

GLD1631

COMPLETION REPORT

GEOHERMAL EXPLORATORY WELL S-87-1

Sulphurdale, Utah

For

Mother Earth Industries, Inc.
7350 E. Evans, Suite B
Scottsdale, Arizona 85258



GEOHERMAL MANAGEMENT Co.

P.O. Box 2980 Evergreen, CO. 80439-2980

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Prepared By
Geothermal Management Company
P.O. Box 2980
Evergreen, Colorado 80439

October 1987

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COMPLETION REPORT FOR S-87-1
Sulphurdale, Utah

I. ABSTRACT

A geothermal exploratory "slim hole" designated S-87-1 was drilled on Mother Earth Industries, Inc. Federal Geothermal Lease Number U29557 between the dates of June 28 and July 15, 1987. The well is 2207 ft. south and 1682 ft. east of the northwest corner of Section 7, T26S, R6W, SLB&M.

The well penetrated highly fractured rocks of the upper and lower portions of the Three Creeks Tuff member of the Sullion Canyon Volcanic series (Moore and Samberg, 1979). Significant flows of mixed thermal and non-thermal waters were encountered at a depth of 821 feet, however the well produced neither steam nor gas despite occurrences of partial and total lost circulation in numerous fractured zones.

Though the well was drilled to a total depth of 1175.5 feet, it was plugged back to 960 feet using sand, gravel, gel, and cement. This was done in order to stop the perceived movement of cool waters from S-87-1 into the nearby production well 34-7B as evidenced by increases in the conductivity of the 34-7B condensate.

The prime contractor for the well was Sierra Drilling Company, Salina, Utah; the drilling plan was designed by William Jackson of Salt Lake City, Utah; surveys were done by Sunrise Engineering, Inc. of Fillmore, Utah; Safety Services were provided by Bell Safety of Evanston, Wyoming; wellsite geological supervision was by Geothermal Management Company of Evergreen, Colorado; plugging was directed by Robert Nicholson of Henderson, Nevada; petrographic examination of drill cuttings was done by Joseph Moore of Salt Lake City, Utah. All other activities were conducted by Mother Earth Industries, Inc.

This completion report is submitted in compliance with 43 CFR 3360 and GPO Order No. 5. Also submitted is USGS Form 9-1960 appropriately completed.

II. LOCATION

This report pertains to MEI exploratory slim hole S-87-1 located near Sulphurdale, in Beaver County, Utah within the Cove Fort-Sulphurdale KGRA.

Specifically, the well is 2207 feet south and 1682 feet east of the northwest corner of Section 7, T26S, R6W, SLB&M, and 140 feet N61E of MEI's production well 34-7E (Lady Linda) on Federal Geothermal Lease No. U29557.

Figure 1 depicts the location of the well relative to the section corner; Figure 1a is a topographic map of the drilling area, while Plate I (in the pocket) is a survey plat of the entire MEI production area. Following Figure 1a is a letter of commendation from the U.S. Bureau of Land Management to MEI with regard to MEI's concern and contributions in the management of public lands as evidenced by their reclamation of drill sites.

III. WELL DRILLING AND CONSTRUCTION HISTORY

In order to cost-effectively search for extensions of the dry steam geothermal resource discovered in wells 34-7A and 34-7B, exploratory well S-87-1 was drilled in a "slim hole" configuration as follows:

On June 26, 1987, 13.375" conductor casing was set to 10 feet below ground level and Redi-Mix cemented. Beginning on June 28, a 9.875" hole was drilled to 254 feet at which depth 254 feet of 7" 20#/ft. J55, ST&C casing was landed and cemented in place with full returns of cement to the surface. The well was then drilled to 930 feet using 6.25" bits and weighted drilling mud.

Due to significant lost circulation below 820 feet, an attempt to drill with air was made from 930 to 940 feet, however it was not possible to dry out the well and mud drilling was resumed from 940 feet to 1172.5 feet though most of this interval was drilled "blind", that is, without returns of the drilling fluid. From 1172.5 to total depth of 1175.5 the well was drilled blind with air and foam.

Conductivity values steam condensate measurement well 34-7B suggested the possibility of communication between the lower portion of S-87-1 and 34-7B. Because any flow of water into a dry steam well is highly undesirable, S-87-1 was plugged back to 960 feet using a sand, gravel and gel mixture from 1175.5 to 1060 feet and cement from 1060 to 960 feet. After S-87-1 was plugged and shut in on July 15, 1987, condensate conductivities at 34-7B returned to their original values.

A drilling history, describing daily events between June 28 and July 15, 1987, accompanies this report as Appendix A. Figure 2 is a profile of the well as completed; Figure 3 is a drilling curve showing the rate of drilling progress, and Figure 4 shows the Blowout Preventer stack used on the 7" casing. Appendix B, attached, is MEI's basic drilling procedure developed for slim exploratory wells.

