ABSTRACT

During the latter half of 1980, the U.S. Department of Energy, Division of Geothermal Energy (DGE), through its Nevada Operations Office (NV), completed drilling and testing efforts for a 6,000-foot geothermal exploratory hole on the western approaches to Mount Hood, near Portland, Oregon. The intent of the drilling was to encounter a hydrothermal reservoir in a postulated fracture system and confirm the existence of a moderate-temperature (200°F) geothermal resource in the Old Maid Flat (OMF) vicinity of Mount Hood.

The exploratory hole, OMF No. 7A, was completed to a total depth of 6,027 feet in 54 days using conventional rotary drilling techniques. The hole was found to be incapable of producing fluids with the desired temperatures. A maximum hole temperature of about 235°F was recorded at total depth and a temperature gradient of about 3.3°F/100 feet was exhibited over the lower 1,000 feet of hole.

A variety of technical data, including physical samples such as cores, cuttings, and borehole fluids, plus geophysical well logs were acquired. Data analyses by the Oregon Department of Geology and Mineral Industries is continuing, with results to be made available through future separate reports.

Project accomplishment was made possible only through the combined efforts of the United States Forest Service, the United States Geological Survey, the Oregon Department of Geology and Mineral Industries with assistance from Southern Methodist University, the Northwest Geothermal Corporation, and Fenix & Scisson, Inc.

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I. INTRODUCTION

A. Purpose and Background

This report summarizes major activities for drilling a 6,000-foot geothermal exploratory hole on the western approaches to Mount Hood, Oregon, during August and September of 1980. The exploratory hole, designated as Old Maid Flat No. 7A (OMF No. 7A) is located in the Mount Hood National Forest about 50 miles east of Portland, Oregon, as shown in Figure 1.

The specific drill site, shown in Figure 2, was selected based upon temperature data from a nearby 4,000-foot-deep temperature gradient hole, OMF No. 1, and upon surface structural considerations which indicated a potential for encountering a fractured hydrothermal reservoir system with temperatures in excess of 180°F. If sufficient fluid productivity were associated with the expected temperatures, the Northwest Geothermal Corporation (NGC) intended to drill the necessary production wells in the Old Maid Flat vicinity to develop and commercialize the resource with the primary intent of providing hot water for space heating in the Portland, Oregon, metropolitan area.

B. Project Participants

The project was conducted under the overall cognizance of the DOE Division of Geothermal Energy (DGE), with field implementation by contractors of the DOE Nevada Operations Office (NV) and the DOE Idaho Operations Office (ID) in cooperation with the United States Forest Service (USFS), United States Geological Survey (USGS), and the NGC. The drilling technical and administrative support services were provided by Fenix & Scisson (F&S) under Contract No. DE-AC08-76NV00038 and the geoscientific support services were provided by the Oregon Department of Geology and Mineral Industries (DOGAMI) under Contract No. DE-FC07-79ID12044.

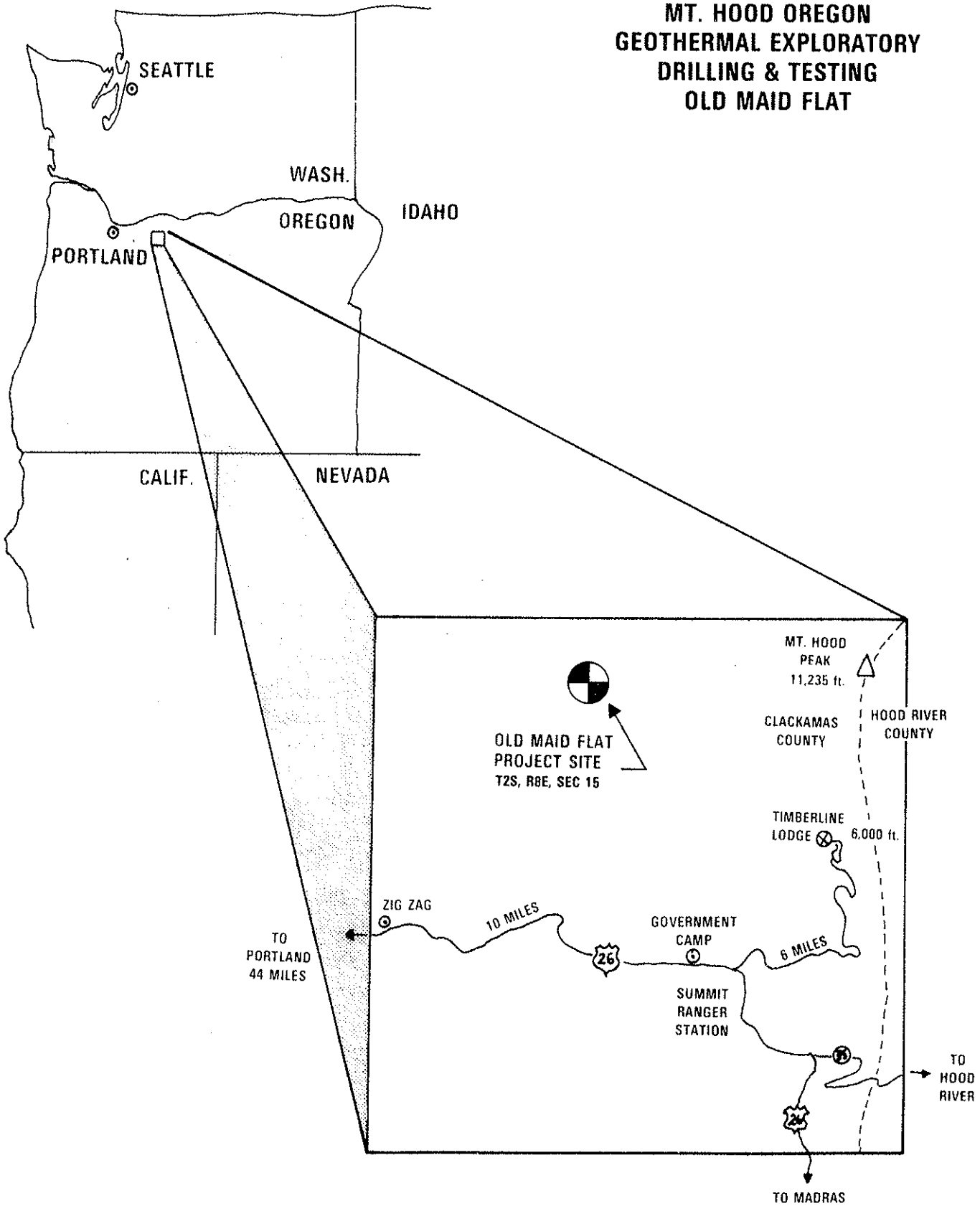
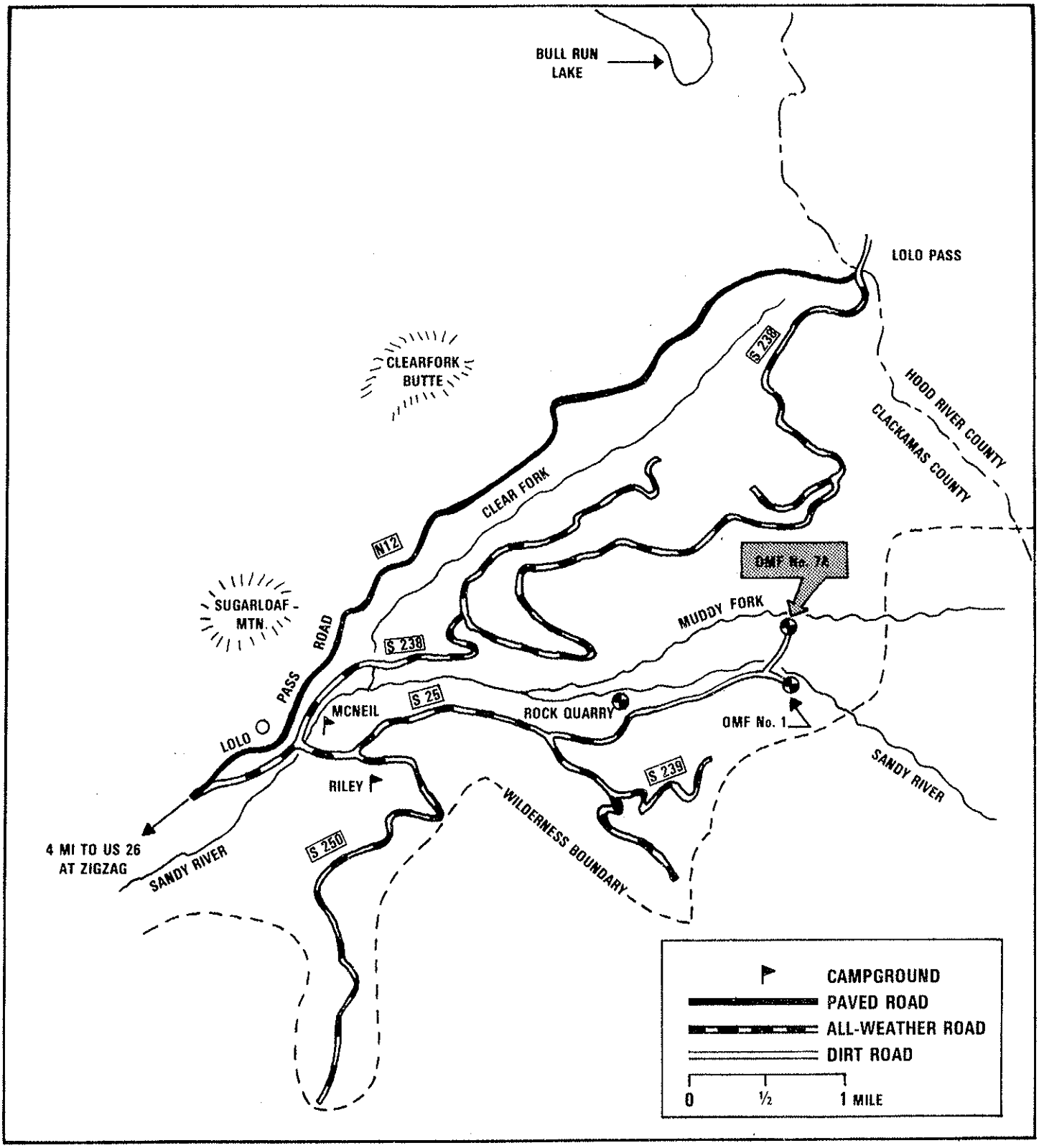


FIGURE 1 GENERAL LOCATION MAP



SITE LOCATION MAP
FIGURE 2

Specific authorities and responsibilities of each of the above-named organizations are set forth in Appendix A.

II. OPERATIONAL PLANNING

A. Permits and Approval

On February 23, 1980, a Plan of Operation (PO) was submitted through the NGC to the USGS Conservation Division, Santa Rosa, California. The PO requested approval for NGC to conduct geothermal exploratory drilling on its Federal Lease No. OR13994 in the Mount Hood National Forest. The USGS, with assistance from the USFS, Mount Hood National Forest, prepared Environmental Assessment (EA) No. 151-80, dated June 25, 1980, and subsequently approved the NGC application for Permit to Drill Old Maid Flat No. 7A. See Appendix B.

B. Project Objectives

The general objectives of the project as set forth in the DOE implementation document, Mount Hood Geothermal Exploratory Drilling and Testing Plan, NVO-218, dated May 1980, were as follows:

1. Confirm the existence of a hydrothermal system with temperatures of about 180°F to 200°F at depths of about 4,000 to 5,000 feet.

2. Determine the quality of the hydrothermal fluids.

3. Determine reservoir productivity characteristics to support future development of the potential geothermal resource in the OMF vicinity of Mount Hood, Oregon.

III. FIELD OPERATIONS

A. Site Preparation

The OMF No. 7A location on National Forest lands in the NE 1/4, Section 15, T2S, R8E, required construction of about 1/2 mile of dirt road and clearing about 3/4 acre of lightly timbered land. On June 24, 1980, road construction was started by Government Camp Excavating Company. Steel culverts were installed at the Sandy River and Ramona Creek crossings; a 12-foot-wide native material road was prepared; the drilling location was cleared; and a 75-foot by 50-foot by 12-foot-deep earthen pit was excavated and lined with 20-mil-thick plastic sheeting.

