GL04410

UNION 76

GEOTHERMAL DIVISION

TECHNICAL REPORT

COVE FORT SULPHURDALE UNIT

WELL #14-29

PERMIT #0072

COVE FORT SULPHURDALE UNIT #14-29

INDEX

COVE FORT SULPHURDALE UNIT #14-29

PREFACE

Organization of Report

Cove Fort Sulphurdale Unit Well #14-29 (CFSU #14-29) was spudded on May 25, 1979, and drilled to a total depth of 2620'. Total loss of circulation was encountered repeatedly during drilling, resulting in much of the hole being drilled without returns. Unconsolidated formation below 2451' made drilling operations even more difficult. Cements, especially adapted for lost circulation, and consolidation chemicals were employed with limited or no success resulting in abandonment of the well at the total depth of 2620' on July 9, 1979.

This report presents the technical details involved in the drilling of Union Oil Company's CFSU #14-29. The report consists of the eleven chapters listed in the Index, as well as logs taken by Schlumberger. The contents of each chapter is summarized in the following. All depths in the report refer to rotating kelly bushing (K.B.) unless otherwise indicated. The kelly bushing is 22' above ground level (G.L.).

Chapter 1 presents a summary of the operations required to drill and complete CFSU #14-29. A listing of contractors is also presented.

Chapter 2 summarizes what was learned about the hydrothermal system intersected by CFSU #14-29. This includes data on formation lithologies, fluid chemistries, and other geological information.

Chapter 3 contains a well history describing the day to day operations during the drilling of CFSU #14-29. Also included are a detailed description of the casing strings, a diagrammatic sketch of the well bore, and a listing of deviation surveys with the corresponding maximum reading thermometer results.

The two fishing operations engaged in while drilling this well are described in Chapter 4.

A time-depth progress graph is presented in Chapter 5. This graph also indicates the occurrence of events of major technical interest while drilling CFSU #14-29.

Chapter 6 lists the various kinds of logging data taken during the drilling of CFSU #14-29. Copies of each of the individual logs are supplied with the report. Maximum reading thermometer temperature surveys taken at various times when the hole had been static for two or more hours are also listed here.

Chapter 7 presents technical information about the drill bits used in CFSU #14-29.

Chapter 8 describes cementing operations carried out during casing jobs, while trying to control lost circulation, and while abandoning the hole.

Chapter 9 is a technical summary of the drilling fluids used in drilling this well and the corrosion analysis. This section was prepared by Magcobar, the sales, service and engineering company responsible for the drilling fluids program.

Chapter 10 provides the analysis of the formation fluid obtained from CFSU #14-29.

Chapter 11 describes the equipment and procedures used on the wellsite to protect personnel from the potential danger of H_2S.

COVE FORT SULPHURDALE UNIT #14-29

OUTLINE

I. General Information

- A. Well Record
- B. Contractors Used

II. Drilling Operations

- A. Rig Information
- B. Preparation of Location and Setting of Conductor to 38' (K.B.)
- C. 26" Hole: 38' to 230' (20" Casing Set to 224')
  1. General Description of Hole Drilled
  2. Problems Encountered and Their Resolution
     - a. Complete Loss of Circulation: 833' to 1249'
     - b. Setting 13-3/8" Casing
- E. 12¼" Hole: 1240' to 2080' (9-5/8" Casing Hung from 998' to 2078')
  1. General Description of Hole Drilled
  2. Problems Encountered and Their Resolution
     - a. Lost Circulation from 1265' to 1429'
     - b. Twisted-off Drill Pipe at 1330'
     - c. Lost Circulation from 1429' to 2080'
     - d. Stuck Drill String at 1460'
- F. 8-3/4" Hole: 2080' to Total Depth at 2620'
  1. General Description of Hole Drilled
  2. Problems Encountered and Their Resolution

a. Intermittent Returns to Surface: 2213' to 2407'

b. Unconsolidated Formation: 2451' to Total Depth at 2620'

G. Well Abandonment

COVE FORT SULPHURDALE UNIT #14-29

I. GENERAL INFORMATION

UNION OIL CO. OF CALIFORNIA

GEOTHERMAL DIVISION

A.

WELL RECORD

Abandoned

LEASE Cove Fort Sulphurdale Unit
WELL # 14-29
FIELD Cove Fort
LOCATION 2519.44' South and 442' East of the Northwest corner of Section 29, T25S, R6W, S.L.M.
B.H.L.
DEPTH: T.D. 2620' T.V.D. 2620' E.T.D. Surface
COMPANY ENGINEER J. Hamblin/H. Moss

SPUD DATE 5/25/79 COMP. DATE 7/9/79
CONTRACTOR Brinkerhoff-Signal, Inc.
RIG # 3
ELEVATIONS: GROUND 6219'
K.B. TO GROUND 22'
K.B. TO LOWER CASING HEAD
Cut off - below ground
TYPE WELL: EXPL. XX DEV.
STM HOT WTR INJ
DRY HOLE XX
APPROVED

CASING RECORD

SIZE	WEIGHT	GRADE	THREAD	TOP	BOTTOM	REMARKS
30"	.375 Wall	H40	Welded	G.L.	38' K.B.	Cemented surf. to 38'
20"	94#/ft	K55	Buttress	20' KB	224' K.B.	Cemented surf. to 224'
13-3/8"	54.5#/ft	K55	Buttress	20' KB	1240' K.B.	Cemented surf. to 1240'
9-5/8"	36#/ft	K55	Buttress	998' KB	2078' K.B.	Cemented 998'-2078'

WELL HEAD ASSEMBLY

	MAKE	TYPE	SIZE	PRESSURE RATING
CASING HEAD SPOOL	None- Well plugged and abandoned to surface, 5/8" steel plate welded on 20" casing			
EXPANSION SPOOL				
MASTER VALVE(S)				
CASING HEAD VALVES				
EXPANSION SPOOL VALVES				
SWAB VALVE				

STEAM ENTRIES: DEPTH LBS. INCREASE

Not Applicable - No Flow

	SLOTS FROM	SLOTS TO	BLANK FROM	BLANK TO
SLOTTED LINER				

None

TEST DATA ORIFICE SIZE

RIG TEST DATE	WHP	FLP	TEMP	POUNDS/HOUR

REMARKS: Total Cost of Well = $1,065,407.
Cost Per Foot = $406.64

B. CONTRACTORS USED

Brinkerhoff-Signal, Inc.

B & W, Inc.

Cove Fort Service

Del Mar Construction

Donham Oil Tool

Dowell

Dresser Industries

Go-International

Grant Oil Tool

Duane Hall Trucking

Halliburton

HOMCO

Howard Construction

Hughes Tool Company

Marion Kessler

La Sal Oil Company

Mac's Welding

Mid-Continent Supply

Midway Fishing Tool

Mountain States Inspection

Oilwell Supply

Philadelphia Quartz

San Juan Casing Service

Schlumberger

R. F. Smith Corporation

B. CONTRACTORS USED (cont'd)

Smith Tool Company

Thatcher Chemical

West Coast Oil Tool

W-K-M Wellhead Systems

COVE FORT SULPHURDALE UNIT #14-29

II. DRILLING OPERATIONS

A. RIG INFORMATION:

Brinkerhoff-Signal rig #3 is a 133', 700,000# rated Lee C. Moore with 19' substructure and a National 55 Draw-works. The rig is rated to drill to a depth of 12,000'. It is powered by two Caterpillar D-379-TAC diesel engines rated at 1000 H.P. at 1000 RPM. The rotary table is 20½" Mid-Continent.

B. PREPARATION OF LOCATION AND SETTING OF CONDUCTOR TO 38' K.B.:

In the Spring of 1979, various operations were conducted to prepare the location for drilling. The location, sump, and roads were built to the specifications of the "Approved Unit Plan of Operations". A 36" conductor hole was drilled to 16' G.L. (38' K.B.) by Dick Howell's Drilling Service. Thirty-inch (30") conductor pipe was run and cemented from surface to 16' G.L. (38' K.B.) with Ready-Mix Cement, purchased locally.

C. 26" HOLE: 38' to 230': (20" Casing Set to 224')

Brinkerhoff-Signal rig #3 moved in, rigged up, and was placed on dayrate at 1800 hours, 5/25/79. The well was spudded

at 1800 hours on 5/25/79, and 17½" hole drilled to 260' (volcanics). The hole was opened to 26" from 38' to 230' when a cone on the hole opener locked.

Two hundred-twenty five feet (225') of 20", 94#/ft, K55 buttress casing was set and cemented to surface, through the float shoe at 224'. The 30" and 20" casing were cut off to ground level. A 20" Hydril GK and Double Shaffer blowout preventer were installed, tested and witnessed by a U.S.G.S. representative to U.S.G.S. specifications.

No problems were encountered in drilling the 26" hole.

D. 17½" Hole: 260' to 1249': (13-3/8" Casing Set to 1240')

1. General Description of Hole Drilled:

The 17½" hole was drilled from 260' to 1249' in hydrothermally altered volcanics to 825', conglomerate from 825' to 866' and dolomite-limestone with interbedded sandstone below 866' with severe lost circulation problems.

Complete loss of circulation initially occurred at 833'. Attempts to regain circulation by setting two cement plugs (265ft^3 each) were unsuccessful and the 17½" hole was drilled from 833' to 1243' without circulation. Four additional cement plugs (total volume = 810ft^3) failed to correct lost circulation to total depth.

1240' of 13-3/8", 54.5#/ft, K55 buttress casing was run in the hole. A two-stage cement job was performed with the D.V. collar set at 766', with no cement returns reaching the surface. The 13-3/8" casing was cut off to the surface, 12"-3000# B.O.P. equipment was installed and tested to U.S.G.S. specifications. The 13-3/8" casing was perforated from 800' to 801' and cemented with water returns reaching the surface prior to equipment failure. A cement bond log indicated no cement above 350'.

2. Problems Encountered and Their Resolution:

a. Complete Loss of Circulation: 833' to 1249'

Complete loss of circulation was first encountered at 833'. One thousand barrels of mud were lost attempting to fill the hole. Also unsuccessful was a 265ft^3 cement plug pumped through open ended drill pipe hung at 830'. Circulation was lost again while drilling from 833' to 852'. Two hundred (200) barrels of 25% lost circulation material gel mud were pumped but failed to correct lost circulation. An additional 265ft^3 cement plug was pumped; however, the formation accepted all the cement and attempts to fill the hole were unsuccessful. The fluid level was approximately 250' as indicated on drill pipe.

The 17½" drilling assembly was minimized and 17½" hole was drilled to 1249' while pumping water without

returns. By occasionally (approximately every 30') pumping a high viscosity gel pill, the hole was swept clean and fill problems were solved.

Cement plugs #3, #4, #5, (each 203ft^3) were pumped through open ended drill pipe hung at 935', 893', and 872' respectively. Top of cement plug #5 was located at 787'. The cement was drilled with a 17½" drilling assembly from 787' to 854' with full returns until encountering a void at 854' and the loss of complete returns. Plug #6 (201ft^3) was pumped through O.E.D.P. hung at 861'. Firm cement was located at 780' following plug #6 and drilled with a locked drilling assembly to 872' with full returns. Circulation was again lost at 890' and there was no cement below 915'.

b. Setting 13-3/8" Casing

Before running casing the hole was swept out to total depth (1249'), with a gel pill. Because of lost circulation problems a two-stage cement job was performed. The first stage consisted of a 201ft^3 cement plug formula followed by 546ft^3 of Dowell RFC casing cement. After opening the D.V. collar, set at 766', the casing was found to be on a vacuum. The second stage was pumped through the D.V. collar and consisted of 112ft^3 of Spacer 1000 flush followed by 1142ft^3 of cement. No cement returned to the surface. The

cement in the 13-3/8" casing was cleaned out with a 12¼" drilling assembly from the D.V. collar at 766' to 1201'.

A cement bond log revealed no cement above 820'. To complete cementing the casing, five ½" perforations were shot in the 13-3/8" casing from 800' to 801' and a 13-3/8" RTTS tool was set at 736'. 371ft^3 of cement was pumped through the RTTS with water returns to the surface, prior to a cement truck breakdown. One-inch (1") pipe was run into the 20" x 13-3/8" annulus and indicated no cement to 160' depth where the pipe stopped. A slip joint brace was installed between the 20" and 13-3/8" casings.

Cement was drilled out and the 13-3/8" casing was circulation clean from 773' to 1201'. Another cement bond log indicated good cement bond from 1200' to 350' and no cement above 350', and it was elected to continue without further cementing.

E. <u>12½" Hole: 1240' to 2080'</u>: (9-5/8" Casing Hung from 998' to 2078')

1. General Discussion of Hole Drilled

The 12¼" hole was drilled from 1240' to 1265' before losing all circulation. The hole was drilled through dolomite and dolomitic limestone with continuous lost circulation problems resulting in drilling without returns. Twisting off or parting the drill pipe at 1330' and stick-

ing the string in a tight spot at 1416' resulted in fishing operations, both of which were successful.

Twelve cement plugs (total volume = 1933ft^3) were set while drilling the 12¼" interval. Plug #18 was successful in regaining circulation to 2080' allowing 1081' of 9-5/8" 36#/ft K55 buttress thread casing to be hung at 998' and cemented.

A 12"-900 banjo box and rotating head were installed.

2. Problems Encountered and Their Resolution:

a. Lost Circulation from 1265' to 1429'

Circulation was lost at 1265' in the 12¼" hole. Cement plugs #7 (187ft^3) and #8 (181ft^3) did not regain circulation. However, after pumping plug #9 (181ft^3) through open ended drill pipe, hung at 1245', the hole filled with water. The top of cement plug #9 was located at 1226'. Cement was cleaned out to 1330' with lost circulation recurring at 1310'. The 12¼" hole was drilled to 1345' with no returns and cement plugs #10 (181ft^3) and #11 (248ft^3) were pumped through open ended drill pipe. Cement was located at 1090' and circulation was regained following plug #11.

Cement was drilled out and 12¼" hole was drilled to 1429' before losing complete circulation. Open

ended drill pipe was run to 1429' and cement plug #12 (248ft^3) was pumped. The top of plug #12 was located at 1265' but the hole still could not be filled.

b. Twisted-off Drill Pipe at 1330'

After drilling out plug #12 from 1265' to 1330' without returns, the drill pipe was stuck and twisted off at 216'. The complete fish was recovered on the second try, with the proper size slips and fishing tool.

c. Lost Circulation from 1429' to 2080'

12¼" hole was drilled through dolomite from 1429' to 1995' without returns. Circulation was regained from 1995' to 2075' before again losing returns at 2076'. While pulling out of the hole the drilling assembly was stuck at 1460' requiring a simple fishing job. The 12¼" hole was drilled from 1276' to 1280' without returns.

A series of four plugs (764ft^3 total) were pumped through open ended drill pipe. None of the last plug (#16) was lost to the formation and circulation was regained. Firm cement was drilled out from 1155' to 1408' and soft cement from 1408' to 1543'. All circulation was lost at 1495'. Cement plug #17 (191ft^3), pumped through open ended drill pipe hung at 1543',

did not stop the lost circulation. Cement plug #18 (191ft^3) was successful at regaining circulation. The top of plug #18 was located at 1226' to 2080'. Ten to fifteen percent of the returns were lost after reaching total depth.

The 9-5/8" liner was hung at 998' with the shoe at 2078'. The liner was cemented without any returns to the surface but a casing bond log revealed fair to good bonding the length of the liner.

d. Stuck Drill String at 1460'

While pulling out of the hole, with partial returns, the drill string was stuck at 1416', the top of the 3-blade stabilizer. A free point indicator was run and the drill pipe backed off above the stabilizer. The fish was recovered on the first try using hydraulic jars.

F. 8-3/4" Hole: 2080' to Total Depth at 2620'

1. General Description of Hole Drilled:

The 8-3/4" hole was drilled through dolomite from 2080' to 2407' with intermittent returns. From 2407' to 2620' the hole was drilled with either aerated water or aerated foam. The formation was unconsolidated fractured dolomite from 2415' to 2620'. Four consolidation pills were pumped into the interval in an unsuccessful attempt to consolidate

the formation. Cement plugs #19 and #20 failed to cement off the lost circulation zone and fill on connections continued to be a problem. Inability to consolidate the flowing dolomite formation led to the decision to plug back and abandon the well.

Before the well was plugged, various logs were run by Schlumberger. Air was injected through drill pipe and formation fluid (probably contaminated with drilling fluids) was produced for sampling purposes.