IV. WELL TESTING

No full scale well tests were conducted on S-27-1, however on July 10, at a depth of 930 feet, a decision was made to change from mud drilling to air drilling following penetration of numerous closely spaced fracture zones and continuous lost circulation. When the change was made, the drill pipe was lowered into the well and maximum air pressure (350 psig) was applied so as to lift the mud out of the hole and empty the well. Though some mud was successfully blown out, it was not possible to dry out the well completely because of constant water inflows.

Under air pressure, the well produced, for about .5 hour, an estimated flow of 200 GPM of 92F water having a pH of 7.0 and a conductivity of 1500 micromhos. This suggests a mixture of 900 micromhos non-thermal water and geothermal waters typically having conductivities in excess of 1900 micromhos.

On July 15, after the well had been plugged back to 960 feet with sand, gravel, gel and cement, another air-lift cleanout was attempted. This time the well produced between 15 and 60 GPM for about three hours without fully cleaning up the well. No further tests were conducted and the well was shut in pending further evaluation.

V. GEOLOGY

The Cove Fort-Sulphurdale region, in southwestern Utah, comprises folded and faulted sedimentary and metasedimentary rocks of Paleozoic to Mesozoic age that are overlain, sequentially, by Oligocene to Miocene age ash-flow tuffs and Quaternary basalts. All of the rocks except the basalts have been intruded locally by Miocene quartz monzonite and/or latite porphyry stocks, sills, and dikes.

The rocks penetrated in S-87-1 consist entirely of lavas, breccias and ash-flow tuffs designated as the Three Creeks Tuff Member of the Bullion Canyon Volcanics (one of the oldest of the volcanic units). The Three Creeks Tuff has three distinct zones: an upper and a lower zone of red to grey densely welded tuff and a middle zone of poorly welded white tuff. Only the lower zone of the Three Creeks Tuff has been mapped in the area of interest.

This lowermost zone of the Three Creeks Tuff has been further subdivided into two cooling units. The upper unit is characterized by euhedral plates of biotite up to several millimeters wide and euhedral (beta morphology) quartz crystals while the rocks of the lower cooling unit are mineralogically the same but much finer grained. Rocks representing both units are found in S-87-1, with the contact at 780 feet.

Alteration of the S-87-1 rocks is predominantly of the weak to moderate argillic type. This alteration includes partial to complete replacement of feldspar phenocrysts by clay and/or carbonate minerals, alteration of hornblende to chlorite and carbonate and minor alteration of biotite to hematite, clay, and in more intensely altered spots, pyrite. Intense silicification was noted in two sections within S-87-1. Within these sections, the rocks were also severely brecciated thus suggesting that the breakage and the silica are indications of fault loci.

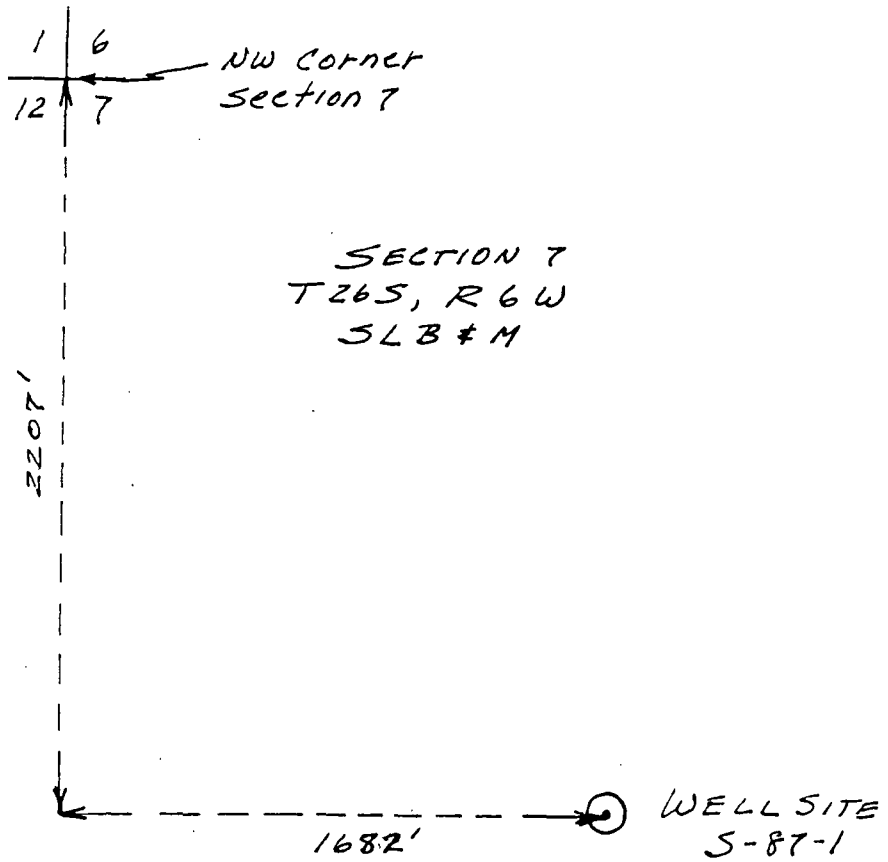
Hydrothermal alteration of the rocks in S-87-1 is significantly less intense than that encountered in 34-7A, 34-7B, or in Union Oil Company's 42-7. This indicates that S-87-1 may have been drilled close to but in the footwall of the fault(s) carrying the geothermal steam resource. It is possible that fault conduits subparallel and related to the steam conduits may have been penetrated below 1050 feet thus accounting for the recorded evidence of fluid communication between the bottom of S-87-1 and 34-7B.