A water supply was established by setting a diesel-driven centrifugal pump at Ramona Creek and ground laying about 1,500 feet of aluminum irrigation pipe to the drill site.

B. Drilling and Completion Summary

1. Conductor Hole and Cellar

On July 10, 1980, R. J. Strasser Drilling Company began drilling the conductor hole with a cable tool rig after a 36-inch pipe had been set to 12 feet* in a hole excavated by a backhoe. By July 23, 1980, the conductor hole, consisting of 18-inch-diameter by 0.375-inch-thick pipe with welded joints, set at a depth of 96.5 feet and grouted to the surface, was completed. An 8-foot by 8-foot by 6-foot steel-sided cellar with concrete floor was then constructed around the conductor pipe to complete preparations for the rotary drilling rig.

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*All depths in this report are subsurface measurements from ground level.

2. Rotary Rig Operations

On August 5, 1980, the 14 3/4-inch surface hole was spudded by Taylor Drilling Company's Rig No. 4. Conventional rotary drilling techniques using lightweight bentonite base drilling fluid were utilized, and the 14 3/4-inch hole was drilled to 1,190 feet in 11 days. After geophysical logs were run, a 10 3/4-inch, 40.5-pound/foot casing string was set at the total depth of 1,190 feet and cemented to the surface using conventional oil field cementing services.

Blowout preventer equipment was installed and on August 19, 1980, the 9 7/8-inch production hole was started. After drilling to about 3,400 feet, the lightweight bentonite mud was circulated out of the hole and drilling proceeded using fresh water as the circulating medium. The water was supplemented with a polymer additive (NALCO WFR II) as necessary to maintain adequate viscosity for hole cleaning. Five cores were taken throughout the 9 7/8-inch hole drilling interval, and on September 28, 1980, the total depth of 6,011 feet was reached. A final bottom-hole core was taken from 6,011 feet to 6,027 feet and a suite of geophysical logs was run. Maximum recorded temperature at total depth was about 235°F.

There were no major problems experienced throughout the 14 3/4-inch and 9 7/8-inch hole drilling process. Minor mud losses of 8 to 10 barrels per hour were experienced between the 100- to 200-foot interval and losses of 12 to 15 barrels per hour were experienced between the 350- to 500-foot interval. The losses were stopped by the addition of Gel Flake lost circulation material.

The most significant drilling problem was a drill pipe failure which occurred while drilling at a depth of 3,925

feet. The drilling string was recovered on the first attempt, but since this was the second failure of a similar nature, the entire drill pipe string was inspected and a major portion replaced, resulting in a four-day delay.

Further details regarding drilling activities are contained in Appendix C, Summary of Daily Drilling Reports, and a Drilling Progress Chart is presented in Figure 3.

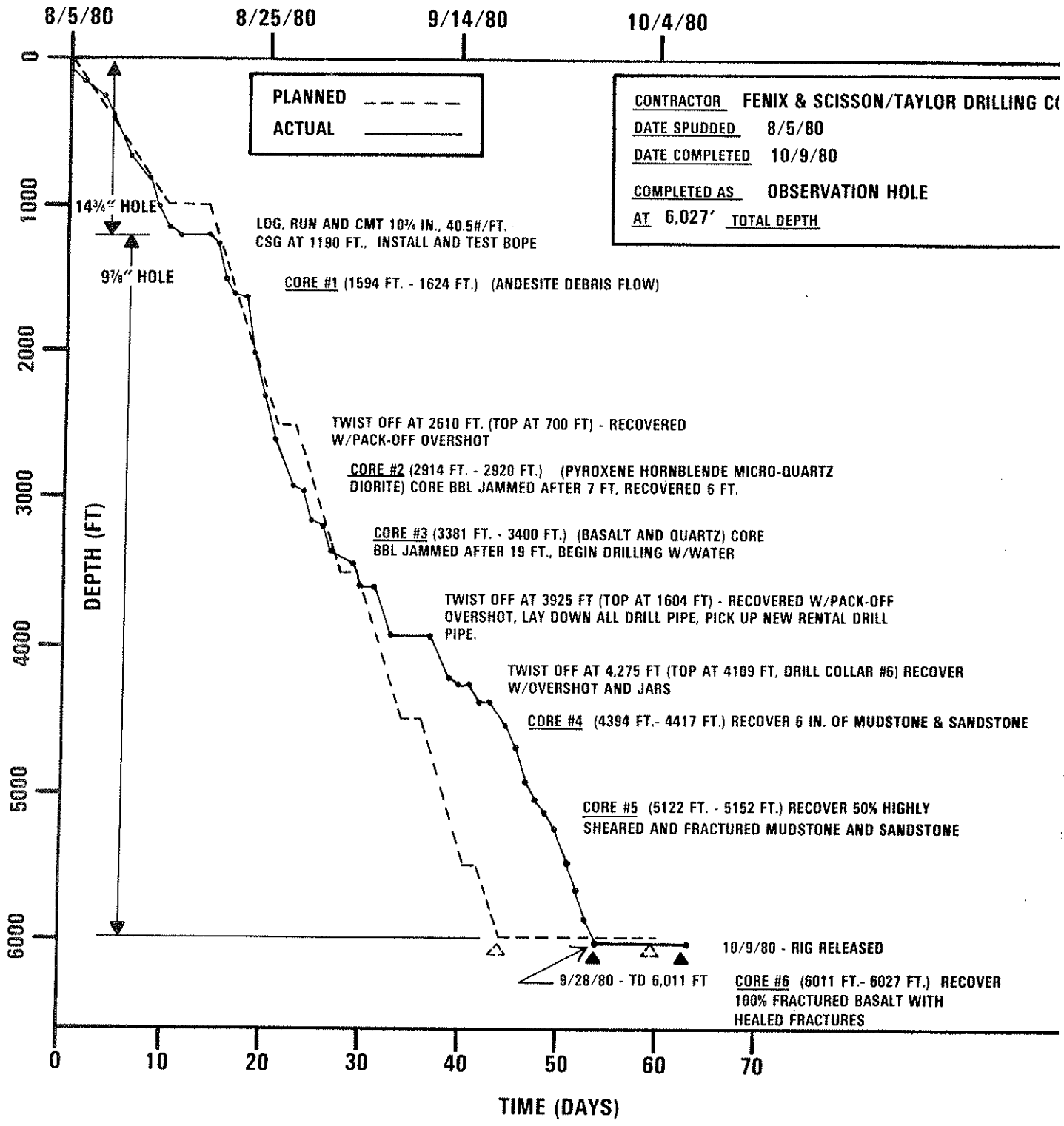
3. Testing and Completion

After completing the geophysical log suite at total depth, the hole was evaluated for potential geothermal production zones by setting open-hole inflatable packers on tubing and swabbing through the tubing. Two successful packer settings were obtained at 3,160 and 4,876 feet. The tubing was swabbed down to 200 feet above each packer setting point and fluid rise was monitored for 7- and 12-hour periods, respectively. Maximum fluid influx rates were less than one gallon per minute and the hole was completed by running 2 7/8-inch water-filled tubing to total depth to provide for final stabilized temperature measurements before plug and abandonment, which is scheduled in September 1981. The executed report of completion and request for abandonment is contained in Appendix D. Current hole completion status is shown in Figure 4 and a summary of the various measured temperature profiles is shown in Figure 5.

More thorough discussions regarding the analyses of data from the drilling and testing operations will be presented in a technical report being prepared by the Oregon Department of Geology and Mineral Industries.

C. Site Restoration

On October 9, 1980, the drilling rig was released and rig demobilization was completed by October 17, 1980. Fluids, primarily