2. Problems Encountered and Their Resolution:

   a. Intermittent Returns to Surface: 2213' to 2407'
   Complete loss of circulation occurred at 2213' and 8-3/4" hole was drilled to 2250' with no returns and from 2250' to 2407' with partial (10% to 60%) returns. The hole had 30' of fill after making a connection at 2407'. It was not possible to clean the hole without fluid returns with the hole standing full of fluid. This prompted a change to aerated water drilling. A jet sub was installed 1686' above the 8-3/4" bit to aid in lifting the fluid and primarily the cuttings. Drilling with aerated water made it possible to clean the hole to present total depth at 2407'.

   b. Unconsolidated Formation 2451' to T.D. at 2620'
   The formation was unconsolidated fractured dolomite

from 2451' to 2620' T.D., resulting in drill fill on connections, plus lost circulation and tight spots. An additional jet sub was added to the drill string 1310' above the bit and the first jet sub was moved to 1873' above the bit. However, it still was not possible to keep the hole clean with aerated water or foam.

While cleaning out the fill to 2580', circulation was partially lost and the drill pipe was stuck. The pipe was worked free after three hours and the jet subs were removed. In an attempt to keep the hole clean the drilling foam was stiffened and high viscosity gel pills or flushes were pumped. The hole was cleaned eut temporarily to 2598' before complete loss of circulation occurred and the top of the fill increased to 2498'.

Fifty-two barrels of sodium silicate-calcium chloride consolidation material was pumped through the bit hung at 2465'. Fill was cleaned out to 2560' but the fill level increased to 2500' on a connection. A second consolidation pill was pumped with similar results. Open ended drill pipe was run to 2465' and a 290ft^3 consolidation pill was pumped. The drill pipe was pulled to 2434' and cement plug #19 (180ft^3) was pumped. Top of firm cement was located at 2466' and drilled to 2490', top of fill. Again

the hole contained fill on connections.

Open ended drill pipe was hung at 2550' and water was pumped to cool the hole. A fourth consolidation pill (207ft^3) was pumped followed by cement plug #20 (180ft^3). Firm cement was located at 2466' and drilled to 2471'. Fill was encountered on connections and it was decided to abandon the well after running various logs based upon inability to keep the hole clean and drill safely.

G. Well Abandonment: Surface (851') to T.D. at 2620'

Excess water from the sump was pumped into the hole through open end drill pipe before setting abandonment plug #1 (250ft^3) through a HOWCO EZSV 9-5/8" cement retainer set at 2000'. Following abandonment plug #1, 50ft^3 of cement, 280ft^3 of drilling mud and abandonment plug #2 (180ft^3) were pumped. The top of cement was located at 851'. The 20" x 13-3/8" annulus was cemented to surface through 1" pipe. Finally the 13-3/8" casing was cemented to surface with 201ft^3 of cement and a 5/8" steel plate was welded on the 20" casing 5' below ground level.

All abandonment procedures were carried out in accordance with U.S.G.S. specifications and witnessed.

GEOLOGIC REPORT ON THE
COVE FORT-SULPHURDALE UNIT #14-29
MILLARD COUNTY, UTAH

LITHOLOGY

The CFSU 14-29 well was drilled to a total depth of 2620 feet where highly fractured dolomite and dolomitic limestone is present. The volcanics and the carbonate units encountered in the CFSU 14-29 well are similar to those found in the CFSU 31-33 well. Both wells were affected by propylitic alteration of the volcanics and sulfide mineralization along fracture surfaces in the carbonates and volcanics.

The following is a description and discussion of the rock types encountered in CFSU 14-29 from the surface to the total depth. The descriptions are based on examination of the well cuttings by binocular microscope.

Interval. . . . . .30-825'

Formation . . . . . .Bullion Canyon Volcanics

Age . . . . . .Oligocene

Lithology . . . . . .Andesite/Latite/Dacite (?)

The well penetrated approximately 800 feet of Mid-Tertiary extrusive and minor intrusive (?) volcanics. These rocks are characterized by variable amounts of propylitic alteration of plagioclase to sericite and clays, and hornblende to chlorite and magnetite. This alteration is similar to that encountered in the volcanics from CFSU 31-33.

Intense alteration of several of the volcanic units has destroyed much of the original texture of the samples in addition to altering the composition. Therefore, the classification of the volcanics from CFSU 14-29 is tentative without the aid of thin sections and chemical analysis.

The volcanics are tentatively divided into three units on the basis of difference in color index, texture, and composition. The upper unit (30-310 feet) is characterized by interbedded porphyritic latites and andesites. The latites consist of 35 to 45% fine-to-medium grained phenocrysts in a light gray aphanitic groundmass. Subhedral feldspar, hornblende, and minor biotite are the predominant phenocrysts. Quartz is present in rare amounts. The majority of the mafic phenocrysts have been completely altered to hematite and magnetite. The andesites of the upper unit consist of 25 to 35% phenocrysts in a dark gray to green or reddish-brown aphanitic groundmass. The groundmass is intensely altered to chlorite, hematite, and clays. The phenocrysts have also been altered in varying

degrees to chlorite, hematite, and magnetite. Calcite veins and breccia are present in rare to trace amounts in the upper unit. Limonite staining is ubiquitous throughout the interval between 30 to 140 feet. In addition, pyrite occurs in rare to trace amounts from 70 to 150 feet.

The middle unit of the Bullion Canyon Volcanics (310-650 feet) is characterized by a porphyritic hornblende-bearing andesite with possible flow breccia and minor intercalated prophyritic latites. Although this andesite shows a great variation in texture and phenocryst composition, it is basically similar to the andesite in the upper volcanic unit. Several samples from the middle unit display a parallel orientation of hornblende and/or feldspar phenocrysts suggestive of a flow structure. Many of the volcanics in this interval also contain angular lithic fragments of latite and andesite and extensive interconnecting veinlets indicating the brecciated nature of the rock. There is a wide variation in phenocryst to groundmass ratio in the andesites of the middle unit. The andesites generally consist of 15 to 35% fine-grained phenocrysts in a gray-green or reddish-brown altered aphanitic groundmass. Hornblende, biotite, and minor pyroxene are the major phenocrysts. The phenocrysts have been altered in varying degrees to chlorite, magnetite, and hematite. The feldspars are partially replaced by sericite and calcite. Quartz, calcite, and epidote are present in veins and veinlets throughout the middle

unit. In addition, rare to trace amounts of pyrite are present below 420 feet. Chlorite-sericite-clay alteration appears to increase below 520 feet.

The lower-most unit (650-825 feet) of the Bullion Canyon Volcanics consists of interbedded porphyritic latites and andesites. This unit is distinctive because it contains a zone of intense alteration and possible fault gouge. The latites and andesites in the intervals between 650-740 feet and 810-825 feet are similar in texture and composition to the latites and andesites described in the upper unit. The latites are lighter-colored and more phenocryst-rich than the andesites. The mafic phenocrysts in the latites and andesites show signs of bleaching and chloritic alteration, however, magnetite is commonly absent. Pyrite, quartz, calcite, and epidote are present in rare to trace amounts throughout this interval. A zone of intense alteration of the volcanics to clay and quartz extends from 740 to 810 feet. The volcanics (possibly latite and andesite) in this zone are bleached white and contain abundant pyrite and other iron sulfides, clay, quartz, and common calcite. A soft clay, which possibly represents fault gouge, was encountered at 800 feet.

Interval. . . . . 825-850/866(?)'

Formation . . . . . Claron Formation/Price River Conglomerate

Age . . . . . Upper Cretaceous(?)

Lithology . . . . . Sandstone & Conglomerate

An unconformity between the Bullion Canyon Volcanics and the Claron/Price River Conglomerate was penetrated at 825 feet. Partial lost circulation was encountered near the contact, and full returns were lost at 833 feet. The lost circulation zone was controlled by a cement plug and full circulation was regained from 833 to 850 feet. Another lost circulation zone was encountered at 850 feet. The well was drilled without returns from 850 to 1249 feet. Therefore, the exact thickness and lithology of the Claron/Price River Conglomerate in this area is uncertain. Cuttings adhering to the rock bits were collected when the bits were pulled out of the hole. The cuttings recovered from the bit at 866 feet were predominantly dolomitic limestone with trace conglomerate. The lower contact of the conglomerate is probably located between 850 and 866 feet.

The Claron/Price River Conglomerate consists of poorly-sorted, angular to subrounded limestone and quartzite cobbles in a matrix of calcareous siltstone and sandstone. The conglomerate is moderately well-to well-cemented and contains common calcite veins and trace amounts of pyrite and vein quartz. The Claron/Price River Conglomerate in CFSU 14-29 differs considerably from the Claron formation encountered in CFSU 31-33. The conglomerate from CFSU 14-29 is coarser-grained and more fragmental than the siltstone and sandstone conglomerate from CFSU 31-33.

Interval. . . . . 850/866 - 2620'

Formation . . . . . Unknown

Age . . . . . Paleozoic (?)

Lithology . . . . . Limestone, Dolomite, Sandstone

An unconformity between the Claron/Price River Conglomerate and carbonate unit of probable Paleozoic age was penetrated between 850 and 866 feet.

Several major lost circulation zones were encountered from 850 to 2620 feet. As was previously stated, there were no sample returns from 850 to 1249 feet except for the cuttings adhering to the bit when it was pulled out of the hole. There were intermittent returns from 1250 to 2600 feet. The following lithologic descriptions are based on the intermittent sample returns, Schlumberger logs, and cuttings removed from the rock bits. The Schlumberger logs were run from 1240 to 2078 feet and from 2078 to 2649 feet.

The upper part of the carbonate unit (850-1313 feet) is characterized by interbedded dolomitic limestones, dolomites, sandstones, and quartzites. The carbonates in the interbedded sequence vary in color, texture, and composition. The carbonate at the top of the sequence consists of a dark gray, massive, recrystallized dolomitic limestone containing trace fossil fragments. Below this interval, white to light gray massive dolo-

mitic limestones with minor chert are interbedded with calcareous sandstones and rare pink quartzites. The sandstone is white to light gray and consists of poorly-sorted, angular to subrounded quartz clasts in a poorly-consolidated calcite matrix. Pyrite and calcite veins are present in rare to trace amounts. Highly-fractured vein quartz and clay were encountered above a major lost circulation zone at 1265 feet.

The lower part of the carbonate unit (1313-2620 feet) is characterized by fractured and brecciated dolomites and dolomitic limestones. The upper part of this interval consists of a light brown to gray, coarsely-crystalline dolomite with minor fine-grained to aphanitic dolomite. Calcite veining and clay are present in rare to trace amounts.

Two major lost circulation zones were encountered at 1330 and 1381 feet. Moderate to high concentrations of hydrogen sulfide gas and carbon dioxide gas were detected in these zones. The well was drilled without returns from 1381 to 1970 feet.

Light gray to light brown finely-crystalline dolomitic limestone occurs below 1970 feet. Pyrite and fracture filling calcite are present in rare to trace amounts.

A major lost circulation zone was encountered at 2035 feet, however, no hydrogen sulfide gas or carbon dioxide gas was

detected in this zone.

The carbonate below the lost circulation zone is predominantly white to light gray, very-fine to fine-grained dolomitic limestone. This limestone is characterized by the presence of galena and pyrite in rare to common amounts and common to abundant soft white clay. The limestone also contains minor brecciated zones.

A sequence of light brown to light gray aphanitic dolomite and dark grayish-brown, fine-grained dolomite with sugary texture occurs from 2280 to 2600 feet. The dolomites contain many brecciated zones with calcite and siliceous veining. Rare to trace amounts of galena, chalcopyrite, and quartz are present intermittently in this interval. Pyrite and calcite occur in rare to common amounts.

The dipmeter log was run from 1268 to 2432 feet. The dips of the carbonates are extremely erratic, indicating the presence of many cavities and fractures. The only consistent formation dips recorded in the carbonate unit occur in a dolomitic interval between 1780 and 1870 feet. The average attitude of the beds in this interval is 42W and 21^{0}NE.

It is difficult to determine the formation and age of the carbonate unit because of the slight returns and the brecci-

ation and dolomitization of carbonates. The dolomitic limestones and dolomites from CFSU 14-29 are very similar to those encountered in CFSU 31-33 from 1150 to 2770 feet. Those carbonates were also characterized by many fractures and cavities, pyrite and galena mineralization, hydrogen sulfide gas, and carbon dioxide gas. The carbonates from CFSU 31-33 were tentatively assigned to the Pakoon Dolomite and Oquirrh formation of lower Permian and Pennsylvanian age.

GEOCHEMISTRY

The CFSU 14-29 well was drilled with aerated water from 2407 to 2620 feet. Fluid returns were intermittent in this interval, and the flowline temperatures ranged from 91° to 115°F. While trying to clean out the fill in the hole at 2620 feet, the hole was gaining fluid at a rate of approximately 100 bbls/hour. The flowline temperature reached a maximum of 170°F. It is probable that some of the fluid was formation water, however, these samples were very contaminated with drilling fluid and drilling fluid additives.

In order to obtain a less contaminated sample of the fluid, the well was flowed for approximately two hours after the Schlumberger logs were run at 2620 feet. Samples were col-

lected every 30 minutes and checked for chlorides, pH, and calcium. Two samples were selected for analysis to determine the chemical composition of the fluid. The chemical analyses were done by Ford Chemical Laboratory, Inc., in Salt Lake City. The results of these analyses are included in the appendix.

The chemistry of the flowline samples from CFSU 14-29 is considerably different than that of the samples from the CFSU 42-7 and 31-33 wells. Flowline samples that best represent reservoir fluid from CFSU 31-33 and 42-7 have salinities of 10,000 ppm and 9405 ppm. The salinities of the samples collected from CFSU 14-29 are 4881 ppm and 4776 ppm. These lower salinities are more characteristic of the shallow fluid collected at depths of 2663 and 2700 feet in CFSU 42-7. However, the chemical characteristics other than salinity of the CFSU 14-29 samples differ from those observed in the shallow fluid of CFSU 42-7 and 31-33. Concentrations of sodium, potassium, and chloride in CFSU 14-29 are much lower than those in CFSU 42-7 and 31-33. The samples from CFSU 14-29 contain significantly higher concentrations of calcium, magnesium, silica, and sulfate.

Tables 1 and 2 contain data based on the silica and Na-K-Ca geothermometer calculations of the flowline discharge of CFSU 14-29 at the total depth of 2620 feet. The equation used for the silica calculations was: $t^{0}C + (1315/5.205-\log SiO_2)-273.15$. The equation was used for the Na-K-Ca calculations was:

$t^0C = (1647/\log(Na/K)+\beta \log (\sqrt{Ca}/Na)+ 2.24)-273.15.$*

The Na-K-Ca temperature estimates of 266°F and 278°F appear to be more reliable than the silica temperature estimates of 605°F and 596°F. The silica concentration in the CFSU 14-29 diluted samples is anomalously high compared to the silica in diluted samples from CFSU 42-7 and 31-33. The silica concentrations from CFSU 14-29 are 96 ppm and 92 ppm. The concentration of silica in CFSU 42-7 and 31-33 ranges from 15 ppm to 34 ppm.

The flowline samples from CFSU 14-29 probably represent small quantities of shallow geothermal fluid that have been contaminated with drilling fluid and drilling fluid additives. The large quantity of drilling fluid and additives injected into the formation while drilling without returns undoubtedly contributed to the unusual composition of the flowline samples.

*Proceedings of the Second UN Symposium on the Development and Use of Geothermal Resources, Vol. I, p. lxxiii (1975).

DISCUSSION

The CFSU 14-29 well may have penetrated the top of a shallow geothermal reservoir consisting of fractured dolomite and dolomitic limestone. The reservoir characteristics are difficult to determine because of the paucity of fluid and rock sample returns while drilling. The formation temperature is difficult to estimate due to the large amounts of cool drilling fluid loss to fractures while drilling without returns. All of the maximum reading thermometers that were run during deviation surveys recorded temperatures less than 100^{0}F below the lost circulation zone at 850 feet.

Figure 1 is a graph of temperature profiles from surveys taken after reaching the total depth. The first survey was taken after the hole had been static (no circulation of injected water) for 4.5 hours. After the hole had been static for approximately 10 hours, drill pipe was run into the hole and air was injected to start the well flowing. The well was flowed for about 2 hours in order to collect fluid samples. The second temperature survey was run after the well had flowed and the hole had been static for 2 hours.