Attached, as Appendix C, is a lithologic description of drill cuttings from this well together with some interpretive comments.

VI. PERMITS

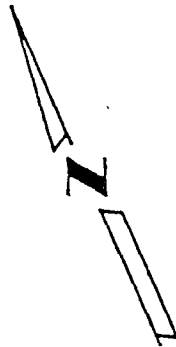
As required by law, MEI applied for and received permits for drilling well S-87-1 from the U.S. Bureau of Land Management and the Utah Division of Water Resources. Also as required, archeological clearance of the site was obtained via the BLM's archeological consultant firm of Intersearch.

Attached to this report as Appendices D-1 through D-6 are copies of permits and clearances received and of correspondence related to permit acquisition and compliance.



1" = 600'

FIGURE 1
LOCATION MAP
S-87-1



SCALE: 1"=30'

REVISIONS			SUNRISE INDUSTRIES	DESIGNED	CHECKED	DRAWN
NO	DATE	BY		DATE	DRAWING NO	EDR
1			9-11-87			
2						
3						

CONSULTING ENGINEERS
Fillmore, Utah

S 87-1

SCALE
1"=30'

SHEET NO
2 OF 3



Re: 587-1 + 587-4 location

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
WARM SPRINGS RESOURCE AREA
15 EAST 500 No.
P. O. BOX 778
FILLMORE, UTAH 84631

IN REPLY
REFER TO:

3240
U-057

October 13, 1987

Mother Earth Industries, Inc.
3761 South 700 East
Suite 200
Salt Lake City, Utah 84106

Gentlemen:

On September 21, 1987, Toby Manzanaras, Geologist, from the BLM Warm Springs Resource Area held an on-site inspection of previous disturbed areas that need reclamation at the MEI Geothermal Project at Cove Fort, Utah.

Toby has reported to this office that the efforts being taken by Mr. Mike Fry in the upkeep, and reclamation work at MEI's Cove Fort Project is beginning to show as an outstanding endeavor. All the drill holes drilled in the past were visited during the inspection and the reclamation work discussed. It was agreed by both parties as to what areas at the drill sites need to be contoured, cleaned and reseeded. The whole geothermal production complex has never looked cleaner, as well kept and orderly as it is now.

The BLM Warm Springs Resource Area extends its compliments and thanks to MEI and its personnel, particularly Mr. Mike Fry, for their concern and contribution in the management of the public lands.

