductility.

BY: Sam Timmons

UNION 76

GEOTHERMAL DIVISION

SUBSURFACE TEMPERATURE SURVEY

CFSU 42-7 - SS - PT

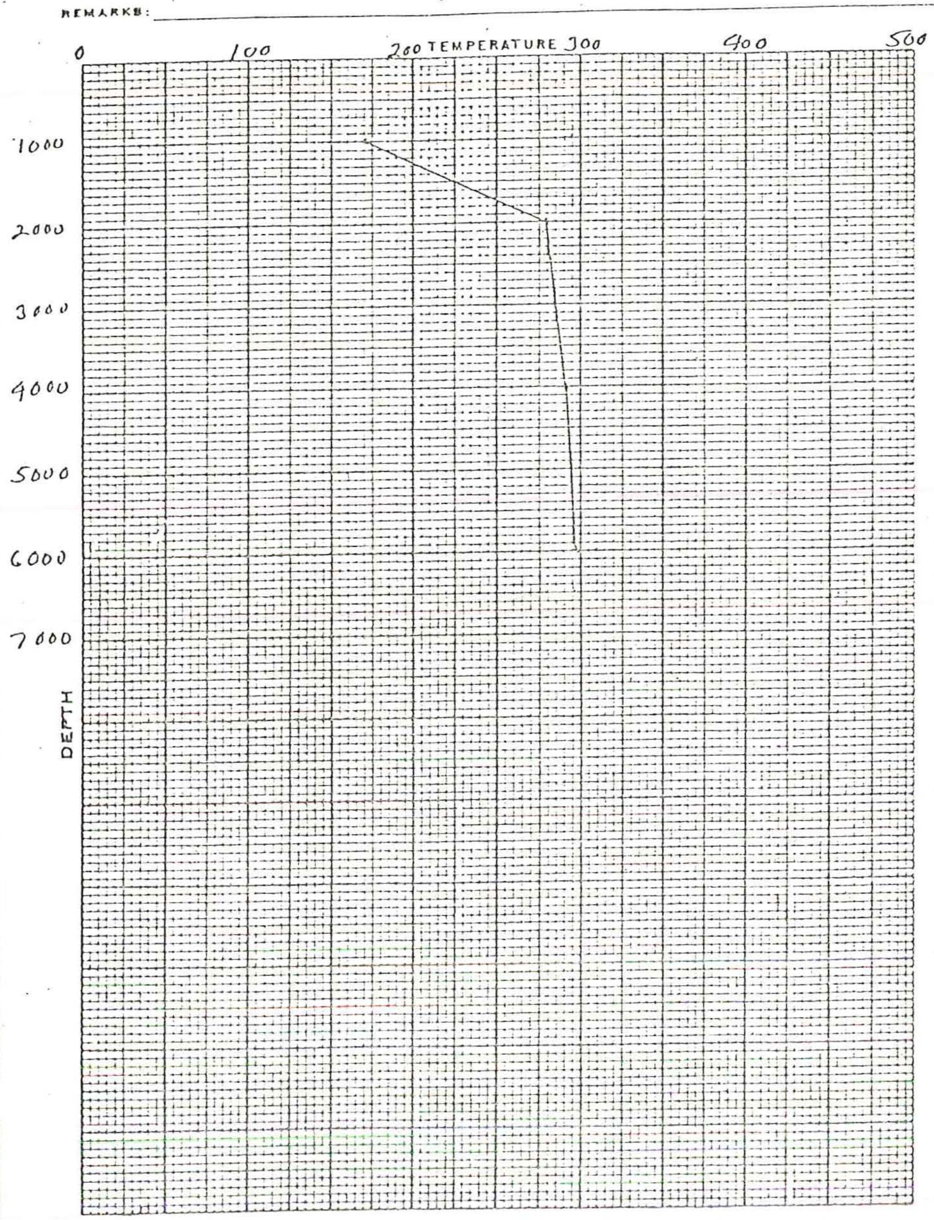
OWNER: Union Oil Company
FIELD: Cove Fort
WELL NAME: Sulphurdale 42-7
CASING:
ELEV:
DATE: 5/19/78
LINER DESCRIPTION: 7" To 7615
Tie back @ 3084
ZERO POINT: Swab Cstg
DEPTH: 7615

HOLE DESCRIPTION:

INSTRUMENT: 104 - 768 FAHR.
SERIAL NO: 10172

MAX TEMP: 298 °F @ 6000

PURPOSE: Gradient Survey
REMARKS:



STABLIZATION PERIOD

PRESSURES	GAUGE	BOMB
CASING PSI	Vac	Vac

DEPTH	TEMP.	DEPTH	TEMP.
1000	171		
2000	280		
3000	285		
4000	292		
5000	295		
6000	298		

BY: Sam Timmons

GEOTHERMAL DIVISION

SUBSURFACE PRESSURE SURVEY

CFSG 42-7 - SS - PT

OWNER: Union Oil Company

FIELD: Cove Fort

WELL NAME: Sulphurdale 42-7

CASING:

ELEV:

DATE: 5/19/78

LINER DESCRIPTION: 7" To 7615
Tie back @ 3064

ZERO POINT: Swab Gate

DEPTH: 7615

HOLE DESCRIPTION:

INSTRUMENT: 4100 PSIG

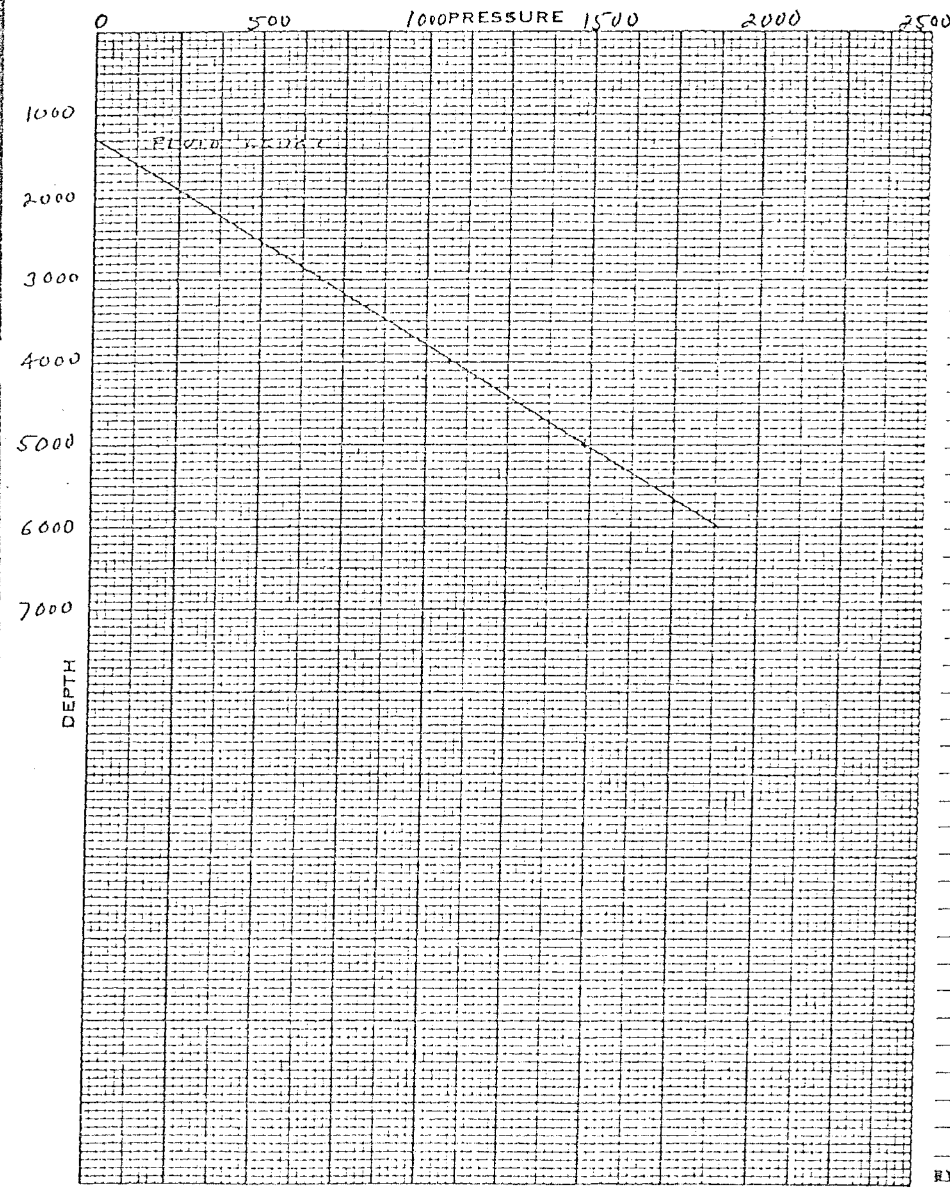
SERIAL NO: 12833

PURPOSE: Gradient Survey

MAX TEMP: 298 °F @ 6000

REMARKS:

STABLIZATION PERIOD:



PRESSURES.	GAUGE	BOMB
CASING PSI	Vac	Vac

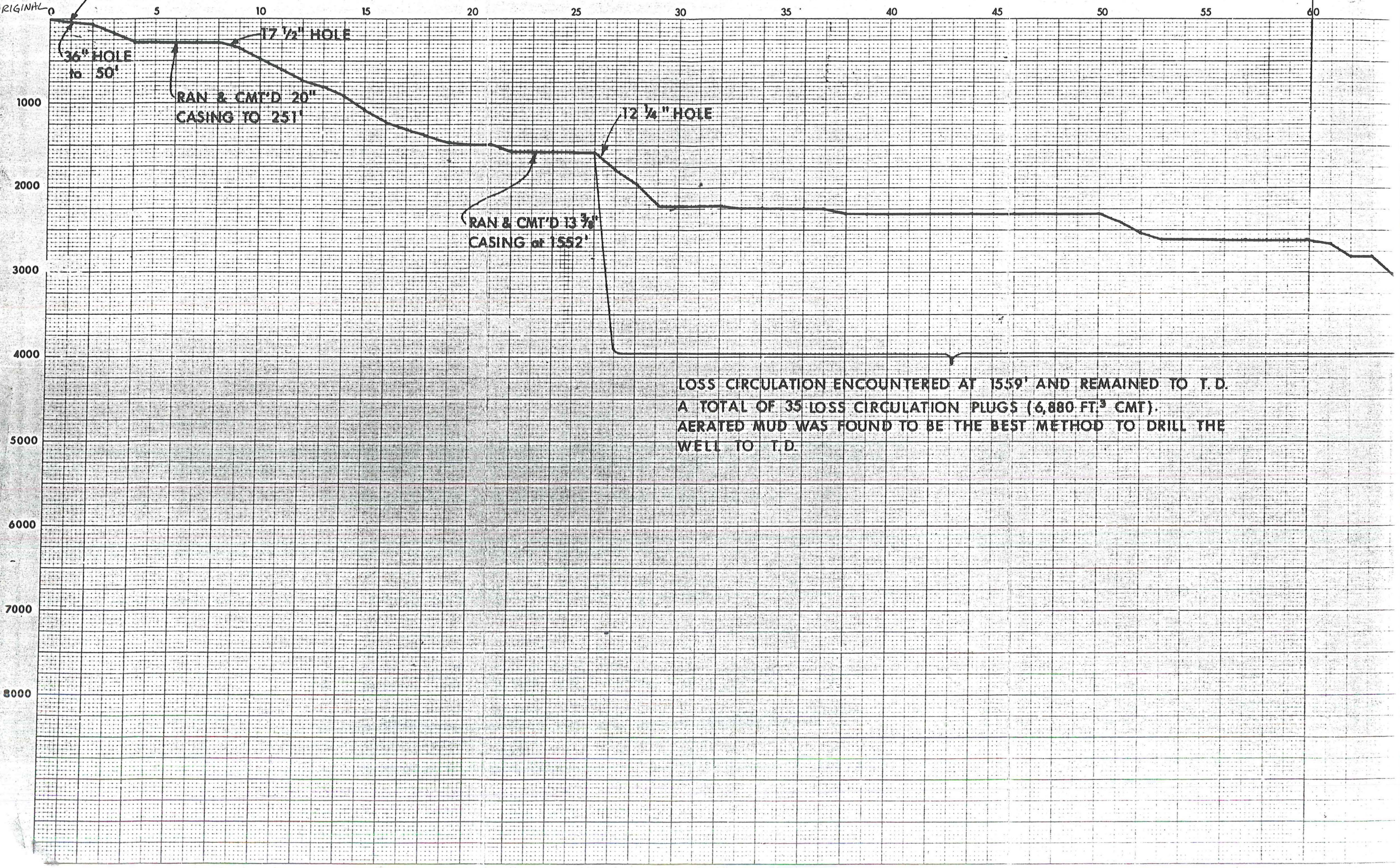
DEPTH	PRESSURE	GRADIENT
1000	MIN	
2000	279	
3000	677	
4000	1072	
5000	1472	
6000	1881	