DRILLING PROGRESS CHART

FIGURE 3

HOLE COMPLETION
STATUS OMF #7A

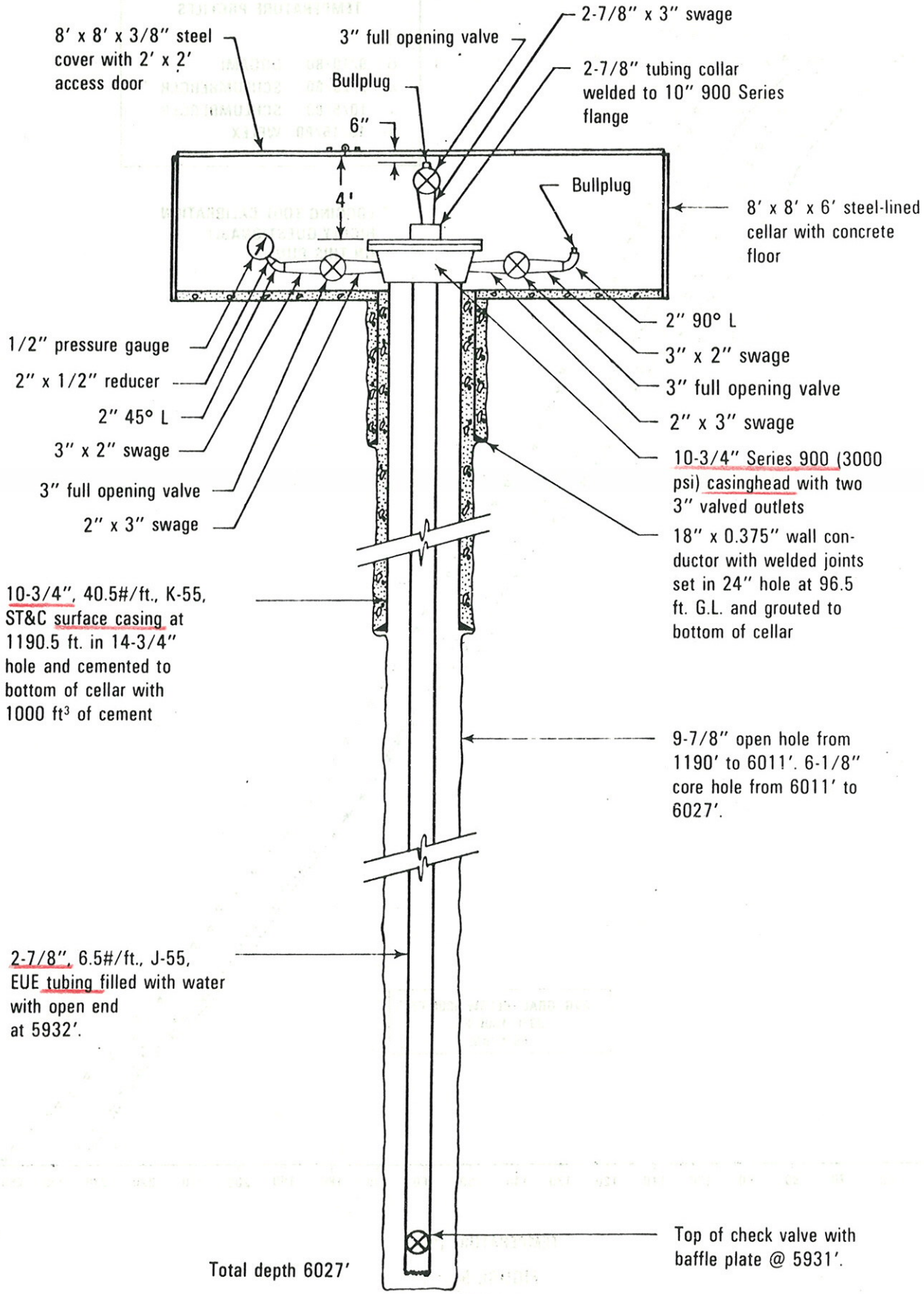


FIGURE 4

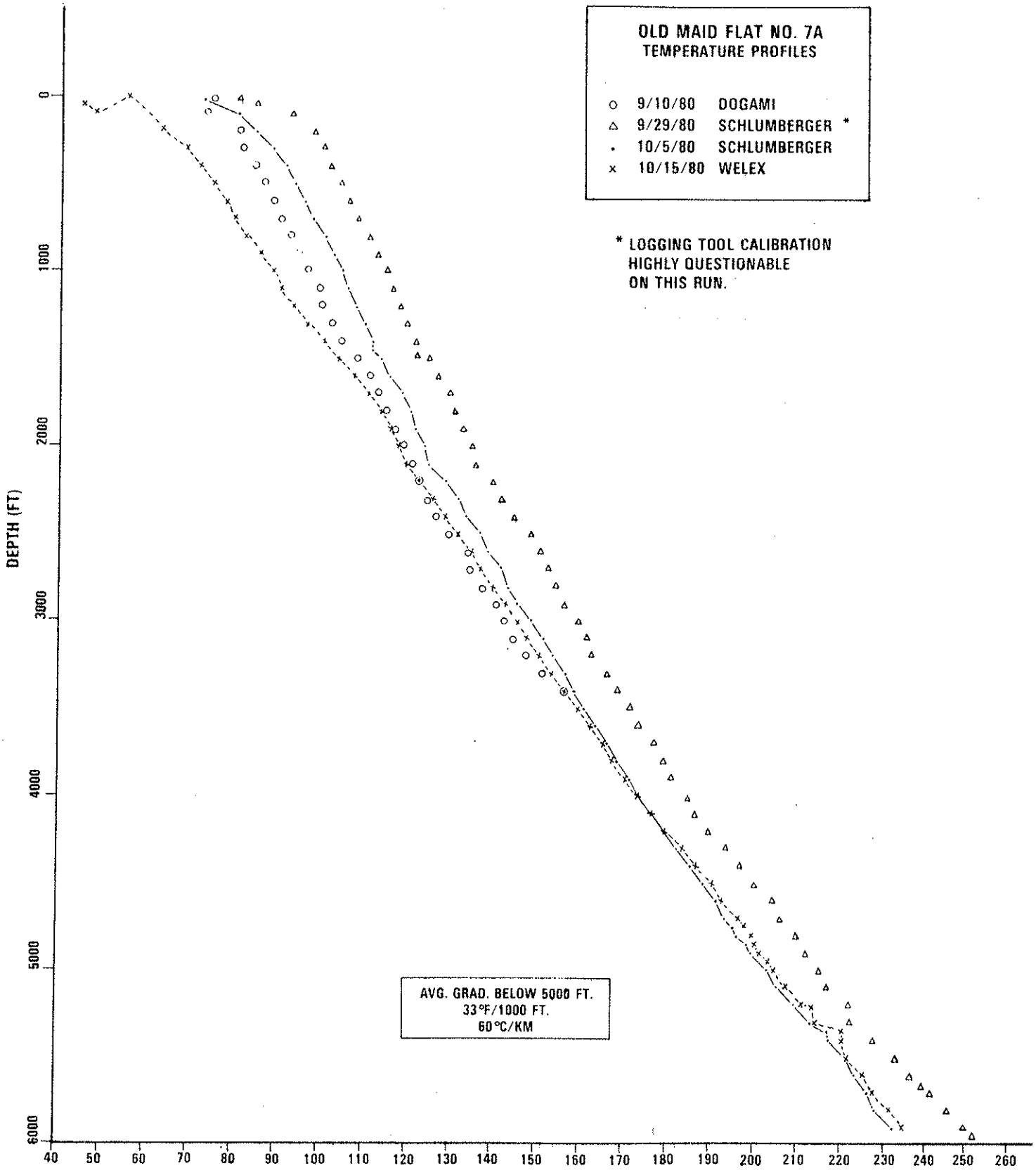

OLD MAID FLAT NO. 7A
TEMPERATURE PROFILES
○ 9/10/80 DOGAMI
△ 9/29/80 SCHLUMBERGER *
• 10/5/80 SCHLUMBERGER
× 10/15/80 WELEX
* LOGGING TOOL CALIBRATION HIGHLY QUESTIONABLE ON THIS RUN.
AVG. GRAD. BELOW 5000 FT.
33°F/1000 FT.
60°C/KM
DEPTH (FT)
0
1000
2000
3000
4000
5000
6000
40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260
TEMPERATURE (°F)

FIGURE 5

consisting of fresh water and drilling mud, were removed from the reserve pit and spread along the dirt access road and at a nearby rock quarry. The plastic lining was removed from the reserve pit, and the pit was backfilled with stockpiled native materials which were part of the pit retaining berm. The site was regraded and debris hauled to a stockpile area at the rock quarry for burning under USFS direction. Bar ditches were cut at three original dry washes along the access road, and the culverts were removed at Ramona Creek and Sandy River to complete interim site restoration activities. Final restoration activities to include seeding disturbed areas will be accomplished after final temperature measurements are obtained during July and August of 1981.

D. Project Costs

The total actual costs incurred to date for the 6,000-foot geothermal exploratory drilling project are $1,300,000, subdivided into major categories as shown in Figure 6. It is estimated that an additional $50,000 will be required to complete hole plugging and abandonment operations during the summer of 1981.

IV. EQUIPMENT AND SERVICES

A. Drilling Rigs

1. Conductor Hole: 12 feet to 96 feet

R. J. Strasser Drilling Company, Bucyrus Erie No. 36L cable tool rig.

2. Main Hole: 96 feet to 6,027 feet

Taylor Drilling Company, Rig No. 4, equipped as follows:

OMF NO. 7A
GEOTHERMAL EXPLORATORY HOLE
DRILLING COST SUMMARY

Total Depth--6,027 feet
Date Drilled--8/5/80 through 10/9/80

	Work Category	Cost ($000)
1.	Access Road and Location Preparation	$ 62
2.	Drill Rig Mobilization and Demobilization	110
3.	Drill Rig (Hourly Rate--Includes Drill Pipe and BOPE)	403
4.	Drilling Mud and Chemicals	27
5.	Geophysical Logging	73
6.	Mud Logging	35
7.	Cementing	25
8.	Casing, Tubing, and Wellhead Hardware	79*
9.	Special Services (Roustabouts, Casing Crews, etc.)	71
10.	Packer Testing	19
11.	Coring	42
12.	Drill Bits	43
13.	Stabilizers	29
14.	Transportation	24
15.	Rentals (Tanks, Water Pipes and Pumps, etc.)	36
16.	Fishing	12
17.	Drilling Supervision and Admin. Support (F&S)	180
18.	Logistical Support (Office Trailer, Vehicles, etc.)	16
19.	Site Restoration	9
20.	Other Miscellaneous	5
	TOTAL	$1,300

*Includes $37K for 2,500 feet of 7 5/8-inch production casing which was purchased but not used since hole was not productive.

Figure 6

a. Draw Works--National 50 N with 500 h.p. input rating.

b. Rotary Table--Oilwell 27 1/2-inch.

c. Substructure--L. C. Moore, 440,000-pound capacity, height 9 feet.

d. Prime Movers--Two Caterpillar-type D353 TA, each rated at 375 h.p.

e. Mast--L. C. Moore, 440,000-pound API hook load, height 127 feet.

f. Crown and Blocks--L. C. Moore, 440,000-pound capacity.

g. Hook--Oilwell 425, 150-ton rating.

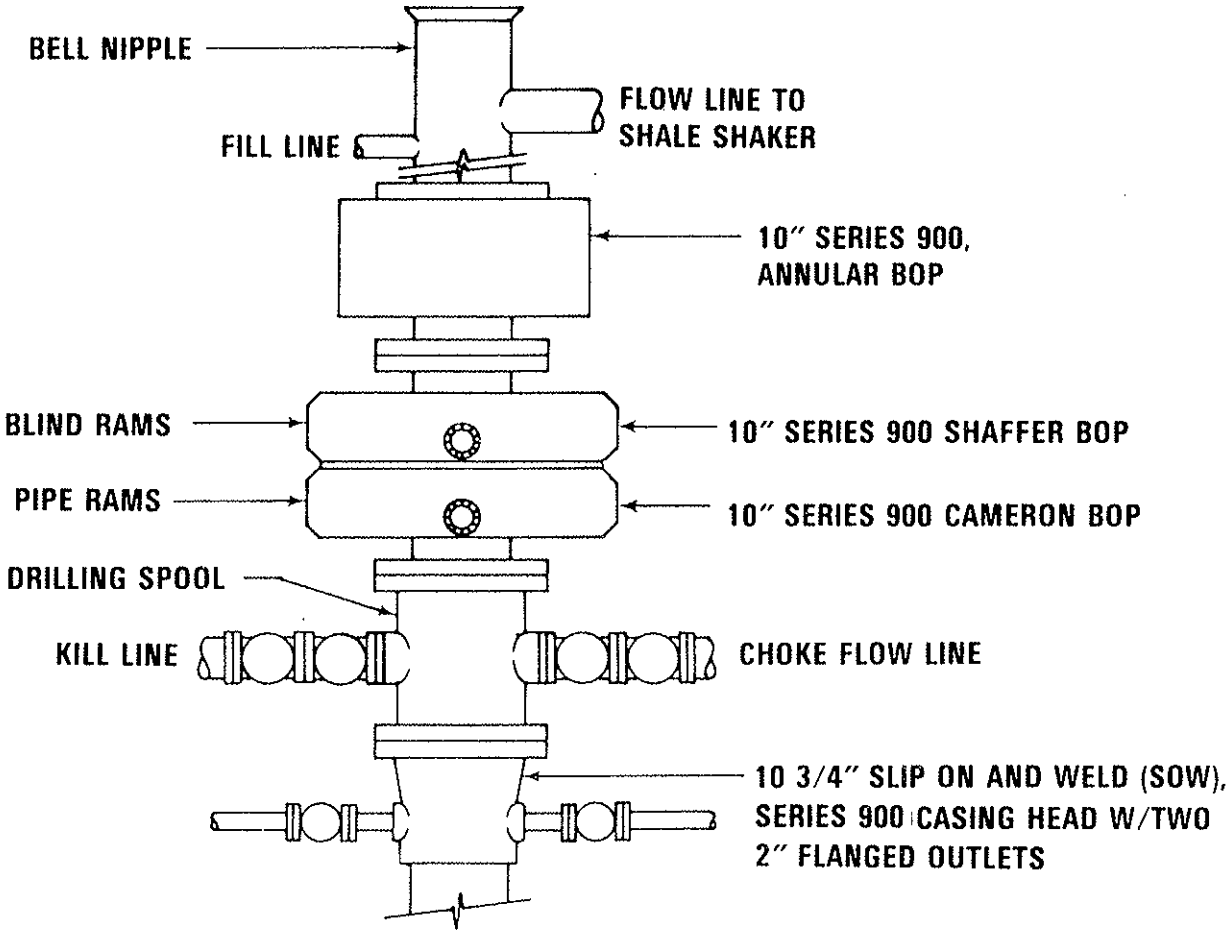
h. Mud Pumps--One Gardner Denver FXQ with 320 h.p. rating, 425 gpm at 1,000 psi maximum; one EMSCO D-500 with 500 h.p. rating, 728 gpm at 1,000 psi maximum.

i. Mud Tanks--Two with 500-barrel capacity each.

B. Containment Equipment

1. A Grant 16-inch Series 600 (2,000 psi rating) rotating head was used while drilling the 14 3/4-inch hole from 96 feet to 1,190 feet.

2. A conventional BOP stack consisting of a drilling spool with kill and choke line connections, one Series 900 (3,000 psi rating) pipe ram, one Series 900 blind ram, and one Series 900 annular preventer was used to drill the 9 7/8-inch hole to total depth. See Figure 7.



CONTAINMENT EQUIPMENT FOR DRILLING 9 7/8" HOLE

FIGURE 7

C. Drilling Fluids

Bentonite base drilling mud with a nominal weight of 9.0 pounds per gallon was used to drill the 14 3/4-inch hole to 1,190 feet and the 9 7/8-inch hole to 3,400 feet. Fresh water was used below 3,400 feet to the total depth of 6,027 feet. A polymer additive (NALCO WFR-2) was mixed with the fresh water at frequencies of about every six hours to maintain sufficient fluid viscosity for hole cleaning. The polymer was mixed with the water in a ratio of about 1 barrel of polymer to 100 barrels of water to obtain a funnel viscosity of about 40 to 50 secs.

D. Drilling String

Both the 14 3/4-inch and 9 7/8-inch holes were drilled with 4 1/2-inch drill pipe and a stabilized bottom-hole assembly. A combination of 10-inch and 7-inch drill collars with a maximum total weight of 60,000 pounds was used for the 14 3/4-inch hole, and a combination of 7-inch and 6 1/4-inch drill collars with a maximum total weight of 53,000 pounds was used for the 9 7/8-inch hole.