Sincerely,

Thomas A. Terry

for Dave Henderson
Area Manager

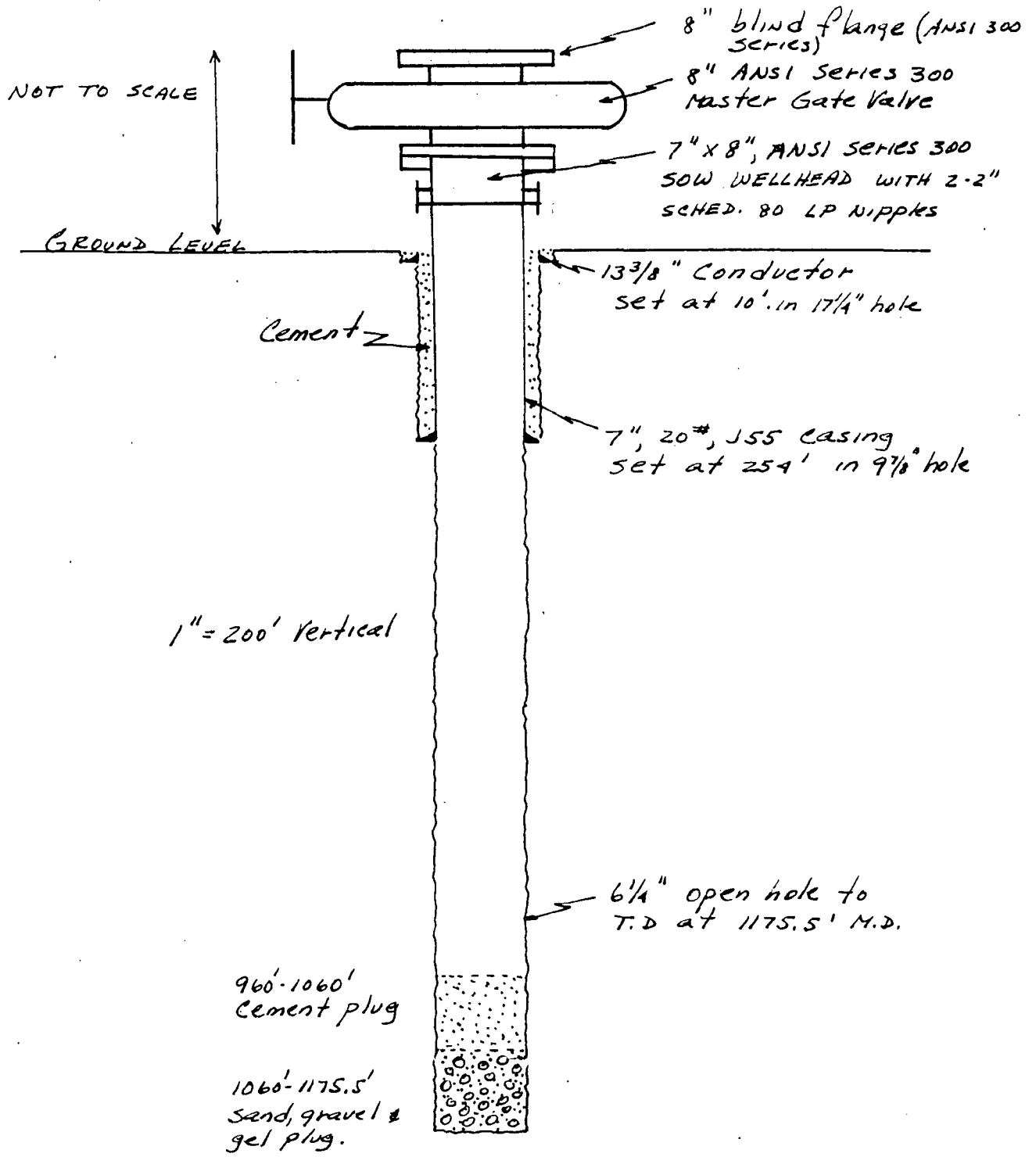


FIGURE 2
 WELL PROFILE
 S-87-1

FOR: MEI
 By: GWH
 Geothermal
 Mgmt. Co

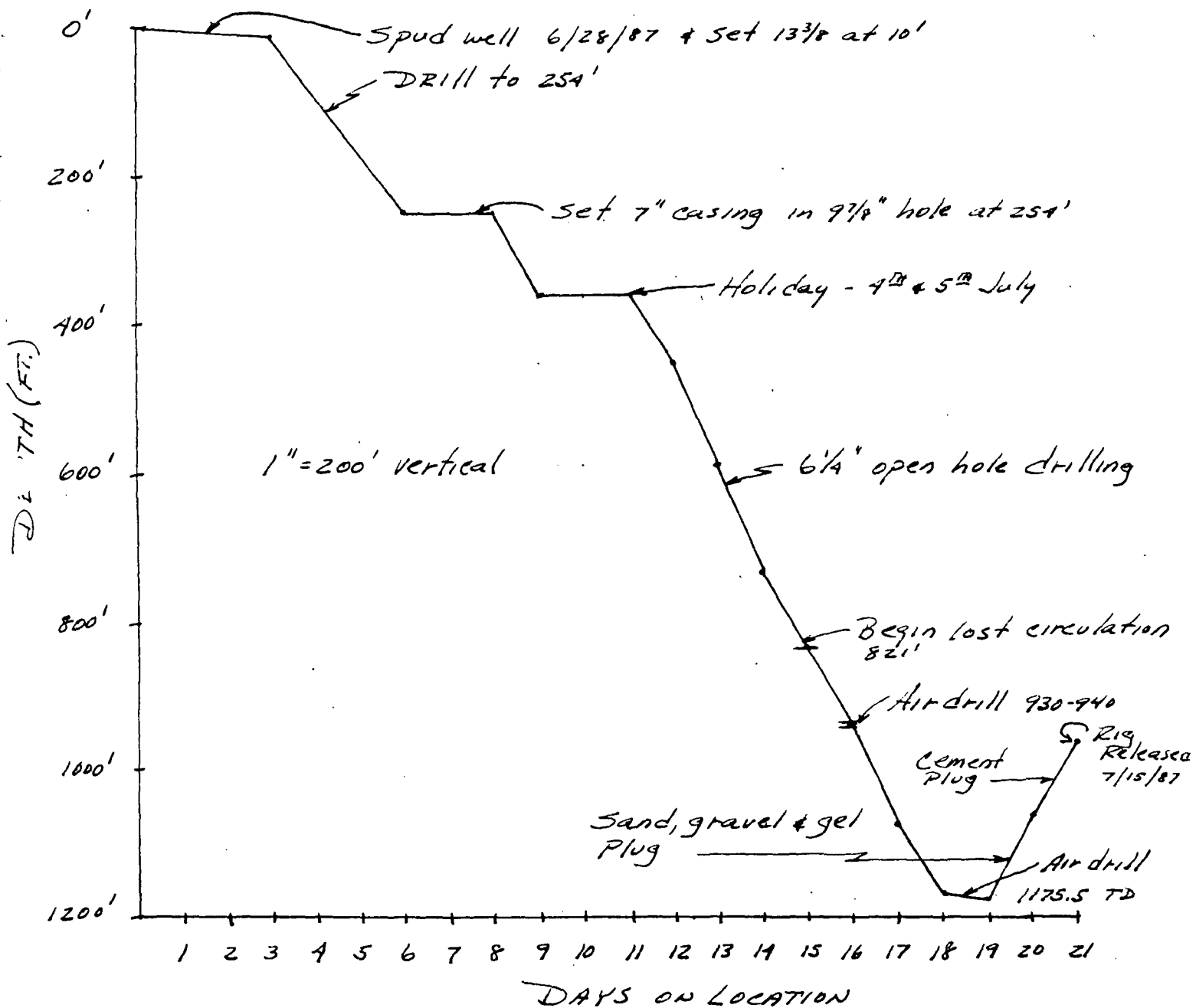


FIGURE 3
 DRILLING CURVE
 S-87-1

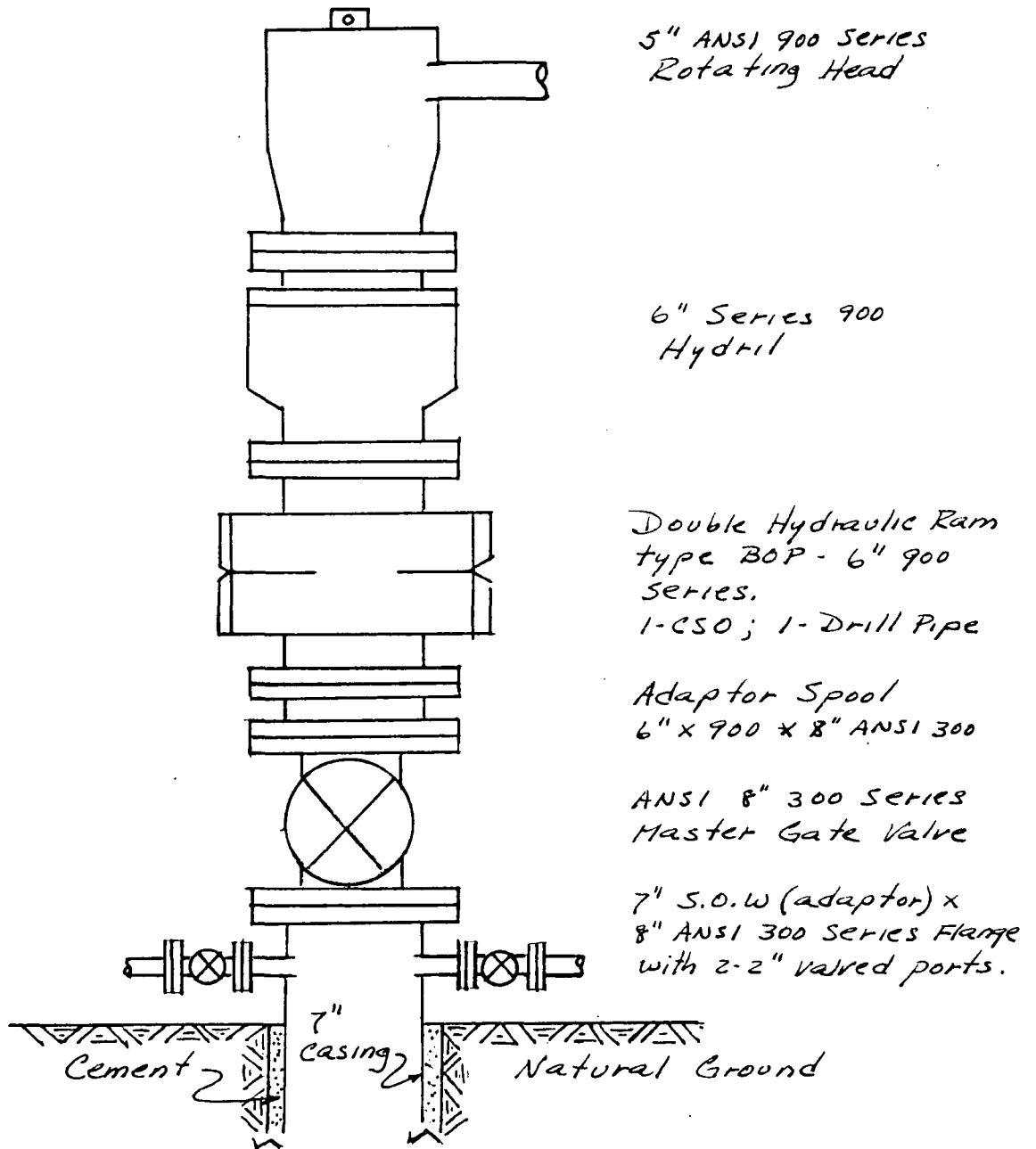


FIGURE 4
7" BLOWOUT PREVENTER STACK

S-87-1

DRILLING HISTORY

MOTHER EARTH INDUSTRIES, INC. WELL 8-87-1 COVE FORT, UTAH

0800-1345	Build flow line, cut off casing, rig for mud drilling, weld holes in mud pit. Mix mud.
1345-1415	RH, drill 9 7/8" hole for 7" surface casing.
1415-1645	Haul water, mix more mud, losing circulation while drilling 6al (boulders, sand and gravel).
1645-2000	Slow drilling in loose boulders to 20'.
6-29-87	
0800-1945	Drill ahead at 1/hr. through boulders and cobbles to 31'. Drilling speed increases in sand, clay and some cobbles to 115'.
1945-2030	Mud wt. = 8.8-9.3, vis=32-37, Tl=72, To=73. FOOH, replace air valve, BH @ 125'.
6-30-87	
0800-0900	RH, 4.5' fill. Increase polymer in mud. Mud wt. = 9.5.
0900-1245	Drilling cobbles, sand and clay to 140'. Solid rock at 140'.
1245-1545	Has meeting for all hands with Bell Safety representative. All passed certification.
1545-2030	Drilling ahead at 8-10/hr. in volcanic formation. Mud wt. = 9.4, vis. = 34, Tl = 71, To = 74, BH @ 220'.
7-1-87	
0730-1200	Drill ahead 220-254' in grey volcanic rock with quartz stringers. Tl=75, Added water to thin mud.