The temperature gradients are generally low (1-3^0/100 ft) from 250 feet to the casing at 2078 feet. The temperatures range from 95^{0}F to 125^{0}F in this zone in the first temperature survey.

In contrast, the temperatures in the second survey range from 150°F to 180°F in the zone above the casing shoe. The discrepancy between the first and second surveys is explained by hot water produced from the lower zone heating up the upper zone before the second survey was taken.

The free water level in the well stands at about 4840 feet above MSL, or approximately 1400 feet below the surface. The free water level in both CFSU 42-7 adn 31-33 is about 5100 feet above MSL.

There is a distinct increase in temperature gradient (40°/100 ft in the first survey) below 2078 feet. The temperature increases to a maximum of 186°F at 2180 feet in the first survey. The increase in temperature gradient below 2078 feet is not as great in the second survey (15°/100 ft). The maximum temperature in the second survey is 196°F at 2180 feet. Both profiles become isothermal below 2200 feet. The increase in temperature gradient below 2078 feet is probably due to the presence of the casing which had not reached equilibrium with the geothermal system.

In both CFSU 14-29 and 31-33, the Bullion Canyon Volcanics and Claron/Price River Conglomerate were not thick enough to extend to the groundwater table. As a result, dolomite was encountered above the water table in both wells. Hydrogen sulfide gas was

encountered in both wells within the dolomite units above the water table. However, unlike the unconsolidated ("sanded") dolomite that occurred above the water table in the Forminco #1 well, dolomite samples in 14-29 and 31-33 showed no signs of sanding.

Estimation of Subsurface Temperatures from
the Silica Content of Water from the Flowline
Discharge, CFSU 14-29
Millard Co., Utah

TABLE 1

Total 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	Estimated temperature from SiO_2, °F (diluted sample)
2620	155	7.03	4881	<.01	96	9:1	960	605
2620	157	7.41	4776	<.01	92	9:1	920	596

Estimation of Subsurface Temperatures from the
Empirical Na-K-Ca Geothermometer for Flowline
Discharge, CFSU 14-29
Millard Co., Utah

TABLE 2

Total Depth, ft.	Temperature of Flowline, °F	TDS	Na	K	Ca	Estimated Temperature from Na-K-Ca $\beta = 1/3$ °F
2620	155	4881	1280	36.5	332	266
2620	157	4776	1220	41.5	332	278

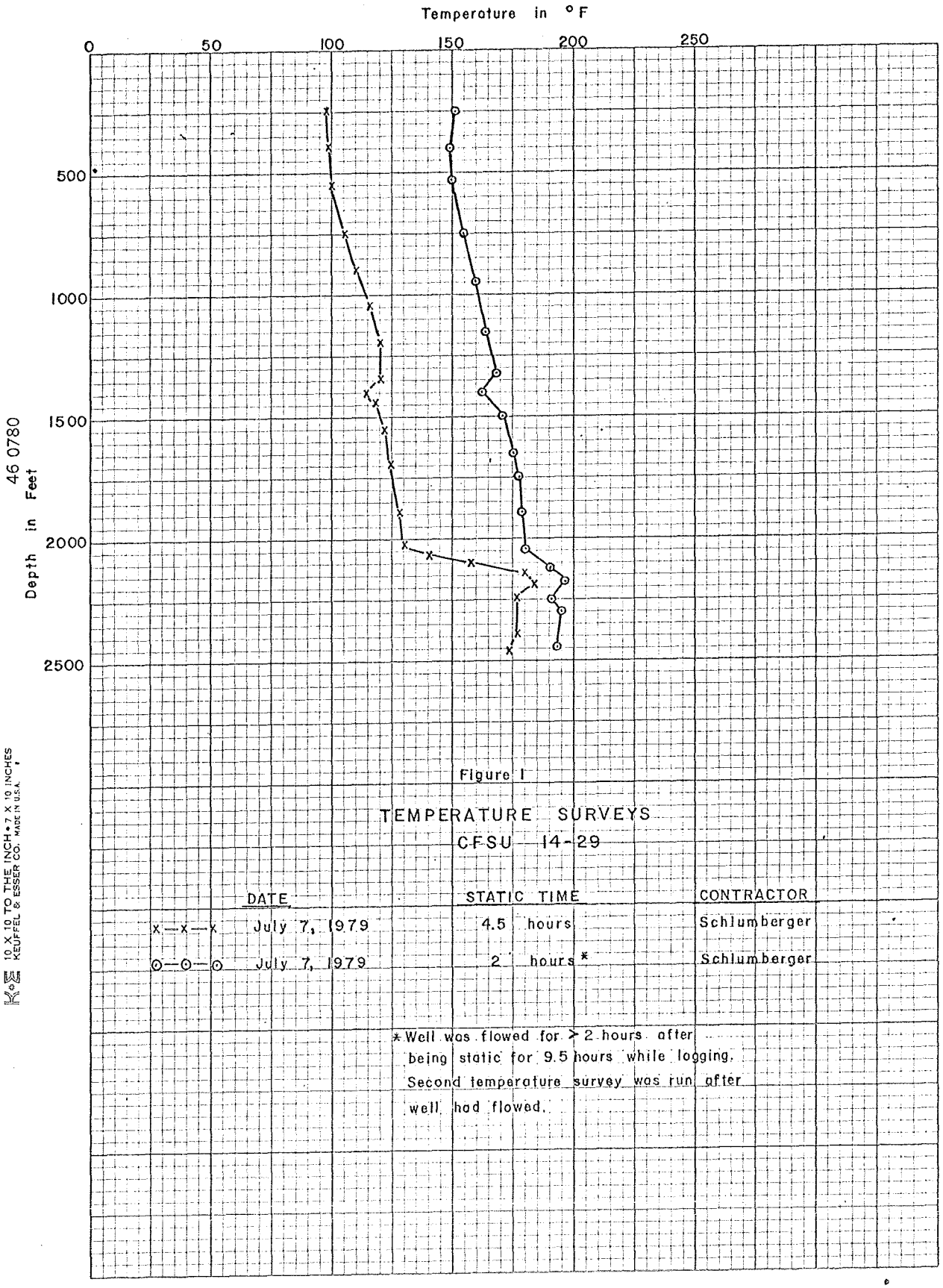


Figure 1

TEMPERATURE SURVEYS
CFSU 14-29

	DATE	STATIC TIME	CONTRACTOR
x—x—x	July 7, 1979	4.5 hours	Schlumberger
⊙—⊙—⊙	July 7, 1979	2 hours *	Schlumberger

* Well was flowed for > 2 hours after being static for 9.5 hours while logging. Second temperature survey was run after well had flowed.

APPENDIX

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit #14-29
Millard County, Utah

Sample Information

Source..... Flowline
Collection Date and Time..... 7-7-79 1345 hr.
Depth of Well at Time of Collection.... 2620 feet
Temperature of Sample..... 157°F
Date Analysis Begun.....

Turbidity	9 NTU	Lithium as Li	265 mg/l
Conductivity	7350 umhos/cm	Total Hardness as $CaCO_3$	1310 mg/l
pH	7.41 Units	Iron as Fe (Total)	.8666 mg/l
TDS at 180°C	4776 mg/l	Iron as Fe (Filtered)	.380 mg/l
Alkalinity as $CaCO_3$	158 mg/l	Lead as Pb	.005 mg/l
Arsenic as As	.745 mg/l	Magnesium as Mg	115.2 mg/l
Bicarbonate as HCO_3	192.76 mg/l	Manganese as Mn	.520 mg/l
Barium as Ba	1.35 mg/l	Mercury as Hg	<.0002 mg/l
Boron as B	6.4 mg/l	Nickel as Ni	.085 mg/l
Cadmium as Cd	.310 mg/l	Nitrate as NO_3-N	<.01 mg/l
Calcium as Ca	332 mg/l	Nitrite as NO_2-N	---- mg/l
Carbonate as CO_3	<.01 mg/l	Potassium as K	41.5 mg/l
Chloride as Cl	2060 mg/l	Selenium as Se	.009 mg/l
Chromium as Cr (Total)	<.001 mg/l	Silica as SiO_2 (diluted)	92 mg/l
Chromium as Cr (Hex)	<.001 mg/l	Silver as Ag	<.001 mg/l
Copper as Cu	.010 mg/l	Sulfate as SO_4	900 mg/l
Surfactants MBAS	---- mg/l	Sodium as Na	1220 mg/l
Fluoride as F	2.50 mg/l	Zinc as Zn	.350 mg/l

GEOCHEMICAL DATA

WELL: Union Oil Company of California
Cove Fort-Sulphurdale Unit #14-29
Millard County, Utah

Sample Information

Source	Flowline
Collection Date and Time	7-7-79 1315 hr.
Depth of Well at Time of Collection	2620 feet
Temperature of Sample	155°F
Date Analysis Begun	

Turbidity	25 NTU	Lithium as Li	.357 mg/l
Conductivity	7500 umhos/cm	Total Hardness as $CaCO_3$	1250 mg/l
pH	7.03 Units	Iron as Fe (Total)	1.336 mg/l
TDS at 180°C	4881 mg/l	Iron as Fe (Filtered)	.410 mg/l
Alkalinity as $CaCO_3$	144 mg/l	Lead as Pb	.002 mg/l
Arsenic as As	.660 mg/l	Magnesium as Mg	100.8 mg/l
Bicarbonate as HCO_3	175.68 mg/l	Manganese as Mn	.450 mg/l
Barium as Ba	1.20 mg/l	Mercury as Hg	<.0002 mg/l
Boron as B	6.0 mg/l	Nickel as Ni	.080 mg/l
Cadmium as Cd	.235 mg/l	Nitrate as NO_3-N	<.01 mg/l
Calcium as Ca	332 mg/l	Nitrite as NO_2-N	---- mg/l
Carbonate as CO_3	<.01 mg/l	Potassium as K	36.5 mg/l
Chloride as Cl	2030 mg/l	Selenium as Se	.012 mg/l
Chromium as Cr (Total)	<.001 mg/l	Silica as SiO_2 (diluted)	96 mg/l
Chromium as Cr (Hex)	<.001 mg/l	Silver as Ag	<.001 mg/l
Copper as Cu	.008 mg/l	Sulfate as SO_4	1020 mg/l
Surfactants MBAS	---- mg/l	Sodium as Na	1280 mg/l
Fluoride as F	2.43 mg/l	Zinc as Zn	.336 mg/l

Well History

Union Oil Company of California

union

COMPANY: Union Oil Company of California			TYPE WELL: Geothermal	Hot Water
			SEC 29 T 25S R 6W M S.L.M.	
LEASE: Cove Fort Sulphurdale Unit	WELL NO.: 14-29		COUNTY: Millard	
LOCATION: 2519.44' South and 442' East of the Northwest corner of Section 29, T25S, R6W, S.L.M.			AREA: Cove Fort-Sulphurdale	

ELEVATION	SPUD	COMP.	ABAND.	TOTAL DEPTH	PLUG	RECOMP.
6219'	5/25/79	--	7/9/79	2620'	0-2620'	

HOLE DEVIATION: ☐ 141' Maximum possible — B.H.L. Straight Hole

CASING RECORD

SIZE	CEM. LOG.	DEPTH	SAX	W.S.O. - PERFS. - REMARKS
30"		38' KB	35	
20"		224' KB	826	
13-3/8"		1240' KB	2382	Cemented in two stages
9-5/8"		998'-2078'	KB 712	

WELL DATA

ELEC. LOG 2078'-2462'
DIPMETER 2088'-2466'
CORE RECORD
HISTORY
CORE ANALYSIS
PALEO. LETTER

MARKERS - HORIZONS

DATE	DEPTH	PROGRESS HISTORY
5/25/79		Moved in and rigged up Brinkerhoff-Signal Rig #3. Center punched hole with 26" hole opener and 17½" bit from 38' to 42'. Drilled 17½" hole from 42' to 49'. Commencement of drilling was witnessed by U.S.G.S representatives Andrew H. Carpenter and Frank S. Dalton.
5/26/79		Drilled 17½" hole from 49' to 158'.
5/27/79		Drilled 17½" hole from 158' to 260'. Opened 17½" hole to 26" from 38' to 84'.
5/28/79		Opened 17½" hole to 26" from 84' to 162'.
5/29/79		Opened 17½" hole to 26" from 162' to 230'. Cone on hole opener locked. Circulated hole clean.
5/30/79		Laid down hole opener. Ran 7 joints 20", 94# buttress casing. Total length = 224.61'. Shoe set at 2240'. Cemented casing through shoe at 224' with 826ft^3 of class "G" cement mixed with 2% $CaCl_2$. Displaced with 403ft^3 mud. Had good returns throughout job. Pumped 97ft^3 cement to sump. Cut off 30" conductor. Nipplied up 20" B.O.P.

Form 3358 (Rev 6/67)

5/31/79 Installed 20" Double Shaffer, B.O.P. and 20" Hydril. Installed choke manifold, kill line, and hydraulic connection lines plus remote B.O.E. control in dog house. Attempted B.O.E. test. Tightened leaks.

6/01/79 Tested blind and pipe rams and Hydril to 500 psi for ½ hour each. Held O.K. Test witnessed by Andrew H. Carpenter, Frank S. Dalton, and John Reeves with the U.S.G.S. Tested kelly cock. R.I.H. to wiper plug at 202'. Drilled plug and cement to shoe at 224'. Drilled shoe. Drilled 17½" hole from 260' to 273'.

6/02/79 Drilled 17½" hole from 273' to 303'. Drilled 17½" hole from 303' to 480'.

6/03/79 Drilled 17½" hole from 480' to 670'. Performed H_2S drill. Drilled 17½" hole from 670' to 795'.

6/04/79 Circulated hole while holding H_2S school. Drilled 17½" hole from 795' to 833'. Lost circulation at 833'. P.O.H. Lost 1000 bbls mud attempting to fill hole.

6/05/79 Filled hole with mud. Lost small amount of mud. R.I.H. with O.E.D.P. to 830'. HOWCO pumped 56ft^3 water followed by 265ft^3 "B" cement premixed with 1:1 perlite, 40% SSA1, 3% gel and 0.5% CFR-2. 5% Flo-Cele with 2% $CaCl_2$ added at mixer. Displaced cement with 18ft^3 water and 31ft^3 mud. C.I.P. at 0545 hours. P.O.H. Filled hole - stood full. W.O.C. R.I.H. with 17½" B.H.A. to cement at 777'. Cleaned out cement from 777' to 833'. Drilled 17½" hole from 833' to 852'. Lost returns. Mixed 200 bbls 25% LCM gel mud. Drilled without circulation from 852' to 866', while pumping LCM. Attempted unsuccessfully to fill hole.

6/06/79 Hung O.E.D.P. at 866'. HOWCO pumped 56ft^3 water followed by 265ft^3 "B" cement premixed with 1:1 perlite, 40% SSA1, 3% gel and 0.5% CFR-2. 5% Flo-Cele and 2% $CaCl_2$ plus 1% nut hull added at mixer to first 100ft^3 of slurry. Displaced with 45ft^3 water. C.I.P. at 0120 hours. Attempted unsuccessfully to fill hole. P.O.H. W.O.C. R.I.H. with 17½" drilling assembly to 866'. No cement in hole. Drilled 17½" hole without circulation from 866' to 973'. Removed stabilizers from assembly. Washed fill from 913' to T.D. at 973'. Drilled without circulation from 973' to 1000'.

6/07/79 Drilled 17½" hole with no circulation from 1000' to 1103'.

6/08/79 Drilled 17½" hole without circulation from 1103' to 1209' with no circulation.

6/09/79 Drilled 17½" hole without circulation from 1209' to 1243'. P.O.H. for locked drilling assembly. Reamed 17½" hole from 240' to 1000'.

6/10/79 Reamed 17½" hole from 1000' to 1243'. Drilled 17½" hole from 1243' to 1249'. P.O.H. R.I.H. with O.E.D.P. to 935'. Dowell mixed and pumped plug #3 of 203ft^3 class "G" cement mixed with 20% silica flour, 22% kolite, 8% D-53 and 3% $CaCl_2$. Displaced with 47ft^3 mud. P.O.H. W.O.C. 4 hours. R.I.H. with O.E.D.P. to top of cement at 893'. Dowell mixed and pumped plug #4 of 203ft^3 same slurry. P.O.H. W.O.C. 4 hours. R.I.H. with O.E.D.P. to cement at 872'. Dowell mixed and pumped plug #5 of 203ft^3 same slurry. P.O.H. W.O.C. 4 hours.