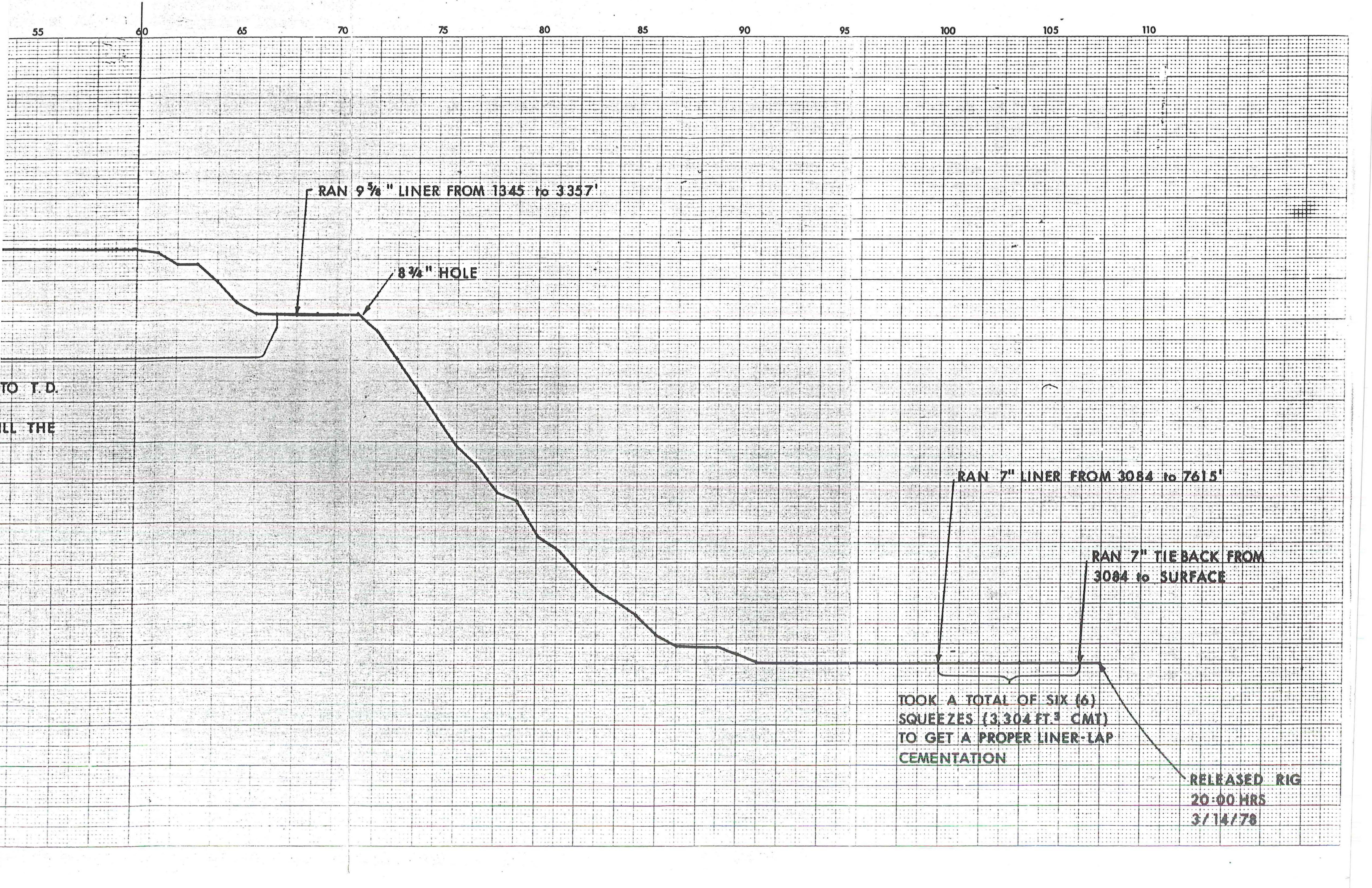
BY: Sam Timmons

Report #4 Original

COVE FORT - SULPHURDALE WELL # 42-7

DAYS / DEPTH




55
60
65
70
75
80
85
90
95
100
105
110
RAN 9 5/8 " LINER FROM 1345 to 3357'
8 3/4" HOLE
TO T.D.
LL THE
RAN 7" LINER FROM 3084 to 7615'
RAN 7" TIE BACK FROM
3084 to SURFACE
TOOK A TOTAL OF SIX (6)
SQUEEZES (3,304 FT.3 CMT)
TO GET A PROPER LINER-LAP
CEMENTATION
RELEASED RIG
20:00 HRS
3/14/78