1200-1230	Circulate and condition mud prior to casing.
1230-1330	FOOH
1330-1500	Rig up to run casing. Set 254' of 7" 20#J55, ST&C casing at 254'.
1500-1605	Mix and pump 100 sacks class 6 cement. Full returns to surface. Bump ping on shoe.
1605-1930	WOC. Clean up pumps, pits, and equipment. Unload BOP rental equipment.
7-2-87	
0700-0800	Unload more BOP equipment. WOC.
0800-1530	Cut off 7" casing, weld on starter flange, Bolt on 8" Gate Valve and cross-over spool. Add 2" nipples, choke and kill lines. Nipple up double raw BOP and rotating head. Weld on short flow line. Hook up accumulator.

1530-1734 Testing BOP to 500 PSI with Toby Manzanares of Fillmore BLM as witness. 1st test NG. Small leak at flange of 2" choke line. 2nd test lost 60 PSI at fitting. 3rd test OK, (lost 40 PSI). Blind Rams OK at 405 PSI. Test approved by Manzanares.

7-3-87 Begin 24 hour operations.

0000-0300 RIH. Tag cement at 140'. Drill out 114' of cement.

0300-0330 Clean out mud pit.

0330-0430 Mix fresh mud.

0430-0730 Drill ahead in hard grey volcanic rock. Mud wt.=8.4, vis=30.

0730-0800 Stopped drilling to taper shoulder on Kelly saver sub.

0900-2100 Drill ahead to 360' in predominantly hard volcanic rock. Drilling rate 8-9'/hr. Some softer zones (faults?) 1-2' wide that drill at 10-15'/hr. Mud wt.=8.1-8.7, vis=32-33. Water and detergent added. Air noted in mud.

2100 PDDH. SD for July 4th holiday.

7-4-87 Holiday

7-5-87 Holiday