6/11/79 R.I.H. with O.E.D.P. to cement at 787'. Filled hole with mud. R.I.H. with 17½" drilling assembly to 787'. Cleaned out cement to 854'. Lost all returns. P.O.H. R.I.H. with O.E.D.P. to firm cement at 861'. Dowell mixed and pumped plug #6 of 201ft^3 class "G" cement mixed with 20% silica flour, 22% kolite, 8% D-53 and 3% $CaCl_2$. Displaced with 45ft^3 water. P.O.H. W.O.C. 4 hours. R.I.H. with O.E.D.P. to cement at 780'. Filled hole with mud.

6/12/79 R.I.H. with 17½" drilling assembly to 780'. Cleaned out cement to 872'. Lost all returns. Reamed to 1249'. Pumped high viscosity gel pill. P.O.H. Rigged and ran 29 joints 13-3/8" 54.5#/ft K55 buttress casing. Hung casing with shoe at 1240', insert float at 1199' and HOWCO D.V. collar at 766'. Dowell mixed and pumped first stage of 203ft^3 class "G" cement mixed with 20% silica flour, 22% kolite and 8% RFC followed by 546ft^3 class "G" cement mixed 1:1 perlite with 40% silica flour, 3% gel and 0.5% TIC followed by 120ft^3 class "G" cement with 40% silica flour and 0.75% TIC. Displaced with 1041ft^3 water. Bumped plug with 500 psi. C.I.P. at 1630 hours. Opened D.V. collar and found casing on vacuum. W.O.C. 4 hours. Dowell mixed and pumped preflush for second stage of 112ft^3 spacer 1000 followed by 1142ft^3 class "G" cement mixed 1:1 perlite with 40% silica flour, 3% gel and 0.5% TIC. Displaced closing plug with 666ft^3 water. Bumped plug with 1000 psi. No cement returns to surface. C.I.P. at 2330 hours.

6/13/79 W.O.C. Removed 20" B.O.P.'s. Cut off 20" and 13-3/8" casings. Installed 13-3/8" x 12"-900 W-K-M S.O.W. casing head. Tested weld to 1000 psi. Installed two 12"-900 Cameron G.R.C. B.O.P.'s, 12"-900 Hydril and Grant rotating head.

6/14/79 Completed nippling up B.O.P.'s. Tested blind rams to 1600 psi for ½ hour. Tested pipe rams to 1500 psi for ½ hour. Tested Hydril to 1600 psi for ½ hour. Tested kelly cock to 1400 psi. Picked up 12¼" drilling assembly. R.I.H. to 766'. Cleaned out D.V. collar. R.I.H. to 1191'. Cleaned out cement and insert float to 1201'.

6/15/79 P.O.H. Ran Schlumberger Cement Bond Log and Gamma Ray from 1204' to surface. Log indicated fair bond from 1204' to 820' and no bond above 820'. Maximum reading thermometer was 118°F. Perforated casing with 5 shots at 800'. Fluid level fell from sight in hole. R.I.H. and set HOWCO RTTS at 736'. Dowell mixed and pumped through RTTS, 371ft^3 class "G" cement mixed 10% RFC with 12% kolite. Had water returns to surface after mixing 84ft^3. Mixing hopper on pump truck failed. Displaced cement from tools with 95ft^3 water. Released pressure on packer after one hour with no bleed back. P.O.H. W.O.C. 5 hours. R.I.H. with O.E.D.P. to cement at 773'. P.O.H. Ran 160' of 1" pipe into 13-3/8" x 20" annulus. Unable to work pipe lower. Pulled 1" pipe. R.I.H. with one stand of drill pipe. Installed slip joint brace between 20" and 13-3/8" casing.

6/16/79 R.I.H. with 12¼" drilling assembly to cement at 773'. Cleaned out cement to 805'. R.I.H. to 1204'. Circulated clean. P.O.H. Ran Schlumberger Cement Bond Log with Gamma Ray from 1200' to surface. Log indicated good bond from 1200' to 350' and no cement above 350'. R.I.H. with 12¼" drilling assembly to 1204'. Closed pipe rams and tested perforations to 100 psi surface pressure. Cleaned out cement from 1204' to 1249' and shoe at 1240'. Drilled 12¼" hole from 1249' to 1330'. Lost all returns at 1265'. P.O.H.

6/17/79 R.I.H. with O.E.D.P. to 1200'. R.I.H. to 1310'. Cleaned out fill to 1330'. Dowell mixed and pumped plug #7 of 187ft^3 class "G" cement mixed 10-0 RFC with 12% kolite and 2% $CaCl_2$. Displaced with 67ft^3 water. C.I.P. at 0500 hours. P.O.H. to 750'. W.O.C. 4 hours. R.I.H. to cement at 1295'. Dowell mixed and pumped plug #8 of 181ft^3 class "G" cement mixed 10-0 RFC with 12% kolite and 2% $CaCl_2$. Displaced with 67ft^3 water. C.I.P. at 1015 hours. P.O.H. to 733'. W.O.C. 4 hours. R.I.H. to cement at 1245'. Attempted to fill hole with water. Hole took fluid at rate of 30 bbls/hour. Hung O.E.D.P. at 1245'. Dowell mixed and pumped plug #9 of 181ft^3 class "G" cement 10-0 RFC with 12% kolite and 2% $CaCl_2$. Displaced with 62ft^3 water. C.I.P. at 1545 hours. P.O.H. to 682'. W.O.C. 4 hours. R.I.H. to cement at 1226'. Filled hole with water. P.O.H.

6/18/79 R.I.H. with 12¼" drilling assembly to cement at 1226'. Cleaned out cement to 1330'. Lost all returns at 1310'. Drilled 12¼" hole from 1330' to 1345' with no returns. P.O.H. R.I.H. with O.E.D.P. to 1344'. Dowell mixed and pumped plug #10 of 181ft^3 class "G" cement mixed 10-0 RFC with 12% kolite and 2% $CaCl_2$. C.I.P. at 0515 hours. P.O.H. to 781'. W.O.C. 4 hours. R.I.H. to cement at 1343'. Dowell mixed and pumped plug #11 of 248ft^3 class "G" cement mixed 8-0 RFC with 21% kolite and 2% $CaCl_2$. Displaced with 78ft^3 water. P.O.H. to 748'. W.O.C. 4 hours. R.I.H. to cement at 1090'. P.O.H. R.I.H. with 12¼" drilling assembly to 1090'. Cleaned out cement to 1345'. Drilled 12¼" hole to 1348'.

6/19/79 Drilled 12¼" hole from 1348' to 1429'. Lost all returns at 1381'. P.O.H. R.I.H. with O.E.D.P. to 1429'. Dowell mixed and pumped plug #12 of 248ft^3 class "G" cement mixed 8-0 RFC with 26% kolite, 20% silica flour and 2% $CaCl_2$. Displaced with 92ft^3 water. P.O.H. to 1054'. P.O.H. R.I.H. with 12¼" drilling assembly to cement at 1265'. Unable to fill hole. Cleaned out cement to 1330' with no returns. Twisted off drill pipe. P.O.H. Top of fish at 216'. R.I.H. with overshot dressed with 6¼" grapple. Fish had fallen down hole to 320'. Unable to engage fish. P.O.H. R.I.H. with overshot dressed with 5-3/4" grapple. Engaged fish at 320'. Chained out of hole.

6/20/79 Recovered complete fish. Found bit pinched ½". Changed bit. R.I.H. to 1330'. Reamed from 1330' to 1429' with no returns. Drilled 12¼" hole from 1429' to 1532' with no returns.

6/21/79 Drilled 12¼" hole from 1532' to 1829' with no returns.

6/22/79 Drilled 12¼" hole from 1829' to 1903'. Stuck drill pipe at 1903'. Worked free (one hour). Reamed from 1832' to 1903'. Drilled 12¼" hole from 1903' to 2076'. Regained partial returns from 1995' to 2035'. Pumped 75 bbls High-Vis gel slurry with 25% LCM flush. P.O.H. Experienced a tight place at 1676'. Stuck drill pipe at 1460'. Worked pipe and pumped gel pill every hour.

6/23/79 Continued to work stuck pipe. Regained 30% returns. Rigged up and ran Go-International Free Point Indicator. Found pipe free at 1377'. Stuck at 1416', top of three blade stabilizer. Backed off drill pipe at 1224'. P.O.H. R.I.H. with screw-in sub, bumper sub, hydraulic jars and accelerator. Screwed into fish. Jarred and worked fish free in three hours. P.O.H. Recovered fish completely. R.I.H. with RR bit #5. Washed to 2076'. Drilled 12¼" hole from 2076' to 2080' with no returns.

6/24/79 P.O.H. R.I.H. with O.E.D.P. to 2070'. Dowell mixed and pumped through drill pipe at 2070', plug #13, 191ft^3 class "G", premixed with 8.2% RFC, 20% silica flour, 25% kolite and 2% $CaCl_2$. Displaced with 95ft^3 water. C.I.P. at 0400 hours. Pulled drill pipe to 1220'. W.O.C. 4 hours. R.I.H. with drill pipe. Found top of cement at 1885'. Pumped plug #14, same as #13. C.I.P. at 0900 hours. Pulled drill pipe to 1220'. W.O.C. 4 hours. R.I.H. with drill pipe. Top of cement at 1698'. Pumped plug #15, same as #14. C.I.P. at 1400 hours. Pulled drill pipe to 1220'. W.O.C. 4 hours. R.I.H. with drill pipe. Found top of cement at 1490'. Pumped plug #16, same as #15. C,I.P. at 1900 hours. Pulled drill pipe out of hole. W.O.C. 4 hours. R.I.H. with drill pipe. Round top of cement at 1155'. Filled hole with water.

6/25/79 R.I.H. with RR bit #5 to 1155'. Drilled firm cement from 1155' to 1408' and soft cement from 1408' to 1543'. Lost ½ bbls water/minute from 1415' to 1495'. Lost all returns at 1495'. P.O.H. R.I.H. with O.E.D.P. to 1543'. Mixed and pumped plug #17, 191ft^3 class "G" cement, premixed with 20% silica flour, 25% kolite, 8.2% RFC and 2% $CaCl_2$. C.I.P. at 2130 hours. Allowed cement to fall out of drill pipe. Pulled drill pipe to 1081'. Pumped 35 bbls water through drill pipe. Did not fill hole. W.O.C.

6/26/79 W.O.C. to 0130 hours. Attempted to fill hole with water, without success. R.I.H. with O.E.D.P. to top of cement at 1466'. Mixed and pumped plug #18, same as #17. C.I.P. at 0300 hours. Pulled drill pipe to 1000'. Filled hole with water. Circulated hole. P.O.H. W.O.C. 9 hours. R.I.H. with RR bit #5. Found top of cement at 1226'. Drilled firm cement from 1226' to 1480'.

6/27/79 Drilled firm cement with 12¼" bit from 1480' to 2080'. Lost 10% to 15% returns. P.O.H. Ran Schlumberger DIL Log from 2080' to 1240', FDC-CNL-GR from 2080' to 1240', and HDT from 2080' to 1240'. Maximum temperature = 134° after 5½ hours. R.I.H. with RR #5 to 2080', circulated. P.O.H.

6/28/79 Ran 26 joints 9-5/8" 36# K55 buttress casing, total of 1080.54', with shoe at 2078', float at 1994', Midway 9-5/8" x 13-3/8" hanger at 998'. Hung liner. Mixed and pumped through shoe at 2078', 338ft^3 "G" cement premixed with 10-0 RFC, 12% kolite. Followed by 275ft^3 class "G" cement with 1:1 perlite, 40% silica flour, 3% gel and .05% TIC, followed by 99ft^3 "G" cement with 40% silica flour and .05% TIC. Bumped plug with 500 psi. Floats O.K. No returns to surface throughout job. C.I.P. at 0900 hours. P.O.H. Fluid 20' from surface. W.O.C. Removed Grant Rotating Head and

6/28/79 Continued -

Hydril. Installed 12"-900 banjo box and rotating head.

6/29/79 Ran RR bit #5. Found cement at 920'. Drilled cement out of 13-3/8" from 920' to 998', top of hanger. P.O.H. R.I.H. with bit #6. Drilled cement from 998' to 1000'. R.I.H. to 1975'. Drilled cement with 8-3/4" bit from 1975' to 1994' plus wiper plug, float and cement to 2043'. P.O.H. Ran Schlumberger CBL. Tool failed. Repaired tool.

6/30/79 Reran CBL, indicated good cement from 1500' to 2030' and fair cement from 1200' to 998'. R.I.H. with bit #7. Drilled cement from 2043' to 2078'. Drilled 9-5/8" shoe. Cleaned out open hole from 2078' to 2080'. Drilled 8-3/4" hole from 2080' to 2213' with fluid returns. Lost circulation at 2213'. Drilled 8-3/4" hole from 2213' to 2250' with no returns and from 2250' to 2407' with partial (10-60%) returns. Had 30' fill on connection at 2407'. Unable to clean hole with no returns and hole standing full. P.O.H. Rigged for aerated water drilling.

7/01/79 Continued rigging for aerated water drilling.

7/02/79 R.I.H. with 8-3/4" drilling assembly to 2050'. Installed jet sub 1686' above bit. Broke circulation with aerated water. R.I.H. to 2347'. Cleaned out fill to 2407'. Drilled 8-3/4" hole from 2407' to 2620' with aerated water. From 2451' to 2620', formation was unconsolidated. P.O.H. Worked pipe through tight spots from 2620' to 2500'. Picked up additional jet sub 1310' above bit and moved other to 1873' above bit. R.I.H. to top of fill at 2510'. Cleaned out fill to 2550'. Unable to keep hole clean with aerated water or foam.

7/03/79 Cleaned out fill to 2580'. Lost circulation. Stuck pipe at 2580'. Worked pipe free after 3 hours. P.O.H. and checked tools. Removed jet subs. R.I.H. to top of fill at 2565'. Had 65' fill on connection. Stiffened foam. Had 65' fill remaining. Pumped high viscosity gel pills with stiff foam. Had 65' fill on attempted connection. While circulating with aerated stiff foam, hole thiefed 100 bbls/hour of fluid.

7/04/79 Cleaned out fill with foam and gel pills to 2598'. Stuck pipe. Worked free. P.O.H. Changed bit and drilling assembly. R.I.H. to 2050'. Pumped 1000 bbls at 650 gpm. Unable to fill hole. R.I.H. to top of fill at 2498'. P.O.H. to 2465'. Dowell pumped 52 bbls sodium silicate-calcium chloride consolidation pill. R.I.H. to 2498'. Cleaned out fill to 2560'. Had 60' fill on connection. P.O.H. to 2050'. Mixed

7/04/79 Continued -

chemicals. R.I.H. to top of fill at 2500'. P.O.H. to 2465'. Dowell pumped 52 bbls sodium silicate-calcium chloride consolidation pill.

7/05/79 Cleaned out fill from 2500' to 2560', with 60' fill on connection. P.O.H. R.I.H. with O.E.D.P. to 2465'. Dowell pumped a 290ft^3 sodium silicate-calcium chloride consolidation plug. Pulled drill pipe to 2434'. Dowell mixed and pumped through drill pipe at 2434', 180ft^3 class "B" cement mixed with 8% RFC, 20% silica flour and 13% kolite. Displaced with 224ft^3 water. P.O.H. W.O.C. 6 hours. R.I.H. with 8-3/4" drilling assembly. Found top of cement at 2466'. Drilled firm cement from 2466' to 2490'. Cleaned out fill from 2490' to 2577', with 45' fill on connection. P.O.H.

7/06/79 R.I.H. with O.E.D.P. to 2550'. Pumped water from sump to cool hole. Dowell mixed and pumped a 37ft^3 sodium silicate-calcium chloride consolidation plug. Pulled drill pipe to 2470'. Dowell mixed and pumped 180ft^3 "G" cement with 8% RFC, 20% silica flour and 13% kolite. Displaced with 224ft^3 water. C.I.P. at 0345 hours. P.O.H. W.O.C. 6 hours. R.I.H. with an 8-3/4" drilling assembly. Found top of cement at 2466'. Drilled firm cement from 2466' to 2471'. Cleaned out fill from 2471' to 2540'. Had 40' fill on connections. P.O.H.