E. Drill Bits

A total of 12 rotary drilling bits and 3 coring bits were used, as summarized in Figure 8.

F. Tubulars

1. Conductor Casing: 18-inch diameter, 3/8-inch wall thickness with beveled and welded joints set at 96.5 feet.

2. Surface Casing: 29 joints, 10 3/4-inch, 40.5 pounds per foot, short thread and coupling (ST&C), K-55 set at 1,190.5 feet with centralizers on the bottom five joints.

ROTARY BIT RECORD

Run No.	Size	Make	Type	Depth Out	Feet Drilled	Rotating Hours
1	14 3/4"	Security	M4N	183	87	17 1/2
2	14 3/4"	Security	M4N	546	363	54
3	14 3/4"	Security	H7J	820	274	43
1 Rerun	14 3/4"	Security	M4N	1153	333	32 3/4
2 Rerun	14 3/4"	Security	M4N	1190	37	5 1/4
4	9 7/8"	Smith	DTJ	1400	210	15 1/2
5	9 7/8"	Smith	F3*	1594	194	17 3/4
6	9 7/8"	Smith	F3	2914	1290	82
5 Rerun	9 7/8"	Smith	F3	3160	240	23 1/2
7	9 7/8"	Smith	F3	3600	421	51 1/4
8	9 7/8"	Security	S84F	3925	325	26 1/4
9	9 7/8"	Security	S84F	4275	350	53
10	9 7/8"	Smith	F4*	4394	119	17 1/4
11	9 7/8"	Smith	F3	5122	705	80 1/2
12	9 7/8"	Smith	F4	6011	859	86 1/2

CORE BIT RECORD

1	6 1/8"	Christensen	MC22	2920	36	6 1/2
2	6 1/8"	Christensen	MC20	4417	42	20 1/4
3	6 1/8"	Christensen	MC23	6027	46	10 3/4

*Indicates tungsten carbide insert bit; all others mill tooth type.

Figure 8

3. Tubing: 187 joints, 2 7/8-inch, 6.5 pounds per foot, J-55, external upset ends (EUE) to 5,932 feet with a check valve at 5,931 feet.

4. Wellhead: One 10 3/4-inch Gulfco, Series 900, slip-on and weld (SOW) casinghead with two 2-inch threaded outlets swagged to two 3-inch full opening valves; a 10-inch nominal blind flange, center bored, with a 2 7/8-inch tubing coupling welded on to support the 2 7/8-inch tubing is bolted to the top of the casinghead. See Figure 4.

G. Cementing

1. Conductor Casing: 238 cubic feet of Class C "high early" cement was pumped through a 1 1/2-inch pipe to obtain fill-up around the 18-inch casing from 96 to 20 feet; the upper 20 feet of annulus was filled from the surface with 162 cubic feet of grout; total cement plus grout volume was 400 cubic feet.

2. Surface Casing: Conventional oil field cementing services were used to pump a lead slurry consisting of 600 cubic feet of Halliburton "light" (12.8 lb/gal) cement followed by 400 cubic feet of Halliburton Class G (14.8 lb/gal) containing 2 percent calcium chloride. Total cement volume pumped was approximately 30 percent in excess of calculated hole requirement before returns to the surface were obtained.

H. Hole Deviation Surveys

During the drilling operation, hole inclination measurements were taken about every 200 feet from the surface to 5,100 feet, and then at 5,400 and 6,000 feet. Inclination was measured using a non-directional single-shot instrument. Maximum measured hole inclination was 2 1/2 degrees.

A directional deviation survey calculated from the Schlumberger Dipmeter log is plotted in Figure 9. As can be seen from the plot, the total horizontal displacement at a measured depth of 5,928 feet is 204.4 feet, with a bearing of N 54°32' E.

V. DATA ACQUISITION

A. Mud Logging

A commercial mud logging service, R. F. Smith Corporation, Geothermal Division, was employed to monitor drilling fluid returns from the base of the conductor pipe, 96 feet, to total depth. A continuous lithologic log was prepared based upon drill cuttings samples taken on 10-foot intervals. A summary of the lithologic log is shown in Figure 10. In addition to the lithologic log, the following parameters were recorded on a continuous basis: (1) in and out flow line temperatures; (2) mud pit volume; (3) noncondensible gas concentrations including hydrogen sulfide, carbon dioxide, methane, and ethane; (4) drilling rate; (5) rotary table speed; and (6) mud pump pressure. A representative mud logging data sample is shown in Figure 11. Reproductions of the entire mud log are available from:

Rocky Mountain Well Log Service
Post Office Box 3150
Denver, CO 80201
Telephone: (303) 825-2181

or

Dept. of Geology & Mineral Industries
1069 State Office Building
Portland, OR 97201
Telephone: (503) 229-5580

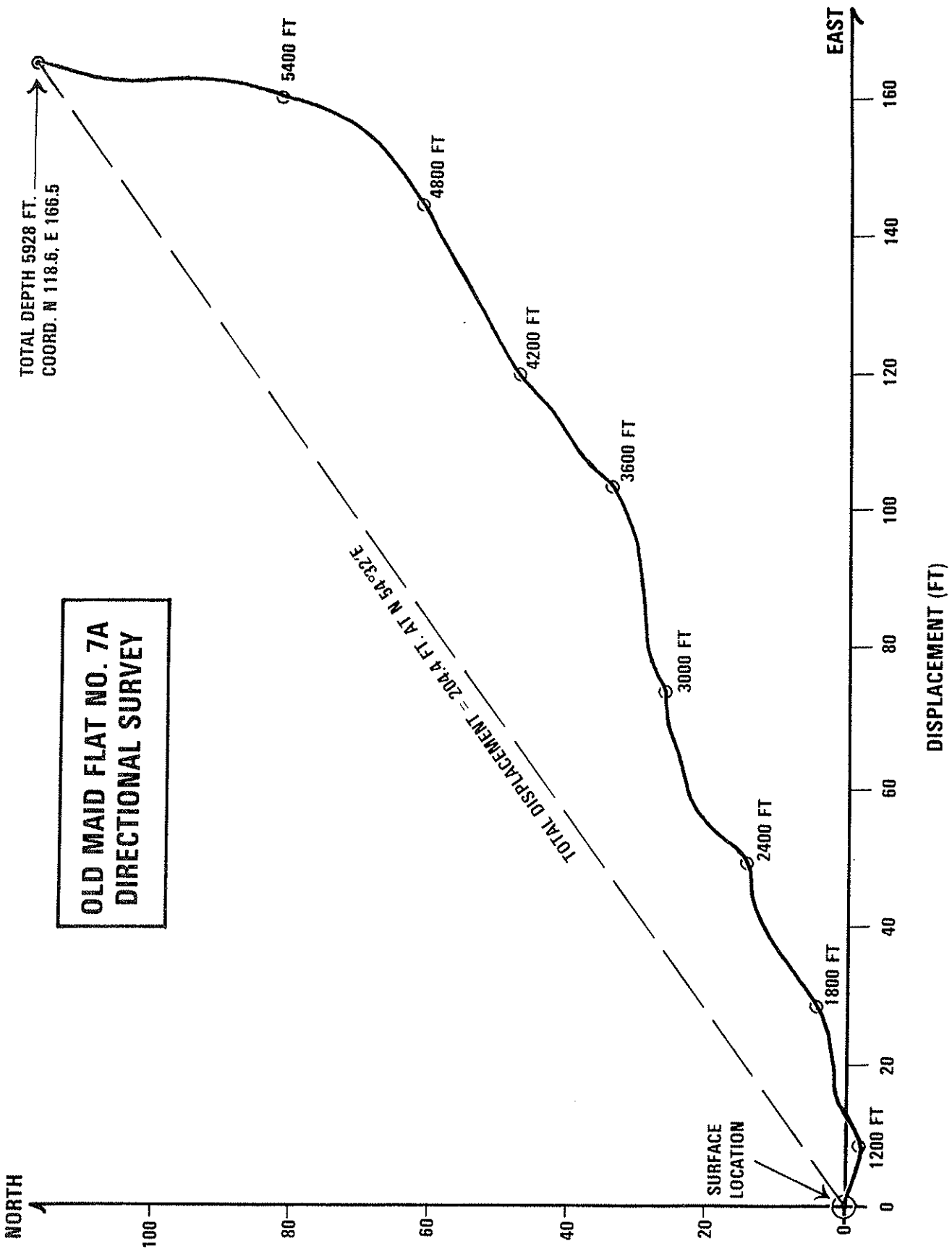
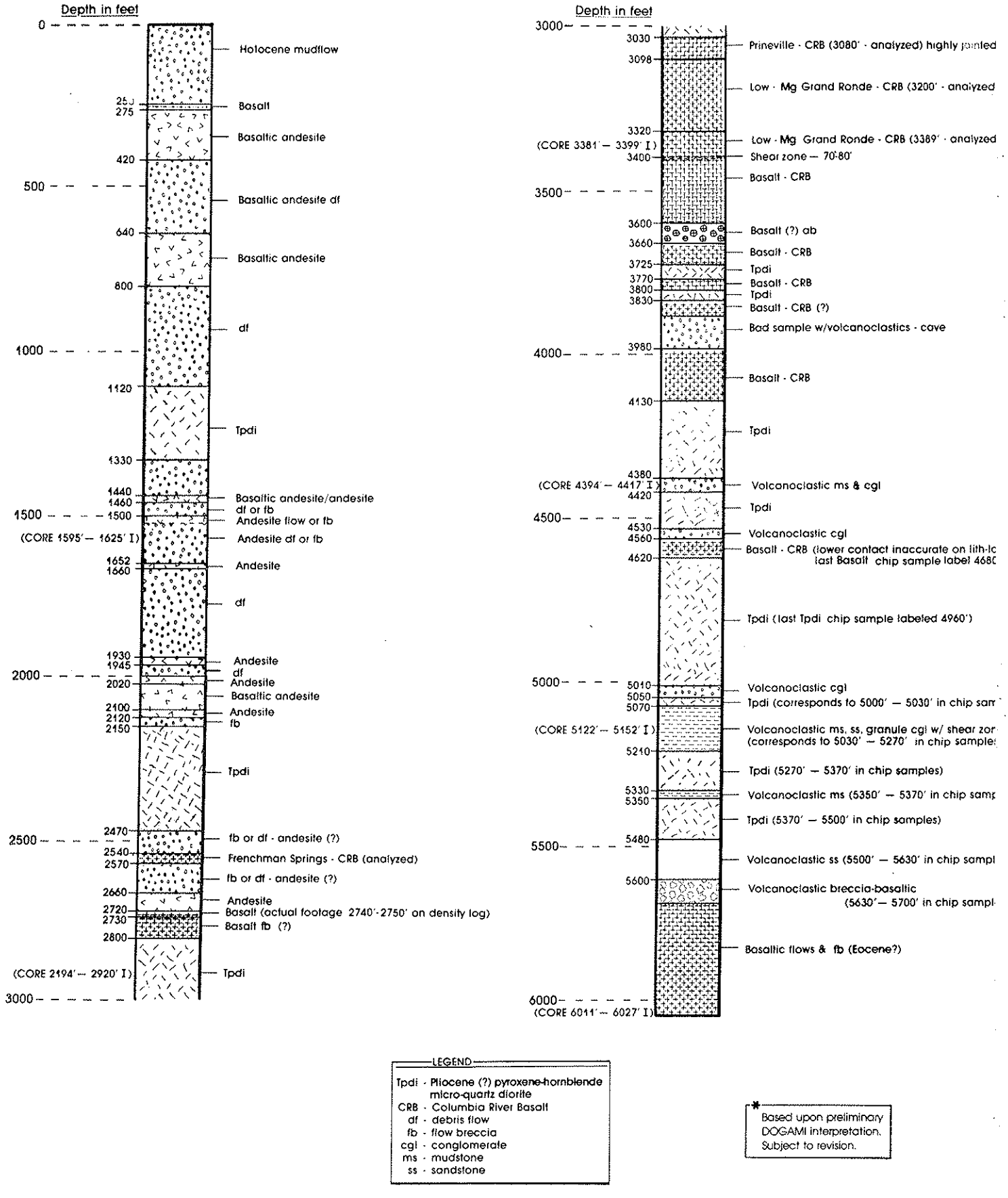

OLD MAID FLAT NO. 7A
DIRECTIONAL SURVEY
TOTAL DEPTH 5928 FT.
COORD. N 118.6, E 166.5
TOTAL DISPLACEMENT = 204.4 FT. AT N 54°32'E
5400 FT
4800 FT
4200 FT
3600 FT
3000 FT
2400 FT
1800 FT
1200 FT
SURFACE LOCATION
NORTH
EAST
DISPLACEMENT (FT)
DISPLACEMENT (FT)
0
20
40
60
80
100
120
140
160

FIGURE 9

OMF-7A SUMMARY LITHOLOGIC LOG *



LEGEND

Tpdi - Pliocene (?) pyroxene-hornblende micro-quartz diorite
CRB - Columbia River Basalt
df - debris flow
fb - flow breccia
cgl - conglomerate
ms - mudstone
ss - sandstone

* Based upon preliminary DOGAMI interpretation. Subject to revision.