7-6-87

0000-0030 Construct a flat slip to use with DC.

0030-0230 Continue PDDH, change bit, new rotating head rubber. RIH.

0230-2315 Drill ahead 360-453' in grey volcanic rock. Drilling rates 3 - 7'/hr.. Mud wt.=7.6-8.8, vis= 27-37, Mud Temps.: 360'- Ti=78, To=81; 400'- Ti=72, To=79; 415'- Ti=75, To=82; 420'- Ti=68, To=82; 430'- Ti=83, To=84; 440'- Ti=82, To=90; 450'- Ti=91, To=92.

0545 H₂S drill.

2315-2400 PDDH. Change bit. Teeth worn and 1 bad cone.

7-7-87

0000-0030 RIH. Mud wt.=8.7, vis=30, Drilling rate is 7.5-8.5'/hr.

0030-2000 Drilling ahead 453-587'. In hard volcanic rock with grey to green to blue-grey chips. Drilling rate averages 6-12'/hr. Mud Temps.: 460'- Ti=81, To=82; 480'- Ti=88, To=90; 500'- Ti=82, To=89; 520'- Ti=90, To=95; 530'- Ti=88, To=96; 540'- Ti=92, To=96; 560'- Ti=91, To=99.

2000-2115 Fix catwalk.

2115-2130 PDDH to change bit.

2130-2400 RIM. Ream with new 6 1/4" soft formation
 milled tooth bit to BH at 587'. Mud wt.=
 9.2, vis=32.

7-8-87 0000-1715 Drill ahead 587-737'. Soft zones 603-604',
 607', fracture zone 632-634'. Drilling rate
 8-9 1/4 hr. 682-689 is gouge zone. Lost 2 bbls
 mud. Mud pump pressure 125-150 PSI. Mud wt.=
 9.3-9.6, vis=32-34. Mud temps.: 587' - 11=98,
 10=99; 600' - 11=98, 10=99; 620' - 11=95, 10=
 98; 640' - 11=97, 10=100; 660' - 11=98, 10=100,
 air=68; 680' - 11=99, 10=100, air=81; 700' -
 11=102, 10=108, air=85; 720' - 11=109, 10=109,
 air=85.