7/07/79 Ran Schlumberger temperature log from 220' to 2452'. Maximum reading thermometers indicated 185°, 186° and 186° after 4½ hours static. Log indicated maximum bottom hole temperature to be 176°F. Ran DIL-8 from 2462' to 2078' and Dipmeter from 2466' to 2088'. R.I.H. with O.E.D.P. to 2076'. Injected air through drill pipe. Produced water to surface. Flowed well using air as a lifting method. P.O.H. Ran Schlumberger Temperature Log from 230' to 2464', indicating 196°F. R.I.H. with O.E.D.P. to 465'. Pumped in excess water from sump. P.O.H. R.I.H. with HOWCO EZSV 9-5/8" cement retainer, set at 2000'. Filled casing with water. Mixed and pumped through and below cement retainer, abandonment plug #1, 250ft^3 "G" cement with 8% RFC, 20% silica flour and 13% kolite. Pulled out of retainer. Pumped 50ft^3 "G" cement with 40% silica flour and 0.5% TIC. Displaced with 95ft^3 water. Pulled drill pipe to 1500'. Pumped 280ft^3 drilling mud into hole. Pulled drill pipe to 1100'. Mixed and pumped abandonment plug #2, 180ft^3 "G" cement with 40% silica flour and 0.5% TIC.

7/08/79 W.O.C. 4 hours. R.I.H. with O.E.D.P. Located top of cement at 851'. P.O.H. Laid down 4½" drill pipe. Removed blowout preventers. Ran 1" line pipe into annulus between 20" and 13-3/8" casing to 143'. Mixed

7/08/79 Continued -

and pumped 201ft^3 "G" cement mixed with 8.6% RFC, 20% silica flour and 12% kolite, to surface.

7/09/79 Welded 5/8" steel plate on 20" casing covering 13-3/8" casing, 5' below ground level. Well number indicated on casing. Released rig at 0800 hours, 7/9/79.

Abandonment program witnessed and approved by the U.S.G.S.

CFSU #14-29 R.K.B. to G.L. = 22'

CASING DETAIL

NO. JTS.	DESCRIPTION	LENGTH FEET	BOTTOM FEET	TOP FEET
	30" CASING			
1	30" 3/8" Wall H40 Casing	16	38	G.L.
1	Total:	16		
	20" CASING			
	20" HOWCO Guide Shoe	2.12	224.	221.88
7	20" 94#/ft K55 Buttress Casing	224.61	221.88	0
7	Total:	226.73		
	Landed Above K.B.	- 2.73		
		224.00		
	13-3/8" CASING			
	13-3/8" HOWCO Guide Shoe	2.09	1240	1237.91
11	13-3/8" 54.5#/ft K55 Buttress Casing	471.73	1237.91	766.18
	13-3/8" HOWCO D.V. Tool	3.29	766.18	762.89
18	13-3/8" 54.5#/ft K55 Buttress Casing	766.47	762.89	0
29	Total:	1243.58		
	Landed Above K.B.	- 3.58		
		1240.00		
	9-5/8" LINER			
	9-5/8" HOWCO Guide Shoe	1.78	2078	2076.22
26	9-5/8" 36#/ft K55 Buttress Casing	1071.66	2076.22	1004.56
	13-3/8" x 9-5/8" Midway Liner Hanger	7.10	1004.56	997.46
26	Total:	1080.54		
	Landed Below K.B.	997.46		
		2078.00		

Casing run in hole to	2078.00
K.B. to ground level	22.00
20" & 13-3/8" Casing Cut off 5' below G.L.	5.00
Total Casing in Hole:	2051.00

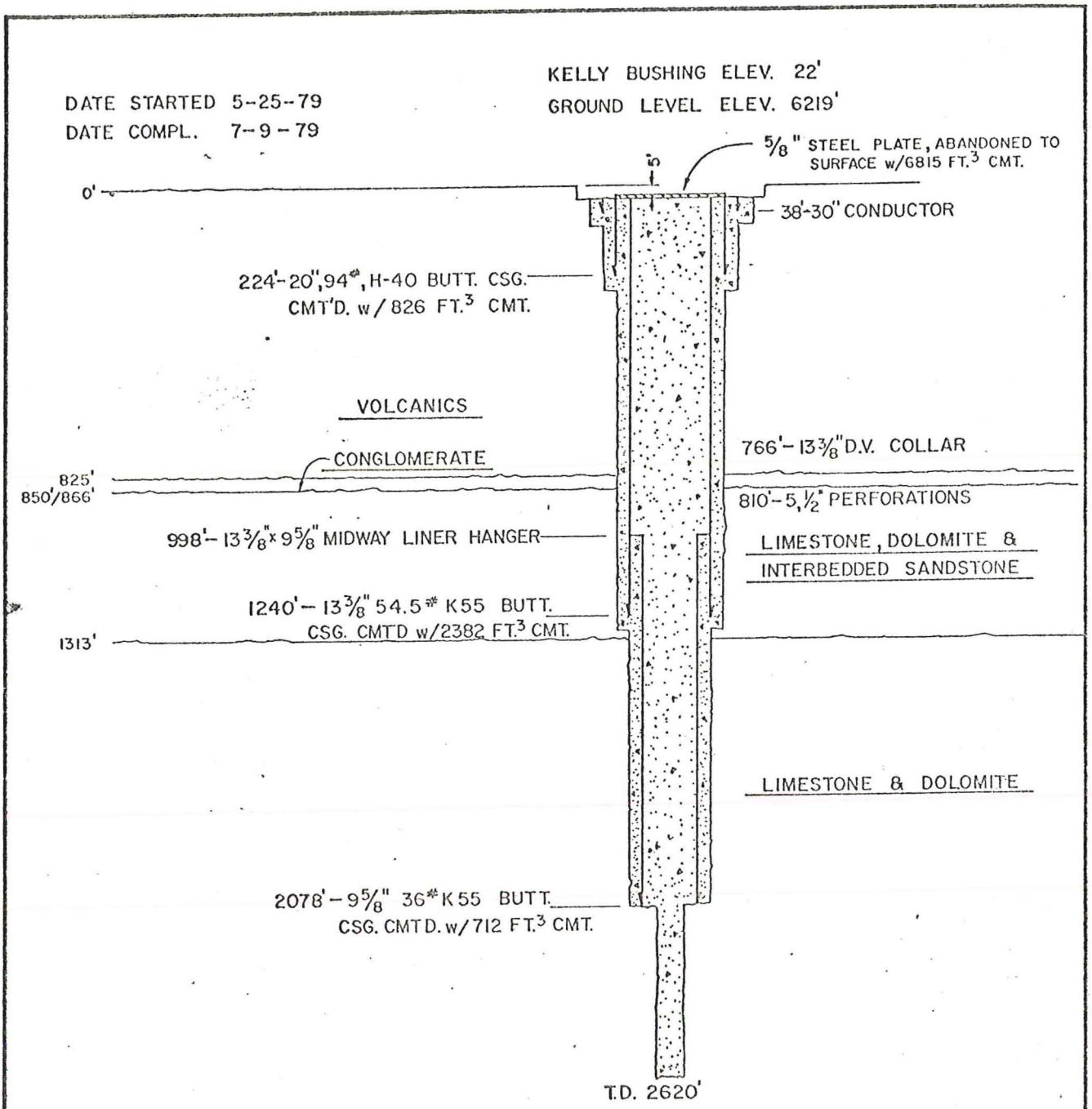
COVE FORT SULPHURDALE UNIT #14-29

DEVIATION SURVEYS

MEASURED DEPTH	DRIFT ANGLE	TRUE VERTICAL DEPTH	MAXIMUM POSSIBLE COURSE DEVIATION	TEMPERATURE MAXIMUM-READING THERMOMETER
60'	0°45'	59.99	.79	--
130'	0°45'	129.98	1.71	--
190'	1°	189.95	2.75	--
246'	0°45'	245.97	3.49	--
303'	0°15'	302.97	3.74	--
375'	0°45'	374.96	4.68	--
543'	1°15'	542.92	8.34	108°F
637'	0°45'	636.92	9.57	108°F
804'	1°45'	803.84	14.67	126°F
1153'	1°45'	1152.67	25.33	100°F*
1480'	3°45'	1478.97	46.71	--
1641'	3°45'	1639.63	57.24	<100°F*
1850'	4°15'	1848.06	70.91	100°F
2360'	5°15'	2355.92	117.58	--
2620'	5°15'**	2614.82	141.37	--

*Little or no circulation

**No survey taken at total depth of 2620' so the previous drift angle of 5°15' was used to extrapolate to total depth.



REVISED	DATE

UNION OIL COMPANY OF CALIFORNIA - GEOTHERMAL DIVISION

DIAGRAMMATIC SKETCH
COVE FORT SULPHURDALE UNIT 14-29
COVE FORT MILLARD CO., UTAH

DRAWN	
FOR:	G.G.
BY:	L.D.C
DATE:	7-30-79
SCALE:	1" = 400'
DRAWING NUMBER	1416

COVE FORT SULPHURDALE UNIT #14-29

FISHING OPERATIONS

Overview

It was necessary to perform fishing operations twice during the drilling of CFSU #14-29. The first incident was caused by torquing and backing off or unscrewing a tool joint.

In the second instance the pipe was stuck in a tight spot caused by formation on top of a stabilizer. The first fish was recovered with only minor difficulty and the second fish was recovered quickly.

Fishing Job #1

Well Depth: 1429'

Date: 6/19/79

Cause: Twisted-off Drill Pipe (Unscrewed)

Results: Fish Recovered with an Overshot and Grapple

While drilling out cement plug #12 at 1330' the drill pipe twisted off two stands into the hole at 216'. The fish consisted of the entire 12¼" drilling assembly (12¼" bit, 12¼" 3-point reamer, 8" drill collar, 12¼" stabilizer, shock sub, ten 8" drill collars, cross-over sub = 556.24') and 558' of 4½" drill pipe. An 11-3/4" overshot with a 6¼" grapple was run into the hole and worked over the top of the fish at 320'. The drill string had apparently

dropped through the cement plug into the hole. Efforts to engage the fish were unsuccessful. The 11-3/4" overshot was pulled out of the hole and a 7-3/4" overshot with 5-3/4" grapple was run in the hole. The fish was engaged at 320' and pulled out of the hole.

Fishing Job #2

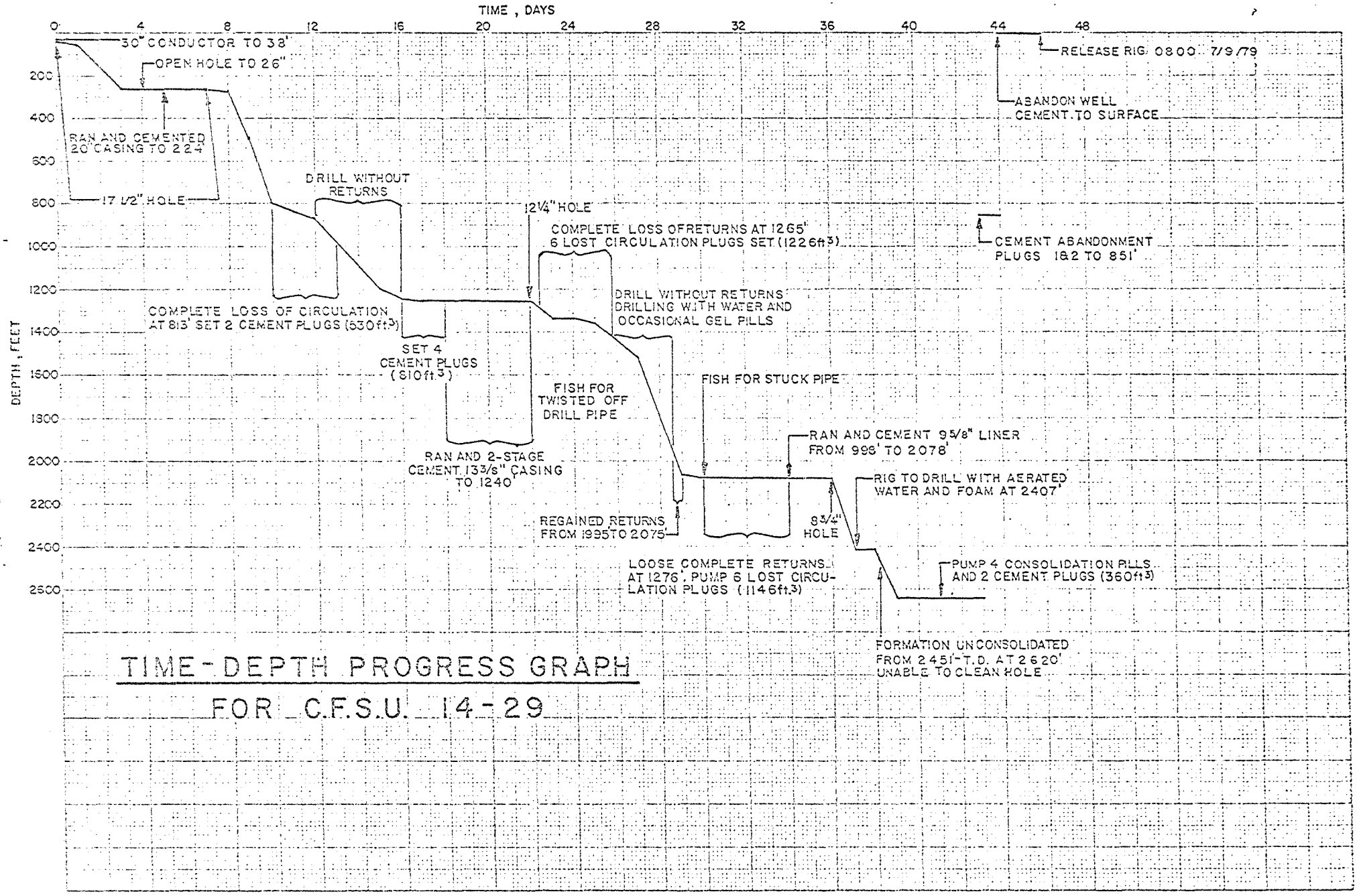
Well Depth: 2076'

Date: 6/22/79

Cause: Stuck Drill String

Results: Backed Off and Jarred Free with Overshot and Jars

While pulling out of the hole to change the 12¼" bit the drill string was first worked through a tight spot at 1675' and then stuck at 1460'. While waiting for fishing tools the hole was swept, with no circulation to surface, with gel pills. 30% returns were regained before Go-International ran a free point and determined the tools were free down to 1377' and stuck at 1416', the top of the 12¼" three blade stabilizer. The drill pipe was backed off at 1224' between two 8" drill collars leaving the fish in the hole. The 236' fish consisted of a bit, bit sub, 8" drill collar, three blade stabilizer, and six 8" drill collars. A screw-in sub, bumper sub, hydraulic jars and accelerator were run in the hole. The fish was engaged, jarred, and worked free in three hours with complete recovery of the fish.



TIME-DEPTH PROGRESS GRAPH

FOR C.F.S.U. 14-29

COVE FORT SULPHURDALE UNIT #14-29

LOGGING DATA[1]

DATE	TYPE OF LOG RUN	TOTAL DEPTH	LOGGED INTERVAL	MAXIMUM READING[2] THERMOMETERS	HOURS SINCE FLUID INJECTION
	SCHLUMBERGER				
6/27/79	Dual Induction-Laterolog 8	2080'	2080'-1240'	121°F	2-1/2
	Formation Density-Compensated Neutron	2080'	2080'-1240'	127°F	3-1/2
	Dipmeter and Four Arm Caliper	2080'	2080'-1240'	134°F	5-1/2
7/07/79	Temperature Log	2620'[3]	2452'-220'	186°F	4-1/2
	Dual Induction-Laterolog 8	2620'[3]	2462'-2078'	185°F	6-1/2
	Formation Density-Compensated Neutron	2620'[3]	2468'-2078'	194°F	7-3/4
	Dipmeter and Four Arm Caliper	2620'[3]	2469'-2078'	198°F	9-1/4
	Temperature Log[4]	2620'[3]	2464'-220'	198°F	2

(1) Copies of all these logs are supplied with the Technical Report.

(2) Three maximum reading thermometers were run simultaneously with each logging tool.

(3) Actual depth was 2540' because of fill on bottom.

(4) Well was flowed for approximately 2 hours before log was run.

FILE NO.