FIGURE 10

EXLOG SMITH

R. F. SMITH CORP.

GEOTHERMAL DIVISION

COMPANY FENIX & SCISSON, INC.

WELL OLD MAID FLAT NO. 7A

FIELD MT. HOOD AREA COUNTY CLACKAMAS

LOCATION SEC 15 T 2S R 8E

STATE OREGON COUNTRY U.S.A.

LOGGING GEOLOGISTS TERRY MACLEOD, JIM HILL

PRESSURE INST TYPE SILICON CHIP TEMP. TYPE J-THERMOCOUPLE

DEPTH LOGGED FROM 96' TO

DATE LOGGED FROM 8-5-80 TO

ELEVATION 2760' KB ☐ DF ☐ GR ☒

-LITHOLOGY-

Sandstone, Siltstone, Graywacke Type #1, Graywacke Type #4, Solution Deposit, Basalt, Peridotite, Schist, Volcanic Mudflow Debris

Breccia, Claystone, Graywacke Type #2, Chert, Mineriz'd Deposit, Other Volcanic, Igneous Rock, Quartzite, Volcaniclastic Debris

Conglom., Shale or Argillite, Graywacke Type #3, Limestone, MELANGE', Tuff or Tuff Brec, Granitic Rock, Serpentine

ENGINEERING DATA

HOLE SIZE
24" to 96'
14 3/4" to 1191'
to

CASING SIZE
18" to 96'
10 3/4" to 1190'
to

DRILLING RATE ☒ FT/HR ☐ MIN/FT

ROCK DENSITY - - - -

DEPTH

LITHOLOGY

AIR AND MUD DRILLING DATA

TEMPERATURE (°F)

IN - - - - - - - -

OUT ———

CO_2 ppm - · - · - · -
on Air Drilling

TOTAL MUD GAIN/LOSS ——— · ——— · ———

PRESSURE PSIG

IN - - - - - -

OUT ———

METHANE ppm

ETHANE ppm

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H_2S ppm

Resistivity

REMARKS

DESCRIPTIONS

CORE RESULTS

SURVEYS

FORMATION TESTS

MUD AGITATOR
ELECTRIC ☐
AIR ☒

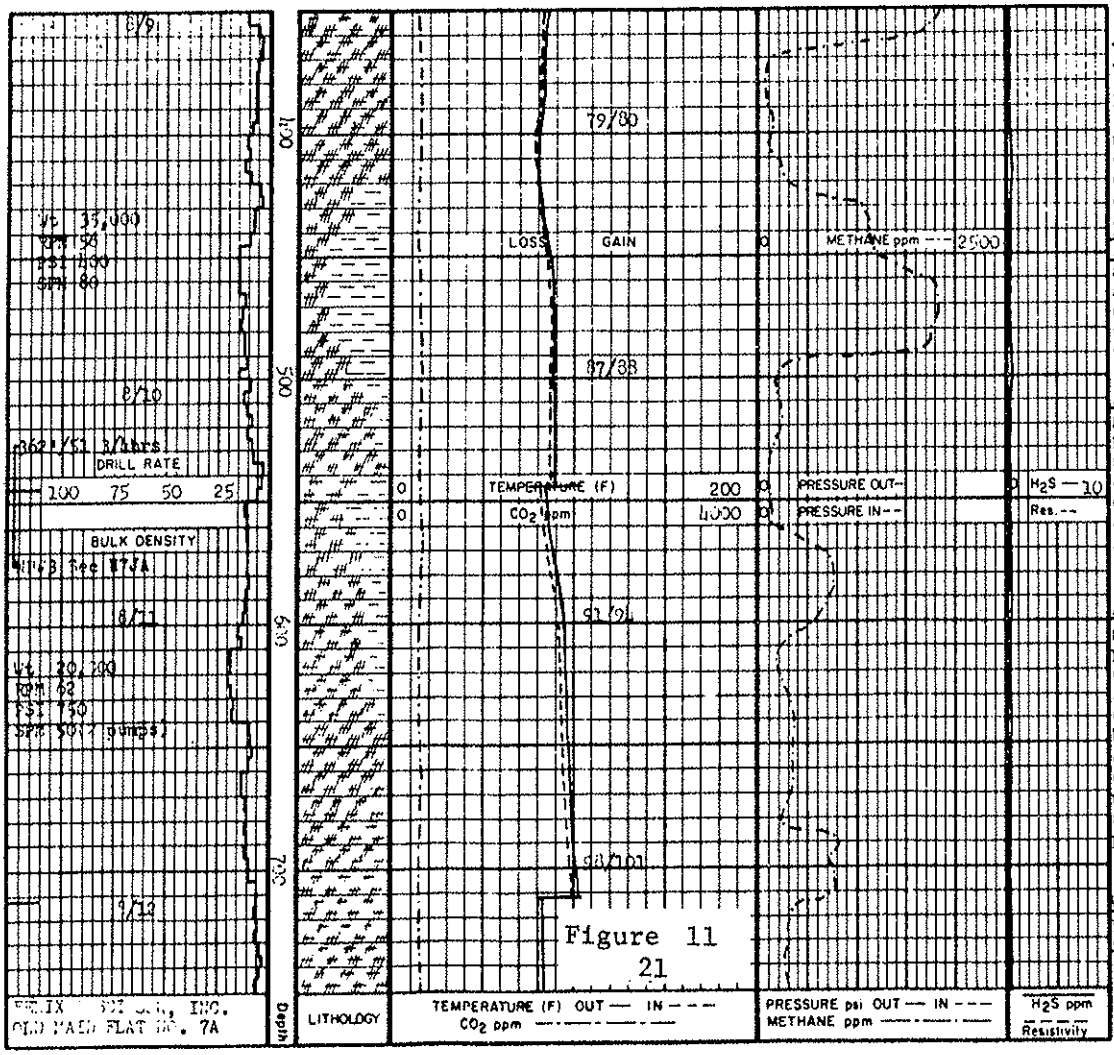

Figure 11

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Porphyritic/Andesitic Basalt: lt-dk gry, rd-brn (FeO altn), phenos of plag & remnant mafics in dk gry aphanitic mtx, com amygdules filled w/silica & dk grn chlor minerals, tr xtln calc, tr dism/sbhdrl py.

Porphyritic/Andesitic Basalt: med-dk gry, gen as above w/decr FeO alt & incr chlor alt, Clay up to 80% of samp, tr calc, tr silic micro veng.

Andesitic Basalt: m-dk gry, occ rd-brn, occ-com plag & tr mafic phenos marked decr in chlor altn @ 520' & cont w/ depth, cont amygduloidal w/ sec silica/chlor fill, tr calc & pyrite.

Andesitic Basalt: lt-dk gry, grn, rd-brn, sl-mod porphyritic, com phenos of plag & remnant mafics partially/totally altd to chlor mins, occ hematite & FeO stn, com amygdules filled w/ chlor/silicic mat decr w/ depth, com mlky-wht silica vn fill, tr dis pyrite

W 60 V 43 PV 20 YP 13 pH 8.5 Fe 2 Cl 270 Ca 4 Sd tr Sol 4%

B. Geophysical Logging

A complete suite of geophysical logs was run by Schlumberger, Inc., prior to setting the surface casing at 1,190 feet and at total depth. Supplemental temperature logging was conducted by Welex, Inc., and DOGAMI. The geophysical logging record is presented in Figure 12. Reproductions of the logs are also available from the above-listed sources.

C. Coring

Six cores were taken from the interval below the surface casing to total depth. Coring equipment and services were provided by Christensen Diamond Products. A 6 1/8-inch diamond core head and 30-foot core barrel were used during each coring operation. The time required for coring totaled about five days and the coring record is as follows:

Core No.	Interval Cored (Feet)	Core Recovered (Feet)	Percent Recovered
1	1594-1624	29.25	98
2	2914-2920	6.00	100
3	3381-3400	19.00	100
4	4394-4417	0.50	2
5	5122-5152	14.00	47
6	6011-6027	16.00	100
TOTALS	124	84.75	68

D. Packer Testing

After the 9 7/8-inch hole was drilled to total depth, Lynes inflatable open-hole packers were run on 2 7/8-inch tubing to isolate and test potential production zones. The first packer

GEOPHYSICAL LOGGING RECORD

Log Type	Logger	Date	Logged Interval (Feet) From	To
Fracture Identification	Schlumberger	8/16/80	96	1191
	Schlumberger	9/29/80	1190	5936
Variable Density	Schlumberger	8/16/80	96	1180
	Schlumberger	9/29/80	1190	5913
Dipmeter	Schlumberger	8/16/80	96	1190
	Schlumberger	9/29/80	1190	5936
Dual Induction	Schlumberger	8/16/80	96	1186
	Schlumberger	9/29/80	1190	5954
Gamma Spectroscopy	Schlumberger	9/29/80	10	5898
Compensated Neutron	Schlumberger	8/16/80	96	1190
	Schlumberger	9/29/80	1190	5926
Compensated Sonic	Schlumberger	8/16/80	96	1180
	Schlumberger	9/29/80	1190	5908
Temperature	Schlumberger	8/17/80	24	1191
	DOGAMI	9/10/80	0	3400
	Schlumberger	9/29/80	0	5952
	Schlumberger	10/5/80	100	5924
	Welex	10/15/80	0	5930

Figure 12

setting was made at a depth of 3,160 feet. The tubing fluid was swabbed down to a level of about 3,000 feet and the fluid rise was monitored utilizing a Schlumberger temperature tool for 7 hours. Fluid influx rate over the last 1-hour period was about 0.25 gallon per minute and the fluid level at the end of the 7-hour period was 2,400 feet. The packer was reset at a depth of 4,876 feet and the tubing fluid was swabbed down to about 4,500 feet. The fluid level rose to 3,345 feet during a 12-hour monitoring period, with the fluid influx rate over the last 1-hour period being about 0.25 gallon per minute.

E. Miscellaneous

An artesian flow, visually estimated at about 10 gallons per minute, had been noted just after taking core No. 1 at 1,624 feet and at various other times during nondrilling periods. Based upon the temperature profile trend in OMF No. 7A, it is postulated that the flow emanates from a depth of about 1,500 feet. After completion of the packer testing an attempt to quantify the flow rate was made by measuring the time required for the flow to fill a 30-gallon container. A flow rate of about 1 1/2-gallons per minute was thereby calculated. After the temperature observation tubing was installed and the well configured as shown in Figure 4, the pressure indicated on the 1/2-inch pressure gage was about 100 psi. Since the gage is recording annulus pressue, the reading is likely an indication of the pressure in the 1,500 feet artesian zone.

APPENDICES

APPENDIX A

PARTICIPANTS' AUTHORITIES AND RESPONSIBILITIES

This appendix identifies the functional project participants and describes their basic authorities and responsibilities.