1715-1745 P.O.H. Change bit. Cone failed.
 Mix new mud.
 2030-2400 Nipple down BOP, cut flange off 7" casing,
 shorten 7" casing, re weld flange. Hydril
 arrived 2215. Install Hydril and nipple up
 BOP.

7-9-87 0000-0230 Finish nipping up BOP and rotating head.
 Adjust position of mud pit and raise the rig
 to fit new stack.
 RIM. Hole under gauge at 697'.
 0415-0600 Test BOP to 500 PSI. Pressure bleeding off
 down-hole. Ream 697-737'. 11=87, 10=92.
 0600-0645 Drill ahead. 11=97, 10=100, air=67.
 0645-0715 Refuel and prime rig.
 0715-0930 Drill ahead to 763'. 11=97, 10=100, air=77.
 0830-1130 SD to get BLM and USFS approval of new stack
 and permission to drill without another BLM
 witness of a BOP test. OK received from Don
 Pendleton at 1130. Written permission to be
 mailed to MEI.

1130-1345 Drilling ahead 763-774' at 8.5 1/4 hr. 11=92,
 10=98, air=80. Mud wt.=8.6, vis=32.
 1345-1400 Wiper run.
 1400-1630 P.O.H. Changed bit. RIM with new 6 1/4" button
 bit #V537. Ream 760-774'. Bottoms-up temp.=101.
 Drilling ahead 774-838'. Very rough 779-785.5.
 Fracture at 786'. Lost 2 bbls mud 800-810'. LC
 at 821'. Continuous circulation loss at 50 BPH
 to 826'. Lost 12 bbls at 826'. Very broken
 formation to 838'.

2130-2400 Mixing mud continuously to try to keep up with
 LC. Lost 45 bbls 821-838'. Mud wt.=8.6-8.8,
 vis=32-35. Mud temps.: 780' - 11=91, 10=99,
 air=80; 800' - 11=93, 10=101, air=76; 820' -
 11=90, 10=104, air=68.

7-10-87

0000-1045 Drilling ahead 838-930'. Losing about 6 bbls per hr. (Lost 42 bbls since midnite). Adding 5 BPH water. Formation hard. Drilling rate 7.5' per hr. 869-871 adding 10 BPH water. 874-881 increased mud loss. 883-886 decreased mud loss. Drilling rate up to 15'/hr. Lost 6 bbls at 920 when making connection. Regained some circulation.

1045-1200 Check for H₂S. Negative. Haul water and mix mud with BOP closed. Open BOP and pump mud. Check again for H₂S. Negative. Lost 70% of water added. (325 bbls pumped into 6.25" hole). Decide to change to air drilling.

1200-1600 Move mud pit, nipple down short flow line. MU new long blooie line and support stand. POOH to 700'. Blow hole clean of mud.

1600-1645 Drill ahead 930-940 with air.

1645-2030 Attempt to blow dry hole with air. Well produced est. 250-300 GPM 92F water with Conductivity of 1500 mmhos. Air at 650 CFM, 100 PSI. Unable to dry out hole.

2030-2130 SD pending decision regarding return to mud. POOH to 280'. Find SWL at 280'.

2130-2400 Replace mud pit and short flow line. Haul water and mix mud plus LCM. Mud statistics 838-940': Mud wt.=8.6, vis=36-55. Temps.: 840'- Ti=94, To=99, air=64; 860'- Ti=81, To=103; 880'- Ti=84, To=103, air=66; 900'- Ti=85, To=102; 920'- Ti=82, To=92, air=66.

7-11-87

0000-0400 Haul water and mix mud and LCM (Hulls, cedar shavings, cellophane, paper pulp). Pump LCM plug from 740'. Lost 26 bbls, then regained circulation. Circulate mud for 30 minutes. Change rotating head rubber.

0400-0530 RIH. Mud wt.=8.8, vis=34, Ti=87, To=91 air=59.

0530-1000 Drill ahead 940-967'. LC at 4 BPH. Mud wt.=8.3, vis=42. Complete LC at 966'. Drill blind to 967. POOH to 800'.

1000-1245 Haul water, mix mud and LCM.

1245-1745 Drilling ahead 967-1016' with constant LC at 10 BPH average rate. Mud wt.=8.6, vis=45, Ti=83, To=87.

1745-1915 Haul water and mix mud.

1915-2400 Drilling ahead 1016-1076'. Very hard to keep mud pit full. Finally ran out of water. Mud temps.: 1040'- Ti=87, To=91, 1060'- To=95.