BIT RECORD

FORM NO. PM-683B

Security DRESSER

SECURITY DIVISION
Dresser Industries, Inc.
OILFIELD PRODUCTS GROUP
P. O. BOX 6504 HOUSTON, TEXAS 77005 (713) 784-6011

1259

CONTRACTOR: Brinkerhoff-Signal	RIG NO.: 3	RIG MAKE: National	DC. OD X ID X LENGTH (HOLE SIZE): 8" x 30' x ____ (____); 7" x 30' x ____ (____); ____ x ____ x ____ (____)
COMPANY: Union Oil Co. of Ca.	FIELD: Cove Fort	RIG SIZE: 55	
LEASE: Cove Fort	WELL NO.: CFSU 14-29	PUMP NO. 1: GD-PZ HE (7x8)	
STATE: Utah	COUNTY: Millard	PUMP NO. 2: Emsco D-500	D.P. SIZE/T.J.: 4 1/2" (X HOLE)
SEC./T'SHIP/RANGE		MUD COMPANY: Magcobar	

	MO./	DAY/	YEAR
SPUD:	5	25	79
U.S.:			
INTER:			

TD: 46
TOTAL DAYS: TOTAL ROT. HRS:

PAGE 1 OF 1
SALESMAN
BUYER
RIG PERSONNEL
FUEL SOURCE WATER SOURCE

RUN NO.	SIZE	TYPE	SERIAL NO.	JETS - 32NDS REG. 1.	R OR RO 2.	3.	DEPTH OUT	FEET	HOURS	FEET PER HOUR	CUM. HRS.	WT. 1000 LBS.	R.P.M.	PUMP PRESS.	PUMP NO. 1 LINER	SPM	PUMP NO. 2 LINER	SPM	MUD PROPERTIES WT.	W.L.	F.V.	PV/YP	% SOL	VER. DEV.	DULL COND 1/4-1/8 T	B	G	RG*	GRADED BY**	REMARKS	DATE	DEPTH
1	17½	JJS STC	AE-5048	18	18	18	260	222	30½	7.3	30½	25	70	325	6	120			64	20	34	5/15	2	0°45	2	2	I					
H.O #1	26	STC PILOT	103771	16	16	16	230	192	49	3.9	79.5	5/30	50	300	6	126	5	60	64	16	45	7/35	2		5	7				CONE LOCKED		
RR 1	17½	STC RTS	AE-5048	18	18	18	1249	1217	145¼	8.4	224¾	40	45	900	6	120	5	70	63	12	34	9/26	2	1°45	4	5	1/8					
2	12¼	STC OGH5	020TE	16	16	16	1330	81'	5½	14.7	230¼	30	65	500	6	120			H_2O						7	5	½			DRILL OUT CMT.		
3	12¼	SEC M845	785505	14	14	14	1429	99	7¼	13.7	237½	30	50	200	6	100			H_2O						2	2				BIT PINCHED		
4	12¼	STC F2	AB1953	14	14	14	2076	647	36	18.0	273½	30	50	1000	6	120	5	62	H_2O						4	4	3/8					
5	12¼	HTC X44	MJ051	14	14	14	2080	4	3/4	5.3	274¼	30	50	1000	6	120	5	62	H_2O						GOOD							
RR 5	12¼	HTC X44	MJ051	14	14	14	——	——			——	——	——		——	——	——	——	——	——	——	——	——		——	——	——			CLEAN OUT CEMENT		
6	8¾	REED Y13JT	601855	16	16	16	——	——			——	——	——		——	——	——	——	——	——	——	——	——		——	——	——			CLEAN OUT CEMENT		
7	8¾	REED Y62JA	539750	0	0	0	2407	327	11¼	29.1	285½	30	50	375	6	140			H_2O						2	4	I					
8	8¾	SEC S84F	820296	0	0	0	2620	213	8½	25.1	294	20	50	550	6	90			H_2O						2	4	1/8			AIR/WATER		
9	8¾	HTC J33	PS-895	0	0	0	——	——			——	——	——		——	——	——	——	——	——	——	——	——		——	——	——			CLEAN OUT FILL		

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

** 1. SALESMAN 2. ENGINEER 3. RIG PERSONNEL

SUBJECT TO PROVISIONS ON REVERSE SIDE

040

COVE FORT SULPHURDALE UNIT #14-29

CEMENTING

Introduction

Two major forms of cementing operations were performed during the drilling of CFSU #14-29. The first type of operation involved attempts to seal off lost circulation zones to enable casing to be competently cemented, and the abandonment of the well. The second type of operation was the cementing of the 20" and 13-3/8" casings and the 9-5/8" liner.

A total of 4072ft^3 of cement was mixed, pumped and set in 20 separate plugs while attempting to plug lost circulation zones. These efforts occupied approximately 13 days of rig time and accounted for a total of approximately $270,000.00.

The cementing of the 20", 13-3/8" casing strings and 9-5/8" liner required an additional 3920ft^3 of cement.

Abandonment of the well called for cementing the hole to the surface. This operation required an additional 904ft^3 of cement.

Lost Circulation

A significant amount of effort was required in attempting to plug lost circulation zones prior to cementing the 13-3/8" casing and 9-5/8" liner. These efforts were necessary to insure that the annulus between the hole and casing would contain a column

of cement without loss to the formation. Voids in the cement, where water might accumulate, can cause casing collapse when the wellbore is heated to high temperatures.

Table 1 presents a description of all cement operations carried out while attempting to control lost circulation in CFSU #14-29. A summary of the logic used in determining cement compositions for the lost circulation plugs is given below. Table 2 presents a summary and description of cement additives used on CFSU #14-29.

Halliburton Services was used for the first two lost circulation plugs and Dowell was employed for all others. Halliburton used API classification "Class B" cement while Dowell employed "Class G" cement in all of their cement plugs. Class "B" is a Portland cement intended for use to a depth of 6000', where moderate sulfate resistance is required. Class "G" cement, similar in composition to Class "B" is intended for use to 8000' and is compatible with accelerators or retarders for use over the complete range of API Classes "A" through "E". A major consideration in choosing a cement class is compatability with the additives.

Lost circulation cement plugs #1 and #2 are standard cement plugs modified with additives condusive to curing lost circulation. Plug #1 was successful, however, plug #2 was not. No further attempts were made to cure lost circulation until the total depth of the 17½" hole was reached.

Dowell employed Regulated Fill-up Cement (RFC) for their lost

circulation plugs. RFC, used by Dowell at CFSU #14-29, is blend of Portland cement containing 5% tricalcium aluminate and a controlled amount of gypsum plaster (D53) to give a slurry with thixotropic properties. The slurry is thin when mixed and pumped, but gels quickly into a rigid state when pumping stops. This property theoretically prevents the cement from migrating into fractures making this system a good lost circulation cement.

The system recommended on CFSU #14-29 consisting of 8% RFC, 25#/sack Kolite has been effective in combating lost circulation problems at E.G.&G. geothermal project at Idaho Falls, Idaho. The 20% silica was added at the request of Union Oil Company to provide a geothermal cement system. Kolite, ground-up coal, is a lost circulation additive. Only certain additives can be used in Regulated Fill-up Cement.

Cementing lost circulation before running the 13-3/8" casing (6/10 and 6/11/79) was the first attempt at using the 8% RFC-25#/sack Kolite system. The system did not get the desired fill up probably due to the system being designed for 175°F when a much lower temperature was actually logged.

Dowell recommended to increase the RFC to 10% and leave out the 20% silica and use the standard amount of Kolite (12½#/sack) for cement plugs #7-#10 set in the 12¼" hole on 6/17 and 6/18/79. The resulting fill up was again disappointing, and cement supplies were diminishing. It was decided to use the 8% RFC, 25#/sack Kolite, and 20% silica cement left on location from previous jobs.

The 8% RFC, 25#/sack Kolite, and 20% silica cement plug #11 on 6/18/79 was successful. However, when circulation was lost again on 6/19/79, plug #12, same as plug #11, did not regain circulation. All efforts to correct lost circulation in the 12¼" hole were put off until immediately prior to running the 9-5/8" liner.

The same 8% RFC cement was used with limited success for the remaining lost circulation plugs #13 to #18. Cement plugs #19 and #20 which were preceeded by sodium silicate/calcium chloride consolidation pills also used 8% RFC cement and failed to consolidate the formation.

Cementing Casing

Table 3 summarizes cementing operations associated with running casing. The 30" casing was cemented in place using ready mix cement poured between the 30" casing and the hole wall prior to the start of drilling operations, furnished locally.

The 20" casing was successfully cemented, by Halliburton, through the shoe with good returns throughout the job. The 13-3/8" casing required perforating and cementing in addition to the two stage cement job. A two stage cement job was performed to reduce the hydrostatic head, or pressure, on the formation allowing the first stage to partially set and support the weight of the second stage thereby reducing the change of fluid loss to the formation.

Because of a failure in setting lost circulation plugs #3 to #6, the Dowell representative recommended adding $CaCl_2$ to the

mix water to lower the setting time of the 8% RFC, 0.5% TIC, 25#/sack Kolite, and silica sand cement for the first and second stage cement jobs. Upon opening the D.V. collar, after pumping the first stage, the 13-3/8" casing was on vacuum caused by fluid falling. The second stage was pumped after a four hour intentional delay without returns to the surface. A cement bond log was run by Schlumberger and revealed the top of the cement in the 20" x 13-3/8" annulus at 820'.

The disappointing results of the two stage cement job resulted in the suggestion to increase the RFC to 10%, leave out the 20% silica, and use the standard amount of Kolite (12½#/sack) for cementing through the perforations. This job was successful in gaining returns to surface until pumping stopped when plugging of the mixing hopper on the Dowell cement truck occurred.

The 9-5/8" liner was successfully cemented with 1:1 perlite, 40% silica, 3% gel and 0.5% TIC.

Abandonment Plugs

The hole was cemented to surface with the 8% RFC, 12½#/sack Kolite, 20% silica cement and the 40% silica, 0.5% TIC cements left on the location from previous jobs.

TABLE 1

LOST CIRCULATION CONTROL EFFORTS AT CFSU #14-29

TABLE 1

LOST CIRCULATION CONTROL EFFORTS AT CFSU #14-29

DATE	SITUATION	PLUG #	DEPTH OF OPEN HOLE FT.	OPEN END DRILL PIPE HUNG AT (FT.)	PLUG VOLUME FT^3	MATERIAL	PERLITE (WT. RATIO)	SILICA %	$CaCl_2$ %	RFC %	KOLITE #/SK. CMT.	T.I.C. %	OTHER	DISPLACEMENT	TIME BEFORE NEXT OPERATION (HRS.)	LOCATION OF TOP OF CMT. (FT.)	THEORETICAL % PLUG LOST	REMARKS
17½" HOLE																		
6/5/79	Lost circulation drilling 17½" hole at 833'	1	833	833	56 265	Water Class B cmt.	1:1	40	2				·3% Gel 0.5% CFR-2; 5% Flo-Cel	·18ft^3 water ·31ft^3 mud		777'	65%	Plug successful.
6/6/79	Lost circulation drilling 17½" hole at 852'	2	866	866	56 265	Water Class B cmt.	1:1	40	2				·3% Gel 0.5% CFR-2; 5% Flo-Cel, 1% Nut-Plug	·45ft^3 water		No cement	100%	Plug not successful. Drilled ahead without returns.
6/10/79	Drilled 17½" hole from 866'-1249' without returns	3	1249	935	203	Class G cmt.		20	3	8%	25			·47ft^3 mud	4	893	10%	Bridge and fill from 1006' to 1243' indicates no fluid loss below 1006'.
		4	1249	893	203	Class G cmt.		20	3	8%	25			·47ft^3 mud	4	872	85%	
		5	1249	872	203	Class G cmt.		20	3	8%	25			·47ft^3 mud	4	787	30%	Regained circulation after setting plug.
6/11/79	Lost circulation drilling out cement at 854'	6	1249	861	201	Class G cmt.		20	3	8%	25			·45ft^3 water	4	780	33%	Regained circulation to 890'.
12¼" HOLE																		
6/17/79	Lost circulation drilling 12¼" hole at 1265'	7	1330	1330	187	Class G cmt.			2	10%	12½			·67ft^3 water	4	1295	85%	Change cement formula fluid level at 450'± follow plug.
		8	1330	1294	181	Class G cmt.			2	10%	12½			·67ft^3 water	4	1226	75%	Unable to fill hole after plug set.
		9	1330	1245	181	Class G cmt.			2	10%	12½			·68ft^3 water	4	1295	90%	Regained circulation.
6/18/79	Lost circulation at 1310' drilling out cement	10	1345	1344	181	Class G cmt.		20	2	8%	12½				4	1343	99%	Formation accepted essentially all of plug #10. Revert to 8% RFC formula.
		11	1345	1343	248	Class G cmt.		20	2	8%	25			·78ft^3 water	4	1090	15%	Plug #11 regained circulation.

Table 1/Lost Circulation Control Efforts at CFSU #14-29/Page 2

DATE	SITUATION	PLUG #	DEPTH OF OPEN HOLE FT.	OPEN END DRILL PIPE HUNG AT (FT.)	PLUG VOLUME FT^3	MATERIAL	PERLITE (WT. RATIO)	SILICA %	$CaCl_2$ %	RFC %	KOLITE #/SK. CMT.	T.I.C. %	OTHER	DISPLACEMENT	TIME BEFORE NEXT OPERATION (HRS.)	LOCATION OF TOP OF CMT. (FT.)	THEORETICAL % PLUG LOST	REMARKS
12¼" HOLE (Cont'd)																		
6/19/79	Lost Circulation at 1381'	12	1429	1429	248	Class G cmt.		20	2	8	25			$.92ft^3$ water	4	1265	50%	Did not regain circulation.
6/24/79	Drilled from 1429' to 2080' with no returns	13	2080	2070	191	Class G cmt.		20	2	8	25			$.95ft^3$ water	4	1885	16%	Immediately pump plug #14 after waiting 4 hours on cement.
		14	2080	1885	191	Class G cmt.		20	2	8	25			$.95ft^3$ water	4	1698	20%	Immediately pump plug #15 after waiting on cement.
		15	2080	1698	191	Class G cmt.		20	2	8	25			$.95ft^3$ water	4	1490	10%	Pump plug #16 after waiting on cement.
		16	2080	1490	191	Class G cmt.		20	2	8	25			$.95ft^3$ water	4	1155	0	Regain circulation.
6/25/79	Lost circulation drilling out cement at 1495'	17	2080	1543	191	Class G cmt.		20	2	8	25				4	1466	70%	Pumped 35 bbls water but could not fill hole after setting plug.
6/26/79	Still have lost circulation after plug #17	18	2080	1466	191	Class G cmt.		20	2	8	25					1226	0	Plug successful. Clean out cement to run casing.
8-3/4" HOLE																		
7/4/79	Drilled through unconsolidated formation from 2451'-2620'	Consolidation Pill #1	2620	2465	290	Sodium Silicate/ Calcium Chloride												Pump Sodium Silicate/Calcium Chloride pills to try and consolidate formation. Unable to make connection after pill pumped because of fill.
		Pill #2	2620	2465	290	Sodium Silicate/ Calcium Chloride												Formation still not consolidated and making fill on connections.
7/5/79	Hole continuing to make fill to 2500'	Pill #3	2620	2465	290	Sodium Silicate/ Calcium Chloride												
		19	2620	2470	180	Class G cmt.		20	2	8	12½			$.224ft^3$ water	6	2466	795%	Formation took most of plug.
7/6/79	Still getting fill after Plug #19	Pill #4	2620	2550	207	Sodium Silicate/ Calcium Chloride												
		20	2620	2470	180	Class G cmt.		20		8	12½			$.224ft^3$ water	6	2466	90%	Unable to succeed at consolidating formation using cement and consolidation pills. Decide to abandon well.

Table 1/Lost Circulation Control Efforts at CFSU #14-29/Page 3

DATE SITUATION	PLUG #	DEPTH OF OPEN HOLE FT.	OPEN END DRILL PIPE HUNG AT (FT.)	PLUG VOLUME FT^3	MATERIAL	PERLITE (WT. RATIO)	SILICA %	$CaCl_2$ %	RFC %	KOLITE #/SK. CMT.	T.I.C. %	OTHER	DISPLACEMENT	TIME BEFORE NEXT OPERATION (HRS.)	LOCATION OF TOP OF CMT. (FT.)	THEORETICAL % PLUG LOST	REMARKS
ABANDONMENT PLUGS																	
7/7/79 Abandon well	1	2620	2000	250	Class G cmt.		20		8	12½							250ft^3 cement pumped through Halliburton EZSV cement retainer at 2000'. 50ft^3 cement on top of retainer. Pulled out of hole to 1700' and displaced 280ft^3 mud.
				50	Class G cmt.		40				0.5		280	0			
	2	2620	1100	180	Class G cmt.		40				0.5			4			Abandonment plug #2 pumped and displaced at 1100'.
7/8/79 Fill 20" x 13-3/8" annulus to surface		851	143	223	Class G cmt.		20		8	12½							1" pipe run in the 20" x 13-3/8" annulus. Annulus cemented to surface.
Surface plug	3	851	152	201	Class G cmt.		20		8	12½							13-3/8" casing cemented to surface.