A. Participants

1. DOE Division of Geothermal Energy (DGE)
2. DOE Nevada Operations Office (NV)
3. DOE Idaho Operations Office (ID)
4. United States Geological Survey, Conservation Division (USGS-CD)
5. United States Forest Service (USFS)
6. Northwest Geothermal Corporation (NGC)
7. Oregon Department of Geology and Mineral Industries (DOGAMI)
8. Fenix & Scisson, Inc. (F&S)

B. Authorities and Responsibilities

1. DGE

   a. Identify overall project technical objectives and authorize project execution.

   b. Select drilling and testing sites.

   c. Provide project funding.

d. Approve project plans and major changes to plans.

e. Monitor compliance with National Environmental Policy Act (NEPA) requirements.

f. Maintain continual cognizance over project progress.

2. NV

a. Develop, coordinate, and issue project operational plan.

b. Provide a drilling support contractor, F&S, to execute the approved operational plan.

c. Direct the activities of the drilling support contractor.

d. Develop project cost estimates and identify operational and cost reporting practices and controls.

e. Maintain liaison with all participating organizations.

f. Provide an NV Project Engineer to maintain technical and administrative surveillance of project activities.

3. ID

a. Provide liaison and assistance for development of the operational plan.

b. Provide a scientific support contractor, DOGAMI, with primary responsibility for the acquisition and analyses of scientific data.

c. Direct and coordinate the activities of the scientific support contractor.

d. Review the operational plan and any major changes to the plan.

e. Determine methods to be used for the public release and dissemination of scientific data and the final disposition of physical samples.

4. USGS-CD

a. Approve the project operational plan.

b. Coordinate with the USFS for the determination of required environmental approvals in accordance with NEPA requirements.

c. Approve applications for permits to drill on Federal leases.

d. Witness certain drilling activities in accordance with the Geothermal Resource Operations orders.

5. USFS

a. Review the project operational plan.

b. Provide advice to assure compliance with rules and regulations for operation on National Forest lands.

c. Prepare the necessary Environmental Analysis Record (EAR).

d. Issue required permits appropriate to lease status.

e. Provide logistical support for operation on National Forest lands.

6. NGC

a. Obtain lease rights and all required permits for conducting geothermal exploration on certain Federal lands within the Mount Hood National Forest.

b. Provide technical data for the preparation of access road and drill site construction drawings.

c. Assist in the preparation of the project operational plan.

7. DOGAMI

a. Assist in defining detailed scientific objectives and in data interpretations for site selection.

b. Assist in the development of project operational plan.

c. Direct and supervise the scientific data acquisition activities.

d. Exercise primary responsibility for the selection of coring points and determinations for downhole fluids sampling, including aquifer testing intervals.

e. Provide recommendations for and interpretations of geophysical logs.

f. Prepare and print a final geologic report of scientific data obtained and interpretations derived from the holes.

g. Execute and administer subcontracts as required for analyses of core, drill cuttings, and fluids. Such analyses shall include; rock conductivity and permeability, petrography, petrochemistry, gas and age dates, and water chemistry.

8. F&S

a. Provide technical specifications, schedules, and cost estimates for drilling and drilling support services subcontracts.

b. Execute and administer subcontracts for drilling and drilling support services.

c. Provide technical direction and on-site supervision for drilling and drilling-related operations.

d. Provide day-to-day logistical coordination.

e. Provide operational and cost reports as identified.

APPENDIX B

Form 9-331 C
(May 1963)

SUBMIT IN TRIPLICATE*
(Other instructions on reverse side)

Form approved.
Budget Bureau No. 42-R1425.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK

RECEIVED
MAR 12 1980
AREA GEOTHERMAL SUPERVISOR'S OFFICE
CONSERVATION DIVISION
U.S. GEOLOGICAL SURVEY
MENLO PARK, CALIFORNIA

1a. TYPE OF WORK: DRILL [X] DEEPEN [ ] PLUG BACK [ ]

b. TYPE OF WELL: OIL WELL [ ] GAS WELL [ ] OTHER ____ SINGLE ZONE [ ] MULTIPLE ZONE [ ]

2. NAME OF OPERATOR: Northwest Natural Gas Co.

3. ADDRESS OF OPERATOR: 123 N.W. Flanders, Portland, Oregon 97209

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements.*)
At surface: Section 15AC, T2S,R8E, (2460' south of north line, 2091' west of east line)
At proposed prod. zone

5. LEASE DESIGNATION AND SERIAL NO.: OR 16994

6. IF INDIAN, ALLOTTEE OR TRIBE NAME: ____

7. UNIT AGREEMENT NAME: ____

8. FARM OR LEASE NAME: ____

9. WELL NO.: 64-15 (7A)

10. FIELD AND POOL, OR WILDCAT: Old Maid Flat

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA: SW¼ NE¼ Sec. 15, T2S,R8E

12. COUNTY OR PARISH: Clackamas | 13. STATE: Ore

14. DISTANCE IN MILES AND DIRECTION FROM NEAREST TOWN OR POST OFFICE*: NE of Zig Zag - 8 miles

15. DISTANCE FROM PROPOSED* LOCATION TO NEAREST PROPERTY OR LEASE LINE, FT. (Also to nearest drlg. unit line, if any): 2460' from the N. boundary.

16. NO. OF ACRES IN LEASE: 2560

17. NO. OF ACRES ASSIGNED TO THIS WELL: None

18. DISTANCE FROM PROPOSED LOCATION* TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR, ON THIS LEASE, FT.: Approx. 2200' N.NE of OMF #1

19. PROPOSED DEPTH: 5000'

20. ROTARY OR CABLE TOOLS: Rotary

21. ELEVATIONS (Show whether DF, RT, GR, etc.): 2760

22. APPROX. DATE WORK WILL START*: July 15, 1980

23. PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	SETTING DEPTH	QUANTITY OF CEMENT
26"	16"	65.0, H-40	Max. 100'	To Surface (100 cu. ft.)
14-3/4"	10-3/4"	40.5, K-55	1000'	To Surface (725 cu. ft.)
9-7/8"	7-5/8"	26.4, K-55	3200'	1,000 cu. ft.

Above quantities based upon 30% excess.

1. Drill 26-in. hole to minimum depth of 40 ft. Set and cement 16-in. conductor pipe from T.D. to surface.
2. Install 16-in., series 600, rotating head, and drill 14-3/4 in. hole to a minimum depth of 600 ft. using rotary mud drilling techniques.
3. Set and cement 10 3/4-in. casing from T.D. of 14-3/4-in. hole to surface.
4. Install 10-in., series 600, double gate BOP and 10-in., series 600, annular BOP, and drill 9-7/8-in. hole to about 3,200 ft. using mud as circulating medium. Core as determined necessary.
5. Switch to water as circulating medium; continue 9-7/8-in. hole to a minimum depth of 4,000 ft. and a maximum of 6,000 ft. Core and conduct aquifer tests as determined necessary.
6. If war anted, run and cement 7-5/8-in. liner from about 3,200 ft. to 800 ft.

IN ABOVE SPACE DESCRIBE PROPOSED PROGRAM: If proposal is to deepen or plug back, give data on present productive zone and proposed new productive zone. If proposal is to drill or deepen directionally, give pertinent data on subsurface locations and measured and true vertical depths. Give blowout preventer program, if any.

24.

SIGNED W. F. Court TITLE Exploration Supervisor DATE 3/13/80

(This space for Federal or State office use)

PERMIT NO. 0113 APPROVAL DATE JUL 2 1980

APPROVED BY ____ TITLE Deputy Conservation Mgr., Geothermal DATE JUL 2 1980

CONDITIONS OF APPROVAL, IF ANY:

APPROVED
SUBJECT TO THE ATTACHED CONDITIONS

CONDITIONS OF APPROVAL FOR PERMIT NO. 0113
Well #64-15
Northwest Geothermal Co.
Federal Lease OR-13994
Mt. Hood Area
Clackamas Co., OR

1. A detailed drilling report shall be given by telephone to the District Geothermal Supervisor in Santa Rosa, CA (707) 525-4326, Monday through Friday at approximately 8:30 a.m. (PST) until subject well is completed or abandoned.

2. A copy of this Permit No. 0113, the approval letter with the approved drilling program, and one copy of each well survey log shall be available at the well site for the Deputy Conservation Manager-Geothermal (DCM-Geothermal). In addition, immediately after completion of each well survey (including daily mud logs), field copies shall be mailed or delivered to the District Geothermal Supervisor, 777 Sonoma Ave., Federal Bldg., Rm. 213, Santa Rosa, CA 95404 and the Deputy Conservation Manager-Geothermal, 2465 E. Bayshore Rd., Suite 400, Rm. 401, Palo Alto, CA 94303.

3. Prior to initiating any variances from the approved well program, such variances must be approved by the DCM-Geothermal.

4. H_2S detectors and alarms will be installed and monitored while drilling operations are in progress.

   NOTE: If H_2S concentrations exceed 25 parts per million or .0025% the operator will immediately contact the District Geothermal Supervisor or the DCM-Geothermal for further instructions.

5. All operations must be conducted in accordance with EA #151-80 and the Special Conditions of Approval for the Plan of Operation as stated in the Joint Letter of Approval dated 6/23/89.

HISTORY

APPENDIX C

SUMMARY OF DAILY REPORTS

6/24/80 to 7/15/80	Removed trees and built road to location under the direction of the U.S. Forest Service. Cleared location, excavated reserve pit, and lined pit with 20-mil Hypolon plastic.
7/10/80	Excavated a hole to 12 feet using a backhoe. Set 36-inch O.D., 3/8-inch wall casing at 12 feet and backfilled annulus with dirt. Moved in R. J. Strasser Drilling Company's Bucyrus Erie 36L and set up. Removed boulders from inside the casing with a clam. Worked days only.
7/11/80	Removed boulders and formation to 18 feet while simultaneously driving the casing. Changed over to a 23 1/2-inch cable tool bit and drilled from 18 to 23 feet.
7/12/80	Rig secured, continued work on location.
7/13/80	Rig secured, continued work on location.
7/14/80	Ran 24-inch O.D., 100.5-lb. casing in the hole. Drilled 23 1/2-inch hole from 23 to 40 feet from inside the casing and driving same ahead.
7/15/80	Drilled 23 1/2-inch hole from 40 to 49 feet and continued driving the 24-inch O.D. casing in the hole, bottom of casing at 59 feet. Drilled into water at 47 feet.
7/16/80	Drilled 23 1/2-inch hole from 49 to 65 feet, bottom of 24-inch casing at 65 feet. Static water level at 35 feet.

7/17/80	Drilled 23 1/2-inch hole from 65 to 85 feet, bottom of 24-inch casing at 85 feet.
7/18/80	Drilled 23 1/2-inch hole from 85 to 92 feet, bottom of casing at 92 feet.
7/19/80	Drilled 23 1/2-inch hole from 92 to 94 feet, casing stopped moving at 92 feet.
7/20/80	Drilled 23 1/2-inch hole from 94 to 96.5 feet, bit stopped drilling. Ran an inside casing cutter in the hole and cut off the 24-inch driving shoe.
7/21/80	Laid down the casing cutter. Ran 18-inch O.D., 3/8-inch wall casing with welded joints and set at 96.5 feet.
7/22/80	Ran 1 1/2-inch O.D. line pipe in the annulus to 96 feet. Rigged up a grout pump and cemented stage No. 1 with 185 cubic feet (140 sacks) of Class C high early cement. Cement in place at 1800 hours. Pulled 24-inch casing and line pipe as cement rose in the hole. Top of stage No. 1 at 40 feet.
7/23/80	Ran 1 1/2-inch line pipe to 40 feet and cemented stage No. 2 with 53 cubic feet of Class C high early cement using a grout pump. Pulled 24-inch casing and line pipe during cementing. Top of stage No. 2 at 20 feet. Dumped 162 cubic feet of ready-mix grout around the 18-inch O.D. casing. Pulled the 36-inch casing during cementing operations. Cement in place at 1330 hours. Top of stage No. 3 at 6.5 feet. Released rig at 1400 hours.
7/24/80	Moved out rig.
7/25/80	Excavated a hole for a cellar using a backhoe. Set in an 8- x 8- x 6-foot-deep steel cellar and pumped 40 sacks of cement in the bottom of the cellar.

8/1/80 to 8/5/80 — Moved in Taylor Drilling Company's rig No. 4 and rigged up. Mixed mud consisting of gel and soda ash. Drilled rat and mouse holes and set in pipe. Welded an adapter flange on the 18-inch O.D. casing for a Grant 20-inch rotating head.