TABLE 2

SUMMARY AND DESCRIPTION OF CEMENT ADDITIVES USED BY HALLIBURTON ON CFSU #14-29

ADDITIVE	DESCRIPTION	FUNCTION OF ADDITIVE			REMARKS
		LIGHTEN SLURRY WEIGHT	ACCELERATE SETTING TIME	CONTROL LOST CIRCULATION	
Perlite (expanded)	treated volcanic material	X			absorbs water under high pressure
Silica Flour	finely powdered silicon dioxide				prevents loss of strength at high temperatures
Gel	Wyoming-type bentonite	X		X	increases suspension of particulate additives; maintains even distribution of other additives reduces slurry weight
$CaCl_2$	in powder or flake form		X		accelerates early strength
CFR-2 (*)	a napthalene polymer		X		a cement dispersant to reduce viscosity and a friction loss reducer
Gilsonite	particulated naturally occurring asphaltite	X		X	inert - does not absorb water; high cement strength; resists corrosion; granular lost circulation additive
Flo-Cele (*)	cellulose flakes			X	lost circulation additive
Nut-Plug (**)	walnut shells			X	granular lost circulation additive
LCM	any mixture of lost circulation material			X	mixture of gilsonite, cellulose flakes, and walnut shells

(*) Halliburton trademark

(**) Magcobar trademark

TABLE 2 (Cont'd)

SUMMARY AND DESCRIPTION OF CEMENT ADDITIVES USED BY DOWELL ON CFSU #14-29

ADDITIVE	DESCRIPTION	FUNCTION OF ADDITIVE			REMARKS
		LIGHTEN SLURRY WEIGHT	ACCELERATE SETTING TIME	CONTROL LOST CIRCULATION	
Perlite (expanded)	treated volcanic material	X			absorbs water under high pressure
Silica Flour	finely powdered silicon dioxide				prevents loss of strength at high temperatures
Gel	Wyoming-type bentonite	X		X	increases suspension of particulate additives; maintains even distribution of other additives
$CaCl_2$	in powder or flake form		X		accelerates early strength
RFC	regulated fill-up cement			X	thixotropic cement
Kolite (*)	ground up coal			X	lost circulation additive
TIC (***)	dispersant			X	dispersant - allows lower pumping pressures

(*) Halliburton trademark

(***) Dowell trademark

TABLE 3

SUMMARY OF CASING CEMENTING OPERATIONS

CFSU #14-29

DATE	CASING SIZE	HOLE SIZE	DEPTH OF OPEN HOLE	CASING FLOAT SHOE AT	OTHER CASING ACCESSORIES	MATERIAL INJECTED	COMPOSITION	VOLUME	REMARKS
	30"	36"	16' G.L.			cement slurry	·ready mix cement	total fill in annulus	
5/30/79	20"	26"	230' K.B.	224'	None	cement slurry	·Class "G" cement 2% $CaCl_2$	$826ft^3$	100% excess volume
						displacement fluid	·drilling mud	$403ft^3$	had good returns throughout job
6/12/79	13-3/8"	17½"	1249'	1240'	·insert float at 1199' ·D.V. collar at 766'	cement slurry	·Class "G" cement, 20% silica flour, 25#/sack Kolite 8% RFC	$203ft^3$	begin 1st stage cement job
					·4 cement baskets below D.V.	cement slurry	·Class "G" cement, 1:1 perlite, 40% silica flour, 3% gel, 0.5% TIC	$546ft^3$	
						cement slurry	·Class "G" cement, 40% silica, 0.75% TIC	$120ft^3$	
						displacement fluid	·water	$1041ft^3$	displaced first stage

DATE	CASING SIZE	HOLE SIZE	DEPTH OF OPEN HOLE	CASING FLOAT SHOE AT	OTHER CASING ACCESSORIES	MATERIAL INJECTED	COMPOSITION	VOLUME	REMARKS
6/12/79	Cont'd -					Preflush	·Spacer 1000	112ft^3	begin 2nd stage cement job
						cement slurry	·Class "G" 1:1 perlite, 40% silica, 3% gel, 0.5% TIC	1142ft^3	100% excess volume for combination of stages 1 & 2
						displacement fluid	·water	666ft^3	displaced second stage and bumped closing plug with 1000 psi; no cement returns to surface; top of cement at 820'
6/15/79					HOWCO RTTS at 736'	cement slurry	·Class "G" 10% RFC 12½#/sack Kolite	371ft^3	pumped 371ft^3 cement through 5½" perforation in 13-3/8" casing at 810', before cement truck malfunctioned; water returns after first 84ft^3 cement pumped
						displacement fluid	·water	95ft^3	displaced cement from tools with water; theoretical top of cement in 17½" hole x 13-3/8" annulus was 315'; actual top of cement 350'
6/28/79	9-5/8"	12¼"	2080'	2078'	float collar at 1994', Midway 13-3/8" x 9-5/8" liner hanger at 998'	cement slurry	·Class "G" 10% RFC 25#/sack Kolite	338ft^3	no returns during cement job but fluid level remained at 20' throughout

DATE	CASING SIZE	HOLE SIZE	DEPTH OF OPEN HOLE	CASING FLOAT SHOE AT	OTHER CASING ACCESSORIES	MATERIAL INJECTED	COMPOSITION	VOLUME	REMARKS
6/28/79 Cont'd-						cement slurry	·Class "G" 1:1 perlite 40% silica 3% gel, 0.5% TIC	275ft^3	80% excess cement volume; good cement job
						cement slurry	·Class "G" 40% silica	99ft^3	
						displacement fluid	·water		displaced fluid until bumped plug; bumped plug to 500 psi; theoretical displacement 500ft^3

DRESSER INDUSTRIES

OILFIELD PRODUCTS GROUP, DRESSER INDUSTRIES, INC. 475 17TH STREET, SUITE 1600 DENVER, COLORADO 80202

MAGCOBAR MUD COST SUMMARY

for
UNION GEOTHERMAL PROSPECT
CFSU 14-29
Section 29, 25 South - 6 West
Millard County, Utah

NUMBER OF UNITS	PRODUCTION DESCRIPTION	AMOUNT
2,031.00	Magcogel	$ 10,926.78
42.00	Kwik Thik	258.72
12.00	Tannathin	138.12
33.00	Cottonseed Hull	627.35
97.00	Mud Fiber	1,249.36
5.00	Aluminum Stearate	346.80
10.00	Ben-Ex	238.10
11.00	Magconol	748.88
215.00	Caustic Soda	6,528.10
370.00	Lime	2,443.80
41.00	Zinc Carbonate	3,911.40
4.00	Soda Ash	113.24
1.00	Sodium Bicarbonate	24.94
	Mag Parts Supplement	26.14
	Trucking Service	478.88
	State Sales Tax	1,122.42
	Sundry Rebill	6,223.54
	Utah County Tax	209.92
	TOTAL MUD COST:	$35,616.49

(Above retyped from Magcobar Mud Cost Summary issued 08/01/79)

MAGCOBAR WELL SUMMARY

DATE: July 30, 1979

COMPANY: Union Oil Geothermal Division
CONTRACTOR/RIG #: Brinkerhoff/Signal 3
WELL NAME: CFSU 14-29
SPUD DATE: May 25, 1979
LEGAL DSCRP: Sec. 29, 25S-6W
COMPLETION DATE: July 6, 1979
COUNTY/STATE: Millard, Utah
MUD ENGINEER(S): Ralph Bowie Jr.
TOTAL DEPTH: 2470'
MAG STOCK POINT(S): Milford, Utah
TOTAL DAYS: 42
TOTAL COST: $35616.49

CASING/BIT INFORMATION

INTERVAL...			HOLE SIZE	BIT SIZE (Ream to 26)	CASING SIZE	# BITS USED
0 '	to	230 '	26	17½	20	2
230 '	to	1235 '	17½	17½	13 3/8	2
1235 '	to	2078 '	12¼	12¼	9 5/8	3
2078 '	to	2470 '	8 3/4	8 3/4		1

DRILLING FLUID INFORMATION

MUD UP AT: _____ '

INTERVAL...			MUD TYPE	MUD WEIGHT (low-high)	DAYS	COST	COST/FT
0 '	to	230 '	Lime	8.3 - 8.6	5	4351	18.92
230 '	to	1235 '	Lime	8.3 - 8.6	10	10513	10.45
1235 '	to	2078 '	Lime	8.3 - 8.6	14	9684	11.49
2078 '	to	2470 '	~~Lime~~ Air ~~Air-mist~~	Air - 8.6	13	11068	28.23

SUMMARY OF COMMENTS/PROBLEMS

(indicate depth interval on left)

For more information see final well report

GEOLOGIC INFORMATION

FORMATION	DEPTH
Volcanic rocks with	'
lime stringers	265 '
Latite	500 '
Andesite	835 '
Altered volcanics	'
with lime stringers	1040 '
No returns	2400 '
Dolomite	2525 '
	'
	'
	'

MAGCOBAR DIVISION, DRESSER INDUSTRIES, INC. 475 17TH STREET SUITE 1600 DENVER, COLORADO 80202

UNION OIL OF CALIFORNIA
GEOTHERMAL DIVISION
for
CFSU 14-29
Section 29, 25 South-6 West
Millard County, Utah

CONTRACTOR: Brinkerhoff/Signal 3

TOOLPUSHER: Mr. Leonard Eshom

CONSULTANT: Union Drilling Foreman Mr. Harold Moss

MUD EQUIPMENT:

PUMPS: #1 Gardner Denver PF8AH
#2 Emsco D-500

SURFACE VOLUME: 900 bbls

SHALE SHAKER: Double screen 60 mesh - Swaco

DESANDER & DESILTER: DeSander - Single cyclone Swaco
Desilter - 4 cone Swaco

OTHER EQUIPMENT: Two, 22-bbl Caustic mixing tanks and accompanying injection system

DRESSER INDUSTRIES

OILFIELD PRODUCTS GROUP, DRESSER INDUSTRIES, INC. 475 17TH STREET, SUITE 1600 DENVER, COLORADO 80202

FINAL WELL REPORT

for
UNION GEOTHERMAL PROSPECT
CFSU 14-29
Section 29, 25 South-6West
Millard County, Utah

CFSU 14-29, located at Cove Fort, Utah (Section 29, 25S-6WO, was spudded on May 25, 1979. A 17½" hole was drilled to 262', then opened to 26" to a depth of 231". A Magcogel-Lime spud mud was used to drill the 17½" pilot hole and had the following characteristics; mud weight of 8.6 #/gal, funnel viscosity of 38-40 sec/qt, P.V. of 10, Y.P. of 8, gel strengths of 7/11, pH of 10.5, Pm/Pf/Mf of 2/.4/.6, Chlorides of 1600, Calcium of 280 mg/1, and total solids of 2½% or less. The average make up water, acquired at a local spring, displayed the following properties; Pf/Mf of 1.3/1.6, Chlorides of 2400 mg/1 and Calcium of 600 mg/1. It was found that a 38-40 sec/qt mud would clean the hole while enlarging it to 26". Therefore, no changes were made in the mud system until it was converted to a Lime base system at approximately 200'. This was accomplished on May 29, 1979 while reaming the 17½" hole to 26". The Lime base mud displayed the following characteristics; mud weight of 8.7 #/gal, funnel viscosity of 38 sec/qt, P.V. of 10, Y.P. of 11, gel strengths of 8/13, pH of 12.0, Pm/Pf/Mf of

9.0/3.0/14.0, Chlorides of 2500 mg/1, Calcium of 540 mg/1, and total solids of 2.5%. A Lime base mud was employed because of its' inherently high pH and alkalinities which would be advantageous if hydrogen sulfide gas should be encountered. The hole was opened to 26" with no problems and 20" casing was set to 224' and cemented on May 30 and June 1. No hydrogen sulfide gas was detected in the mud by the Hach test procedures which was verified by the gas monitoring equipment of the mud logging unit. As a precautionary measure Zinc Carbonate was added to the system as a hydrogen sulfide scavanger. It was found the 5 sacks per tour would maintain 1.5 - 2 #/bbl excess Zinc Carbonate. During this period the shaker was run continuously, and the desander and desilter were operated at one half of the drilling time to limit the amount of Zinc Carbonate discarded.

Cement was drilled on June 1 and drilling ahead commenced using a 17½" bit. No treatment for cement was necessary due to the Lime base mud being utilized. The drilling fluid displayed the following characteristics; mud weight of 8.6 to 8.7 #/gal, funnel viscosity of 35-37 sec/qt, P.V. of 8, Y.P. of 18, pH of 12.0, Pm/Pf/Mf of 9.5/2/2.5, Chlorides of 3000 mg/1, Calcium of 800 mg/1 and total solids of 2.5 - 3%.

Drilling continued to 833' where total returns were lost on June 4, 1979.

Because of the nature of lost circulation problems in the Cove Fort area, cement squeezes were the common method of remedying the condition. Minimum amounts of Cotton Seed Hulls and Mud Fiber were used until abandonment, but basically cement plugs were used to try to remedy the lost returns.

The casing program called for a 13 3/8" casing to be set at approximately 2500'. However, lost circulation problems were so severe that it was elected to set this intermediate string at 1235'. Numerous cement plugs were set with little effect. Basically, the hole was drilled blind using water, alternately, with high viscosity 50 sec/qt, Magcogel-Lime-LCM sweeps each kelly down in an attempt to flush the drill cuttings laterally into the formation fractures and honey cone structures. Only minor torque was experienced even though as much as 60' of fill was reported on trips. It is believed that a water flow in the neighborhood of 825' was flushing the cuttings back into the hole. Numerous attempts were made to seal this zone with cement, unsuccessfully.

Intensive monitoring of any return fluid indicated no hydrogen sulfide was present, and the drill string tested negative to the gas.

Further, treatments of Caustic Soda and Zinc Carbonate were utilized when drilling ahead with returns to keep the hydrogen sulfide gas under control.

After the 13 3/8" casing was set at 1235', a cement bond log was run which indicated that the cementing was successful from 1235' to 825', but above 825' there was little cement. The casing was perforated at 800' and the cement was deverted into the annulus at this point. Bond logs indicated that the cementing operations were successful to approximately 500' below surface. It was elected not to perforate above 500' in consideration of possible weak points if the well were produced.

By June 15, the 13 3/8" BOP's were in place and tested. It was decided to drill ahead before building a mud system. This was economic in nature, as the Magcobar Engineer and Union Drilling Foreman did not want to build a system and lose it to the formation.

At 1265' all returns were lost. Drilling was continued blind with water to 1365' where the drill string was pulled up into the casing in preparation for a cement squeeze. At this time the hole produced 50 ppm hydrogen sulfide gas which was dissipated by a very strong wind. Cement was drilled out and returns lost at 1310'. While coming out of the

hole after setting cement plug #12, a small discharge of hydrogen sulfide gas and carbon dioxide gas was noted. The drill string reflected minor traces of hydrogen sulfide corrosion. Cement plug #12 was drilled out. Drilling continued to 1339' with water when the drill string separated due to failure of a pin and box. It was found that 1159' of fish was left in the hole. The fish was on surface by midnight June 19.

Drilling continued blind using water and high viscosity (50 sec/qt) sweeps to 2076', where the string became stuck. A free point was run, and a shock charge was set at 1224'. The fish (852') was latched onto and jarred free.

Numerous cement plugs were set in an attempt to seal the lost circulation zones between 1235' and total depth of 2085' with little success. The hole was cleaned out with water and Magcogel-Lime sweeps at 2085'. At this time, a 9 5/8" liner was set from 906' to 2078'. The liner was cemented, and then drilled out with an 8 3/4" bit. Preparations were made to begin air drilling. Drilling ahead blind continued with water and Magcogel sweeps each kelly down to 2419' where air-mist drilling operations began July 2.

While drilling with air-mist, a strong Caustic Soda solution

(50lb/bbl) was injected into the make up water to yield an 11 pH fluid. While drilling with air-mist, the hole produced water and the resulting pH of the return fluid varied from 8.5 to 10.0 with an approximate average of 9.0.

Drilling continued with air-mist to 2451' where incompetent dolomite was encountered. The drill string became stuck at 2557'; it was worked free and the decision was made to utilize a constant injection of Foam (Whitcolate & Sulfactex SAL) with a 50 sec/qt viscosity pill each kelly down. This did bring cuttings to the surface, however, the dolomite continued to run and no progress was made.

On July 4 and 5, an attempt was made to seal off the incompetent dolomite with Sodium Silicate. A total of 5 Sodium Silicate plugs were run with no success. Hole cleaning problems continued to be a major problem with the probability of stuck pipe increasing hourly. As a result of the above hole conditions a decision was made to abandon the hole at approximately 1700 hr, July 6 (2525'). Magcobar was released.

UNION GEOTHERMAL PROSPECT
CFSU 14-29
CORROSION REPORT

CORROSION

The Corrosion program was centered on running a Lime base drilling fluid and maintaining 2 #/bbl Zinc Carbonate in the mud for H_2S control

A spud mud was prepared using Magcogel and Lime. As soon as drilling commenced, the mud system was converted to a Lime base system, because of the high alkalinities inherent to this type system. High alkalinities keep the H_2S in solution. This system was chosen by Union personnel as a first line defense against corrosion. The alkalinities were as follows: pH - 12.0, Pm - 15, Pf - 4, and Mf - 9.

Furthermore, 2 to 3 #/bbl Zinc Carbonate was run as a H_2S Scavenger. A careful monitoring of pH and Zinc Carbonate levels coupled with Hach tests indicated no H_2S in the fluid that returned to the surface.

After returns were lost, all sweeps, run in an attempt to force the drill cuttings into the formations, were highly alkaline based on Lime and Caustic Soda content.

A large portion of the footage was made drilling blind with water as a drilling fluid. While drilling in this manner, a high pH Caustic

Soda solution was injected directly into the suction line to increase the pH of the water to 11.0.

Occasionally, minor amounts of fluid returned to the surface. The fluids had pH's in excess of 10. A Hach test was run on any return fluid and constantly displayed negative H_2S content.

After converting to an air-mist-foam drilling fluid, the water that was used was treated with Caustic Soda to yield a 10-11 pH solution. Unisteam was injected at the air compressor for further corrosion abatement. The returning fluid (foam) displayed a pH in the range of 9.5.

H_2S was encountered several times; however, it usually occured during cementing operations and while the drill string was out of the hole. In all cases it was short lived. Only small amounts of H_2S were noted on the drill string. It is believed that only minor amounts of H_2S were encountered.

Operator Union Oil of Calif.
Well CFSU 14-29
Contractor Brinkerhoff
Engineer Ralph Bowie Jr

Location Sec 29,25S - 6W
County Millard
State Utah
Elevation 6190'

MAGCOBAR DIVISION

DRILLING MUD LOG

Page 1 of 2

Hole Size	Casing Size	Interval Length
26 inch	20 inch	230 ft.
17½ inch	13 3/8 inch	1235 ft.
12¼ inch	9 5/8 inch	2078 ft.
____ inch	____ inch	____ ft.
____ inch	____ inch	____ ft.

Spud Date May 25, 1979
Under Surface Date June 1
Finish Date July 6
Total Depth 2525 ft.
Mud Cost $ 35,616.49

DATE	DEPTH	MUD PROPERTIES: WT. LBS./GAL.	SAMPLE TEMP.	VISC. SEC./QT.	PLASTIC VIS.	YIELD POINT	GELS INITIAL	GELS 10 MIN.	pH	FILTRATE API	HT/HP API	Alkalinity Pm	Alkalinity Pf	Alkalinity Mf	Chloride ppm	Calcium ppm	Sand % Vol.	Solids % Vol.	Oil % Vol.	#/bbl. Bentonite	#/bbl. Drill Solids	L.C.M. #/bbl.	"N" Value	"K" Value	MATERIALS: MAGCOBAR	MAGCOGEL	SPERSENE	CAUSTIC SODA	TANNATHIN	Lime	Zinc CO3	Mud Fiber			Drayage	Tax	COST: PER DAY	TO DATE	REMARKS
5/25	30	8.4	64	41							11	.4	.6	1600	280	¼	2	0							80		4		10							33	0	0	
5/26	73	8.6	70	70	10	8	7	11	10.5		16	.5	.7	1400	400	TR	2	0				.32	13	74	70		4		9							642	24	1155	1874	
5/27	260	8.6	73	38	6	30	11	15	11.5		38	1.3	1.6	2000	380	¼	2	0				.22	45	99	55		4		5								19	400	2274	
5/28	262	8.6	85	38	7	35	12	18	11.5		115	19	23	3000	600	TR	2	0				.22	46	00	30		10		10								18	377	2651	
5/29	185	8.6	75	38	8	19	6	14	12		8	28	35	300	600	TR	3	0				.37	13	38	60		5	10	23	10							81	1700	4351	
5/30	231	8.7	75	37	10	11	8	13	12		9	3	14	2500	540	TR	3	0																					
6/01	265	8.6	80	37	8	14	8	12	12		83	2	4	2200	480	0	2	0				.45	69	1	75		4		30								33	685	5036	
6/02	302	8.6	80	37	8	16	10	13	12		95	2	25	3000	800	0	3	0				.35	12	86	60			5	53	15							108	2265	7301	
6/03	602	8.7	95	35	6	16	10	13	12																															
6/04	833	Drilling blind with water																							62		6		25							29	881	8182	
6/05	833	8.5	90	36	12	9	13	18	12		65	3	45	2200	420	0	2	0				.65	18	6	30		3		5								12	245	8427	
6/06	866	8.5	81	34	13	8	9	11	12		15	26	30	2100	440	TR	1	0				.69	14	1	125		8		11		65					84	2155	10582	
6/07	1039	Drilling blind with water																							58		2		10		10					27	560	11142	
6/08	1164	Drilling blind with water																							60		3		4							19	644	11786	
6/09	1243	Drilling bling with water																							202		12		25							70	1693	13429	
6/10	1249	Drilling blind with water and 38-40 sec/qt pills																							150		6		12		10					55	1385	14864	
6/11	650	8.4	78	34	10	4	8	10	11	15.5	35	28	34	2100	280	0	1					.78	56		50		3		10								19	393	15257	
6/12	1250	8.7	75	35	5	24	11	15	12	16.6	12	23	28	1800	720	0			14			.23	35	46	130		6		11								42	893	16150	
6/13	1235	8.6	69	34	5	25	9	13	12	15.0	11	22	31	2100	500	0	2								25		1		5								9	189	16339	
/14		Nipple up 13 3/8" BOPs																																				0	16339	
6/15	1181	Run in hole to drill cement with water																																				0	16339	
6/16	1208	Wait on loggers to cement Bond log																																				0	16339	
6/17	1330	Drilled cement plug out with water																																				29	619	16958	
6/18	1345	Wait on cement to set																																				0	16958	

Operator Union Oil of Calif
Well CFSU 14-29
Contractor Brinkerhoff
Engineer Ralph Bowie Jr.

Location Sec. 29,25S - 6W
County Millard
State Utah
Elevation 6190'

MAGCOBAR DIVISION

DRILLING MUD LOG

Page 2 of 2

Hole Size	Casing Size	Interval Length
26 inch	20 inch	230 ft.
17½ inch	13 3/8 inch	1235 ft.
12¼ inch	9 5/8 inch	2078 ft.
____ inch	____ inch	____ ft.
____ inch	____ inch	____ ft.

Spud Date May 25, 1979
Under Surface Date June 1
Finish Date July 6
Total Depth 2525 ft.
Mud Cost $ 35,616.49

DATE	DEPTH	MUD PROPERTIES: WT. LBS./GAL.	SAMPLE TEMP.	VISC. SEC./QT.	PLASTIC VIS.	YIELD POINT	GELS INITIAL	GELS 10 MIN.	pH	FILTRATE API	HT-HP API	Alkalinity Pm	Alkalinity Pf	Alkalinity Mf	Chloride ppm	Calcium ppm	Sand % Vol.	Solids % Vol.	Oil % Vol.	#/bbl. Bentonite	#/bbl. Drill Solids	L.C.M. #/bbl.	MATERIALS: MAGCOBAR	MAGCOGEL	SPERSENE	CAUSTIC SODA	TANNATHIN	Lime	Soda Ash	Cotton Seed	Benex	Magconol	Drayage	Tax	COST: PER DAY	TO DATE	REMARKS
6/19	1381																						61		8		9							25	517	17475	Ran in hole for cement plug #12 - Drilled with water
6/20	1436																						60		4	1	6							21	448	17923	Twisted off at 1700', Fish on bank at 11:40 p.m.
6/21	1606																						50		4		6							18	379	18302	Drilled blind with water, Swept hole each kelly down with 50 bbl,
6/22	1950																						150		10		22							54	1137	19439	50 sec/qt viscosity pill
6/23	2076																						250		25		65						213	105	2418	21857	Stuck at 1470' while pulling out of hole, Fish on surface at 5:00 p.m.
6/24	2080																						55		4		6		10				221	26	771	22628	Set four cement plugs 2010'-1150'
6/25	1150																												10					7	142	22770	Waited on cement plugs #15 and #16 to set at 1155' - 1495'
6/26	1480																																	0	0	22770	Waited on cement plug #17 to set, ran in hole and drilled cement to 1480
6/27	1744																																		0	22770	Drilled blind to 2080 - prepared to run 9 5/8" casing - noted 50 ppm H_2S
6/28	2084																																			22770	Set 9 5/8" casing at 2084'
6/29	2084																																			22770	Checked cement and drilled out with water - waited on Bond log
6/30	2104																																			22770	Drilled blind 8 3/4" hole, went to air-mist drilling
7/01	2407																																			22770	Drilled with air and Caustic water
7/02	2507																																			22770	Drilled dolomite with air and Caustic water
7/03	2620																									40			Hay cube storage = 125				282	13	949	23719	Attempted to drill dolomite with air
7/04	2565																						105		15		11						153	50	1222	24941	Attempted to clean hole with Magcogel sweeps and Air foam
7/05	2620																						130		25		5	3		11	11			126	2639	27580	Attempted to clean hole with Magcogel sweeps and set NaSi plugs
7/06	2525																								33									45	950	28530	Set NaSi plug followed by 180' of cement
7/07	2525																																					Magcollar released
7/08																																						No report required
7/09																																						No report required
7/10																							130				100		15	$ZnCO_3$			3736		5167	33696	No report required

BIT DATA											PUMP DATA		CONDITION			RIG TUBULAR GOODS								PUMP		
BIT NO.	MAKE	SIZE	TYPE	JET SIZE	FT./HR.	DEPTH OUT	FOOTAGE	HOURS	BIT WT.	BIT R.P.M.	PRESSURE P.S.I.	OUTPUT Bbls./Min.	T	B	G	HOLE SIZE	DRILL PIPE SIZE	DRILL PIPE WT.	DRILL PIPE Grade	DRILL COLLARS OD	DRILL COLLARS ID	DRILL COLLARS LENGTH	LENGTH Liner	LENGTH Stroke	EFF %
1	STC	17½	3JS	185		1243	1211	144¼	35	50	800	14.0				26	4½	16.60	E	8		170	5	16	85
2	STC	12¼	DCHJ	14,14,15		1330	87	5½	20	80	800	14.0				17½	4½	16.60	E	8		280	6	18	85
3	SEC	12¼	M84F	14,14,14		1429	99	7¼	25	35	600	8.0				12¼	4½	16.60	E	8		300			
4	STC	12¼	F2	14,14,14		2000	651		35	40	300	8.0				334	4½	16.60	E	634		450			
5	HTC	12¼	X44	18,18,18		Drilled cement to 1287' 37 3/4 hours																			
6	STC	8 3/4	SBJ	16,16,16		Drilled 60' cement 1 hour																			
7	REED	8 3/4	T62JA	Open		2250	170	29	Varies		Air	2200 ft 3/min													
8	SEC	8 3/4	S84F	Open		2525	275	50	Varies		Air	2200 ft 3/min													

REMARKS	GEOLOGY	
	FORMATIONS	DEPTH
Velcan rocks with		
lime stringers		265
Latite		500
Andasite		835
Altered volcanics with		
lime stringers		1040
No returns		2400
Running dolomite		2525

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

DATE: 07/27/79

CERTIFICATE OF ANALYSIS

UNION OIL OF CALIF.
UNION GEOTHERMAL DIV
BOX 6854
SANTA ROSA, CA 95406

79-005463

SAMPLE: WATER DATED 7/7/79 RECEIVED 7/13/79.

	#4 CFSU 14-29 13:15 T=155 F DEP=2620'	#5 CFSU 14-29 13:45 T=157 F DEP=2620'	DISTILLED WATER
Alkalinity as CaCO3 mg/l	144.00	158.00	
Arsenic as As mg/l	.660	.745	
Barium as Ba mg/l	1.20	1.35	
Bicarbonate as HCO3 mg/l	175.68	192.76	
Boron as B mg/l	6.000	6.400	
Cadmium as Cd mg/l	.235	.310	
Calcium as Ca mg/l	332.00	332.00	
Carbonate as CO3 mg/l	<.01	<.01	
Chloride as Cl mg/l	2,030.	2,060	
Chromium as Cr (Dis) mg/l	<.001	<.001	
Chromium as Cr (Hex.) mg/l	<.001	<.001	
Conductivity umhos/cm	7,500	7,350	
Copper as Cu mg/l	.008	.010	

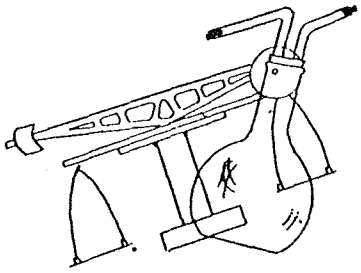
LINDA LAVELL
AUG - 1 1979

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

CERTIFICATE OF ANALYSIS

79-005463

	#4 CFSU 14-29 13:15 T=155 F DEP=2620'	#5 CFSU 14-29 13:45 T=157 F DEP=2620'	DISTILLED WATER	
Fluoride as F mg/l	2.43	2.50		
Hardness as CaCO3 mg/l	1,250	1,310		
Iron as Fe (Dissolved) mg/l	.410	.380		
Iron as Fe (Total) mg/l	1.336	.866		
Lead as Pb mg/l	.002	.005		
Lithium as Li mg/l	.357	.265		
Magnesium as Mg mg/l	100.80	115.20		
Manganese as Mn mg/l	.450	.520		
Mercury as Hg mg/l	<.0002	<.0002		
Nickel as Ni mg/l	.080	.085		
Nitrate as NO3-N mg/l	<.01	<.01		
Potassium as K mg/l	36.500	41.500		
Selenium as Se mg/l	.012	.009		
Silica as SiO2 mg/l	96.00	92.00	<.01	
Silver as Ag mg/l	<.001	<.001		
Sodium as Na mg/l	1,280.00	1,220.00		
Sulfate as SO4 mg/l	1,020	900		



Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

CERTIFICATE OF ANALYSIS

79-005463

	#4 CFSU 14-29 13:15 T=155 F DEP=2620'	#5 CFSU 14-29 13:45 T=157 F DEP=2620'	DISTILLED WATER
Total Dissolved Solids mg/l	4,881	4,766	
Turbidity NTU	25.00	9.00	
Zinc as Zn mg/l	.336	.350	
pH Units	7.03	7.41	

FORD CHEMICAL LABORATORY, INC.

COVE FORT SULPHURDALE UNIT #14-29

H_2S SAFETY PROCEDURES

Protection of all people on and around the Cove Fort Sulphurdale Unit #14-29 location from possible H_2S gas poisoning was of the utmost importance to Union Oil Company of California.

With the help of R. F. Smith Company, Union Oil 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.

There were three H_2S gas monitors on the location: one 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 addition, a sampling system collected vapors at the flow nipple and transported them to the R. F. Smith trailer where they were analyzed continuously by a gas chromatograph.

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 and/or supervisor 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 work wearing masks. If less than 10 ppm H_2S was found, the men could continue work normally. 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 personnel required to be present or perform any type of service on or in the proximity of the CFSU #14-29 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 R. F. Smith Corporation. 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 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.