8/5/80 — Installed rotating head and spudded hole at 1800 hours. Drilled 14 3/4-inch hole from 96.5 to 104 feet in 6 rotating hours. Pump pressure 400 psi; circulation rate 416 gpm. Mud weight 8.5 ppg; viscosity 70 secs.

8/6/80 — Drilled 14 3/4-inch hole from 104 to 183 feet in 19 rotating hours. Tripped for bit No. 2. Mud loss of 8 to 10 barrels per hour. Pump pressure 400 psi; circulation rate 416 gpm. Mud weight 8.6 ppg; viscosity 70 secs. Weight on bit 10,000 lbs.

8/7/80 — Drilled 14 3/4-inch hole from 183 to 244 feet in 14 rotating hours. Changed out No. 2 engine clutch and wait on backup tongs. Downtime 11 1/2 hours. Pump pressure 700 psi; circulation rate 640 gpm. Mud weight 9.1 ppg; viscosity 60 secs. Weight on bit 18,000 to 27,000 lbs.

8/8/80 — Drilled 14 3/4-inch hole from 244 to 356 feet in 12 rotating hours. Cleaned out 40 feet of fill. Repaired mud line, laid down 3 drill pipe joints and picked up 4 drill collars. Pump pressure 600 psi; circulation rate 515 gpm. Mud weight 8.9 ppg; viscosity 65 secs. Weight on bit 27,000 to 42,000 lbs.

8/9/80 — Drilled 14 3/4-inch hole from 356 to 501 feet in 20 rotating hours. Changed out pump No 1 belt idler. Pump pressure 400 psi; circulation rate 525 gpm. Mud weight 9.6 ppg; viscosity 65 secs. Mud loss of 12 to 15 barrels per hour. Weight on bit 40,000 lbs.

8/10/80 — Drilled 14 3/4-inch hole from 501 to 595 feet in 14 rotating hours. Tripped for bit No. 3 and picked up four 7-inch drill collars. Pump pressure 700 psi; circulation rate 761 gpm. Mud weight 9.0 ppg; viscosity 65 secs. Weight on bit 40,000 lbs. Long trip time (8 hrs) caused by tight drill collar connections.

8/11/80 Drilled 14 3/4-inch hole from 595 to 716 feet in 11.5 rotating hours. Tripped for shock sub and laid down two 10-inch drill collars with bad connections. Broke tong head and waited for replacement. Pump pressure 750 psi; circulation rate 760 gpm. Mud weight 9.1 ppg; viscosity 55 secs. Weight on bit 45,000 to 50,000 lbs.

8/12/80 Drilled 14 3/4-inch hole from 716 to 818 feet in 21 rotating hours. Repaired kelly drive bushing and service rig motors and mud pump. Pump pressure 750 psi; circulation rate 760 gpm. Mud weight 9.0 ppg; viscosity 60 secs. Weight on bit 40,000 to 50,000 lbs.

8/13/80 Drilled 14 3/4-inch hole from 818 to 944 feet in 12 rotating hours. Tripped for bit (No. 1 rerun) and repair bit breaker. Pump pressure 750 psi; circulation rate 760 gpm. Mud weight 9.0 ppg; viscosity 60 secs. Weight on bit 40,000 to 50,000 lbs.

8/14/80 Drilled 14 3/4-inch hole from 944 to 1,106 feet in 15.5 rotating hours. Bit plugged during deviation survey. Pulled two stands and broke circulation with 1,500 psi. Repaired leaking standpipe and washed to bottom. Pump pressure 800 psi; circulation rate 760 gpm. Mud weight 9.0 ppg; viscosity 60 secs. Weight on bit 40,000 to 50,000 lbs.

8/15/80 Drilled 14 3/4-inch hole from 1,106 to 1,176 feet in 13 rotating hours. Pick up replaceable wear pad (RWP) rotating stabilizer and ream 180 feet to bottom. Tripped for bit (No. 2 rerun). Pump pressure 800 psi; circulation rate 760 gpm. Mud weight 9.1 ppg; viscosity 68 secs. Weight on bit 50,000 to 60,000 lbs.

8/16/80 Drilled 14 3/4-inch hole from 1,176 to 1,190 feet in 2.5 rotating hours. Circulate and trip out for Schlumberger logs. Begin running log suite.

8/17/80 Completed logging and rigged up to run 10 3/4-inch casing. Maximum temperature logged--93°F. Laid down 10-inch drill collars. Ran 29 joints of 10 3/4-inch, 40.5 lb/ft, K-55, ST&C casing to 1,190.5 feet. Ran float shoe on bottom and float collar on top of first joint. Placed one centralizer 6 feet above shoe and one centralizer on each of the next four collars. The float collar was tack welded and thread lock compound was used on the bottom three joints. Cemented the casing with 600 cubic feet of Halliburton "light" (12.8 lb/gal) cement followed by 400 cubic feet of Halliburton Class G with 2 percent calcium chloride. Cement was displaced at 4 to 6 barrels per minute and 500 psi. Bumped plug with 1,000 psi. Cement in place at 1915 hours.

8/18/80 Waited on cement for 12 hours. Cut off conductor pipe at cellar floor and 10 3/4-inch casing 20 inches above the cellar floor. Bored out casinghead and welded to the 10 3/4-inch casing. Begin installing BOP stack.

8/19/80 Completed installing BOP and tested to 1,200 psi for 30 minutes. Picked up 9 7/8-inch drilling assembly and drilled out cement from 1,147 to 1,170 feet.

8/20/80 Drilled cement from 1,170 to 1,190 feet and 9 7/8-inch hole from 1,190 to 1,400 feet in 16 rotating hours. Tripped for bit, cleaned mud pits and serviced rig. Pump pressure 850 psi; circulation rate 550 gpm. Mud weight 8.7 ppg; viscosity 46 secs. Weight on bit 20,000 lbs.

8/21/80 Drilled 9 7/8-inch hole from 1,400 to 1,594 feet in 18 rotating hours. Trip for core barrel and pick up Christensen 6 1/8- x 3 1/2-inch core bit. Pump pressure 850 psi; circulation rate 550 gpm. Mud weight 8.5 ppg; viscosity 46 secs. Weight on bit 20,000 lbs.

8/22/80 Cored from 1,594 to 1,624 feet in 3 rotating hours. Tripped for core. Recovered 29.25 feet. Repaired pump drive unit and installed automatic driller.

8/23/80 Tripped in with drilling assembly. Reamed core hole and drilled from 1,624 to 1,876 feet in 15 rotating hours. Installed pump drive unit. Pump pressure 880 psi; circulation rate 435 gpm. Mud weight 9.0 ppg; viscosity 46 secs. Weight on bit 40,000 lbs.

8/24/80 Drilled 9 7/8-inch hole from 1,876 to 2,242 feet in 21 rotating hours. Installed new sand line. Pump pressure 800 psi; circulation rate 435 gpm. Mud weight 9.0 ppg; viscosity 46 secs. Weight on bit 40,000 lbs.

8/25/80 Drilled 9 7/8-inch hole from 2,242 to 2,548 feet in 19 1/2 rotating hours. Changed valve and seat on mud pump No. 1. Pump pressure 800 psi; circulation rate 435 gpm. Mud weight 9.2 ppg; viscosity 45 secs. Weight on bit 40,000 to 45,000 lbs.

8/26/80 Drilled 9 7/8-inch hole from 2,548 to 2,638 feet in 7 rotating hours. Twisted off drill pipe at 700 feet below ground level. Pipe had parted below a drill pipe box at the weld point. Waited on fishing tools and recovered with overshot.

8/27/80 Drilled 9 7/8-inch hole from 2,638 to 2,914 feet in 20 rotating hours. Began tripping out for core No. 2. Pump pressure 800 psi; circulation rate 435 gpm. Mud weight 9.2 ppg; viscosity 43 secs. Weight on bit 45,000 to 50,000 lbs.

8/28/80 Finished tripping out. Ran USGS temperature survey. Recorded maximum temperature of 128°F at 2,914 feet. Cored from 2,914 to 2,920 feet in 3 1/2 rotating hours with 12,000 lbs. on bit. Core barrel jammed. Recovered 6-foot core. Repaired rotary drive chain and removed clutch from No. 1 pump drive.

8/29/80 Reamed out core hole and drilled 9 7/8-inch hole from 2,920 to 3,084 feet in 14.5 rotating hours. Repaired mud pump valve. Pump pressure 750 psi; circulating rate 380 gpm. Mud weight 9.1 ppg; viscosity 40 secs. Weight on bit 50,000 lbs.

8/30/80 Drilled 9 7/8-inch hole from 3,084 to 3,160 feet in 9 rotating hours. Replace belts on pump drive compound. Repair rotary drive chain, trip out for bit, and clean mud tanks. Pump pressure 750 psi; circulating rate 380 gpm. Mud weight 8.8 ppg; viscosity 35 secs. Weight on bit 50,000 lbs.

8/31/80 Trip in and drill 9 7/8-inch hole from 3,160 to 3,315 feet in 18 rotating hours. Service rig and repair kelly drive bushings. Pump pressure 750 psi; circulation rate 380 gpm. Mud weight 9.0 ppg; viscosity 40 secs.

9/1/80 Drilled 9 7/8-inch hole from 3,315 to 3,381 feet in 6 rotating hours. Trip for core No. 3. Cored from 3,381 to 3,400 feet in 7.5 rotating hours with 10,000 to 15,000 lbs. on bit. Changed out cutters on 9 7/8-inch rotating stabilizer.

9/2/80 Tripped out with core No. 3 and recovered 19 feet of core. Made up drilling assembly, tripped to bottom and reamed out core hole. Dumped and cleaned mud pits.

9/3/80 Filled mud pits with water and circulated hole. Drilled 9 7/8-inch hole with water from 3,400 to 3,562 feet in 18.5 rotating hours. Pump pressure 800 psi; circulation rate 515 gpm. Weight on bit 30,000 to 45,000 lbs.

9/4/80 Drilled 9 7/8-inch hole from 3,562 to 3,600 feet in 8.5 rotating hours. Tripped for bit and replaced one nonrotating stabilizer with RWP stabilizer. Cut 100 feet of drilling line and tripped in. Stuck drilling assembly at 3,275 feet. Mixed polymer viscosifier/friction reducer (WFR II) and worked pipe free.

	Reamed from 3,225 to 3,300 feet. Pump pressure 1,000 psi; circulation rate 428 gpm. Fluid weight 8.6 ppg; viscosity 33 secs. Weight on bit 30,000 to 45,000 lbs.
9/5/80	Reamed 9 7/8-inch hole from 3,300 to 3,400 feet and tripped out and laid down RWP stabilizer. Picked up nonrotating stabilizer and new bit. Tripped in and drilled with water from 3,600 to 3,725 feet in 4 rotating hours. Pump pressure 1,000 psi; circulation rate 500 gpm. Weight on bit 45,000 lbs.
9/6/80	Drilled 9 7/8-inch hole with water from 3,725 to 3,925 feet in 22 rotating hours. Flushed hole every six hours with slug of polymer viscosifier (WFR II) fluid. Twisted off drill pipe. Pump pressure 1,000 psi; circulation rate 500 gpm. Weight on bit 30,000 to 45,000 lbs.
9/7/80	Tripped out with 17 stands of 4 1/2-inch drill pipe plus box of the tool joint from stand No. 18. Tripped in with 9 7/8-inch overshot and latched on to fish at 1,604 feet. Worked free with 160,000 lbs. pull and tripped out. Laid down all drill pipe and cleaned mud tanks.
9/8/80 to 9/11/80	Inspected all 6- and 7-inch drill collars and 4 1/2-inch drill pipe. Replaced all square-shouldered drill pipe and inspected new drill pipe prior to running. Ran temperature survey to 3,400 feet. Recorded 150°F maximum. Tripped in and reamed 30 feet of 9 7/8-inch hole; cleaned out 10 feet of fill and drilled 9 7/8-inch hole from 3,925 to 4,019 feet in 7 rotating hours.
9/12/80	Drilled 9 7/8-inch hole from 4,019 to 4,202 feet in 24 rotating hours using water with periodic sweeps of 65-70 viscosity polymer fluid. Pump pressure 1,000 psi; circulation rate 500 gpm. Weight on bit 28,000 to 30,000 lbs.

9/13/80 Drilled 9 7/8-inch hole from 4,202 to 4,275 feet in 22 rotating hours. Started out of hole.

9/14/80 Tripped out with drill pipe and 11 drill collars. Had twisted off pin of No. 11 7-inch drill collar. Left five 7-inch drill collars and drilling assembly in hole. Ran overshot and jars and recovered fish after pulling 180,000 lbs. and sixth jar had actuated.

9/15/80 Broke all drill collar connections, inspected and doped all threads. Made up drilling assembly, tripped in and drilled 9 7/8-inch hole from 4,275 to 4,350 feet in 10 rotating hours. Pump pressure 900 psi; circulation rate 435 gpm. Weight on bit 30,000 lbs.

9/16/80 Drilled 9 7/8-inch hole from 4,350 to 4,394 feet in 7 rotating hours. Cut core No. 4 from 4,394 to 4,405 feet. Mud pump failed.

9/17/80 Repaired pump and completed cutting core to 4,417 feet. Recovered 6 inches of core. Changed out rubbers on top nonrotating stabilizer. Laid down shock sub and picked up drilling jars. Started tripping in with new bit.

9/18/80 Reamed core hole from 4,394 to 4,417 feet. Drilled 9 7/8-inch hole from 4,417 to 4,502 feet in 10 rotating hours. Pumped polymer mud pill. Tripped to pick up 3-point reamer.

9/19/80 Drilled 9 7/8-inch hole from 4,502 to 4,659 feet in 18 rotating hours. Repaired valves in mud pump. Pumped polymer mud pill. Pump pressure 850 psi; circulation rate 480 gpm. Weight on bit 30,000 lbs.

9/20/80 Drilled 9 7/8-inch hole from 4,659 to 4,852 feet in 22 rotating hours. Serviced rig and changed shale shaker screen and kelly

drive bushing. Pumped 25-barrel polymer mud pill. Pump pressure 1,000 psi; circulation rate 435 gpm. Weight on bit 30,000 to 35,000 lbs.

9/21/80 Drilled 9 7/8-inch hole from 4,852 to 5,000 feet in 16 rotating hours. Pumped two 25-barrel polymer mud pills. Cleaned mud tanks and repaired mud pump. Pump pressure 1,000 psi; circulation rate 435 gpm. Weight on bit 35,000 to 40,000 lbs.

9/22/80 Drilled 9 7/8-inch hole from 5,000 to 5,122 feet in 14 rotating hours. Pumped two 25-barrel polymer mud pills. Repair leak in standpipe. Tripped for core barrel. Pump pressure 1,000 psi; circulation rate 435 gpm. Weight on bit 40,000 lbs.

9/23/80 Tripped in for core. Cored from 5,122 to 5,152 feet in 7 1/2 rotating hours. Tripped out with core. Recovered 14 feet. Dressed 3-point reamer. Replaced valves in mud pump. Reamed core hole to 5,152 feet and drilled to 5,157 feet. Pump pressure 1,000 psi; circulation rate 180 gpm. Weight on bit 15,000 to 18,000 lbs.

9/24/80 Drilled 9 7/8-inch hole from 5,157 to 5,439 feet in 14 rotating hours. Pumped three 40- to 50-barrel polymer mud pills. Stuck pipe on connection at 5,439 feet, worked free. Pump pressure 1,100 psi; circulation rate 435 gpm. Weight on bit 30,000 lbs.

9/25/80 Drilled 9 7/8-inch hole from 5,439 to 5,624 feet in 14 rotating hours. Pumped one 75-barrel polymer mud pill. Repaired mud pump, fuel line, and standpipe. Pump pressure 1,100 psi; circulation rate 445 gpm. Weight on bit 30,000 lbs.

9/26/80 Drilled 9 7/8-inch hole from 5,624 to 5,801 feet in 22 rotating hours. Pumped three polymer mud pills. Pump pressure 1,000 psi; circulation rate 445 gpm. Weight on bit 30,000 lbs.

9/27/80 Drilled 9 7/8-inch hole from 5,801 to 5,998 feet in 21 rotating hours. Pumped five polymer mud pills. Pump pressure 1,000 psi; circulation rate 435 gpm. Weight on bit 30,000 lbs.

9/28/80 Drilled 9 7/8-inch hole from 5,998 to 6,011 feet in 2 1/2 rotating hours. Tripped out to pick up core barrel. Tight hole at 5,600 feet. Pumped 30-barrel polymer mud pill and worked pipe free. Tripped in with core barrel and washed from 5,925 to 6,011 feet.

9/29/80 Cored from 6,011 to 6,027 feet in 3 1/2 rotating hours with 15,000 lbs. on bit. Pump pressure 800 psi; circulation rate 250 gpm. Tripped out with core. Recovered 16 feet. Rig up Schlumberger and begin logging.

9/30/80 Completed logging. Maximum temperature at total depth--226^{o}F. Laid down drilling assembly.

10/1/80 Waited on tools to run tubing and open-hole packer. Begin running open-hole packer on 2 7/8-inch tubing.

10/2/80 Completed running Lynes inflatable packer to 3,160 feet and set with 1,900 psi. Rigged flow line to 400-barrel tank and swabbed 1,780 gallons of water (fluid level 2,921 feet). Monitored fluid rise with Schlumberger for 7 hours. Total rise--501 feet or 121 gallons.

10/3/80 Swabbed 80 gallons for water sample. Released packer and reset at 4,876 feet. Swabbed 990 gallons. Monitored fluid rise with Schlumberger starting at 1900 hours with fluid level at 4,151 feet.

10/4/80 Continued monitoring until 0700 hours with fluid level at 3,345 feet. Total rise of 806 feet (167 gallons). Swabbed for water sample. Released packer at 1430 hours. Tripped out with packer and rigged up to run Schlumberger temperature log.

10/5/80 Logged to 5,925 feet. Maximum temperature--232°F. Tripped in with packer and set at 3,177 feet. Attempted to inject into formation, but water circulated around packer at 500 psi. Released packer and tripped out. Began laying down drill pipe.

10/6/80 Laid down 4 1/2-inch drill pipe. Tripped in with Lynes packer and set at 2,866 feet. Attempted to inject into formation, but water circulated around packer. Tripped out with packer.

10/7/80 Rigged up USGS and took downhole water samples at 1,470, 2,080, and 3,115 feet. Sampler failed to close at 1,470 feet. Rigged down swabbing equipment and BOPs.

10/8/80 Waited on 2 7/8-inch tubing and check valve.

10/9/80 Ran 187 joints (5,928 feet) of 2 7/8-inch, J-55, 6.5 lb/ft tubing with check valve at 5,931 feet and open end at 5,932 feet. Landed tubing with 8-foot pup joint collar welded to bored out blind flange which was bolted to 10 3/4-inch Gulfco, Series 900 casinghead set 4 feet below ground level. Released rig at 2400 hours.

Form 9-331
Dec. 1973

Form Approved.
Budget Bureau No. 42-R1424

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form 9-331-C for such proposals.)

1. oil well ☐ gas well ☐ other Geothermal Exploratory
2. NAME OF OPERATOR
Northwest Geothermal Corporation
3. ADDRESS OF OPERATOR
123 N.W. Flanders St., Portland, OR 97209
4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.) 2460' FNL & 2091' FEL of Sec. 15, T2S, R8E
AT SURFACE: 2760' G.L. Elevation
AT TOP PROD. INTERVAL: None
AT TOTAL DEPTH: 210.39' N53°17'53"E of surface

5. LEASE
Federal Lease No. OR 13994
6. IF INDIAN, ALLOTTEE OR TRIBE NAME
7. UNIT AGREEMENT NAME
8. FARM OR LEASE NAME
Federal Lease No. OR 13994
9. WELL NO.
7A
10. FIELD OR WILDCAT NAME
Old Maid Flat
11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
12. COUNTY OR PARISH: Clackamas
13. STATE: Oregon
14. API NO.
None
15. ELEVATIONS (SHOW DF, KDB, AND WD)
Ground Level

16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

REQUEST FOR APPROVAL TO:		SUBSEQUENT REPORT OF:
TEST WATER SHUT-OFF	☐	☐
FRACTURE TREAT	☐	☐
SHOOT OR ACIDIZE	☐	☐
REPAIR WELL	☐	☐
PULL OR ALTER CASING	☐	☐
MULTIPLE COMPLETE	☐	☐
CHANGE ZONES	☐	☐
ABANDON*	☒	☐
(other) Completion as Observation Hole	X	

(NOTE: Report results of multiple completion or zone change on Form 9-330.)

17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)*

A. Completion: As Observation Well (Refer Fig. I and II.)
1. Conductor Pipe: A 24" hole was drilled from ground level to 96.5', 18" O.D. x 3/8" wall conductor was set at 96.5' and cemented to the bottom of the cellar with 180 ft^3 Class "C" Neat cement from 96.5' - 20' + 162 ft^3 of Redi-Mix grout from 20' - 6.5' ground level.
2. Surface Pipe: A 14-3/4" hole was drilled from 96.5' to 1190', 10-3/4", 40.5#/ft., ST&C casing was cemented from 1190' to bottom of cellar with 600 ft^3 light-weight + 400 ft^3 Class "G" + 2% $CaCl_2$.

Proposed Abandonment: In Aug. 1981, proposed to permanently abandon OMF #7A as follows:
1. For the aquifer between 1460' and 1500'.
a. A 240' cement plug will be placed from 1360' to 1600'.

Subsurface Safety Valve: Manu. and Type _____ Set @ _____ Ft.

18. I hereby certify that the foregoing is true and correct

SIGNED Gaylord F. Rogers TITLE Staff Supervisor DATE 12/2/80

(This space for Federal or State office use)

APPROVED BY T. A. Shelton TITLE Dist. Super. USGS DATE Dec. 4, 1980
CONDITIONS OF APPROVAL, IF ANY:

*See Instructions on Reverse Side

Instructions

General: This form is designed for submitting proposals to perform certain well operations, and reports of such operations when completed, as indicated, on Federal and Indian lands pursuant to applicable Federal law and regulations, and, if approved or accepted by any State, on all lands in such State, pursuant to applicable State law and regulations. Any necessary special instructions concerning the use of this form and the number of copies to be submitted, particularly with regard to local, area, or regional procedures and practices, either are shown below or will be issued by, or may be obtained from, the local Federal and/or State office.

Item 4: If there are no applicable State requirements, locations on Federal or Indian land should be described in accordance with Federal requirements. Consult local State or Federal office for specific instructions.

Item 17: Proposals to abandon a well and subsequent reports of abandonment should include such special information as is required by local Federal and/or State offices. In addition, such proposals and reports should include reasons for the abandonment; data on any former or present productive zones, or other zones with present significant fluid contents not sealed off by cement or otherwise; depths (top and bottom) and method of placement of cement plugs; mud or other material placed below, between and above plugs; amount; size, method of parting of any casing, liner or tubing pulled and the depth to top of any left in the hole; method of closing top of well; and date well site conditioned for final inspection looking to approval of the abandonment.

GPO : 1976 O - 214-149

2. For the base of the surface pipe, a 200' cement plug will be set from 1090' to 1290'.

3. For the top of the surface pipe, a 50' cement plug will be set from 6' ground level to 56' ground level.

4. A steel plate will be welded on to the 10-3/4" surface casing at 6' ground level, the steel cellar removed and cellar backfilled with native material.

NOTE: Reference letter from DOE/NV, J. N. Fiore, to Ted Hudson, U. S. Geological Survey, dtd. 10-15-80. The operational procedures during P&A and final site disposition measures will be in accordance with stipulations of EA #151-80, dated June 25, 1980, which include:

a. Removal of all fluids (anticipated to consist of about 2,000 gal. of fresh water displaced by cement plugs) for dispersal along the access road or the nearby rock quarry.

b. Removal of culverts at the Sandy River and Ramona Creek crossings.

c. Construction of erosion control ditches and water bars along the dirt access road.

d. Contouring the cleared area to achieve a near natural drainage pattern.

e. Reseeding all disturbed areas in accordance with USFS direction.

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