POOH to 900. Haul water and fill mud pit.
 Unload new pallet of mud and mix with LCM.
 RIH. Drill ahead 1076-1118. Losing 20-25 BPH.
 Hard but fractured volcanic rock. 6-8" void
 at 1103. No extra LC. Void at 1112-1113.
 Lost 50% of circulation in void but regained
 it. Lost all circulation at 1118. Mud temps:
 1080' - 11=86; 10=90; air=50; 1100' - 11=92;
 10=95; air=50.
 Wait for mud from Wilford. Haul water and mix
 mud and LCM. Pumped away 150 bbls without
 returns. Used up all LCM on hand. Vis=180;
 POOH to 700. Pressure pipe with air to seek
 SML. Pressure 50 PSI=115. of water above and
 of drill pipe. SML at 585.
 Drill ahead blind 1118-1169. Formation very
 broken. Drilling rate 8/hr. Gradually thin
 mud until drilling with pure water at 1140.
 Hole staying clean and open. Large fracture
 at 1156. Hydraulics holding entire drill
 string weight. 1165' very broken. 5000-
 10000 lbs. on bit.
 H&S safety meeting for shift crew.
 7-13-87

0000-0430
 POOH to 900. Haul water and fill mud pit.
 Unload new pallet of mud and mix with LCM.
 RIH. Drill ahead 1076-1118. Losing 20-25 BPH.
 Hard but fractured volcanic rock. 6-8" void
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 7-13-87

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 Hard but fractured volcanic rock. 6-8" void
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 H&S safety meeting for shift crew.
 7-13-87

0945-1230
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 10000 lbs. on bit.
 H&S safety meeting for shift crew.
 7-13-87

1230-1330
 POOH to 700. Pressure pipe with air to seek
 SML. Pressure 50 PSI=115. of water above and
 of drill pipe. SML at 585.
 Drill ahead blind 1118-1169. Formation very
 broken. Drilling rate 8/hr. Gradually thin
 mud until drilling with pure water at 1140.
 Hole staying clean and open. Large fracture
 at 1156. Hydraulics holding entire drill
 string weight. 1165' very broken. 5000-
 10000 lbs. on bit.
 H&S safety meeting for shift crew.
 7-13-87

1330-2400
 Drill ahead blind 1118-1169. Formation very
 broken. Drilling rate 8/hr. Gradually thin
 mud until drilling with pure water at 1140.
 Hole staying clean and open. Large fracture
 at 1156. Hydraulics holding entire drill
 string weight. 1165' very broken. 5000-
 10000 lbs. on bit.
 H&S safety meeting for shift crew.
 7-13-87

0945-1330
 Drilling with very little progress.
 H&S alarm sounded. 30 PPM at bioloie line
 detector. Dissipated rapidly.
 Drilling with air and foam. 1172.5-1175.5.
 Air pressure 85-125 PSI. No returns. Not able
 to unload hole; therefore not possible for
 steam at 50 PSI get into well.
 SD. Plan to plug back to 960 with gravelly sand
 and barite, and cement. Purpose is to isolate
 the upper water producing zone from the zone
 that produces steam at 34-7A (Linda) and thus
 to prevent water contamination of the steam.
 Decision prompted by the increase of the
 Conductivity of the 34-7A condensate from
 40-60 mhos to 210 mhos this morning. This is
 interpreted to indicate communication between
 S-97-1 and 34-7A.

7-14-87

0800-1100 Rig cable so as to permit measurement of SWL. MU tremie pipe for emplacement of sand and gravel.

1100-1200 RIH with cable. Find SWL at 260-270 feet.

1200-1800 Use tremie to put 37 five gallon buckets of gravel (-.5") in hole. RIH. Tag gravel at 1080 feet. Pump in mixture of sand and gel followed by 14 buckets of sand and gravel. RIH. Tag fill at 1070 feet.

7-15-87

0615-1030 Prepare to cement. Wait on delivery. Pump fresh water slug into well.

1030-1100 Pump enough cement for 100 feet of fill. Follow with fresh water slug.

1100-1500 WDC, clean up equipment.

1500-1930 RIH. Tag cement at 960'. Unload water from well with up to 140 PSI air pressure.

1930-2000 Pull pipe up into casing.

7-16-87

0830-0930 RIH to 960'. Tag cement. SWL at 260-270'.

0930-1230 Run drift surveys.

1230-1330 PDDH and LD pipe.

1330-1530 Clean up and SD until further notice.

s871drng.hst

EXHIBIT A

DRILLING PROCEDURE

Re: Geothermal Operations
Mother Earth Industries, Inc.
Drilling Procedure
Cove Fort Strat Tests
Beaver County, Utah

Originating
Office: Mother Earth Industries, Inc
Geothermal Operations
Salt Lake City, Utah

Date: March 27, 1987

By: Bill Jackson
(201) 254-2565 (central) *(central)*
(102) 757-5443 (Mob. Ph. w/ Tracker & Skumbert)

OBJECT

Drill a 1500' geothermal exploratory hole for the purpose of obtaining data which can be used as part of long term development at Cove Fort. The drilling procedure will be to drill a 9 7/8" hole to - 250' and set and cement 7" casing; and drill a 6 1/4" hole to T.D.. Enclosed is the detailed Drilling Procedure with attached Programs and Attachments.

HIGGINSON-BARNETT, CONSULTANTS

106 West 500 South Suite 101
BOUNTIFUL, UTAH 84010
(801) 292-4662

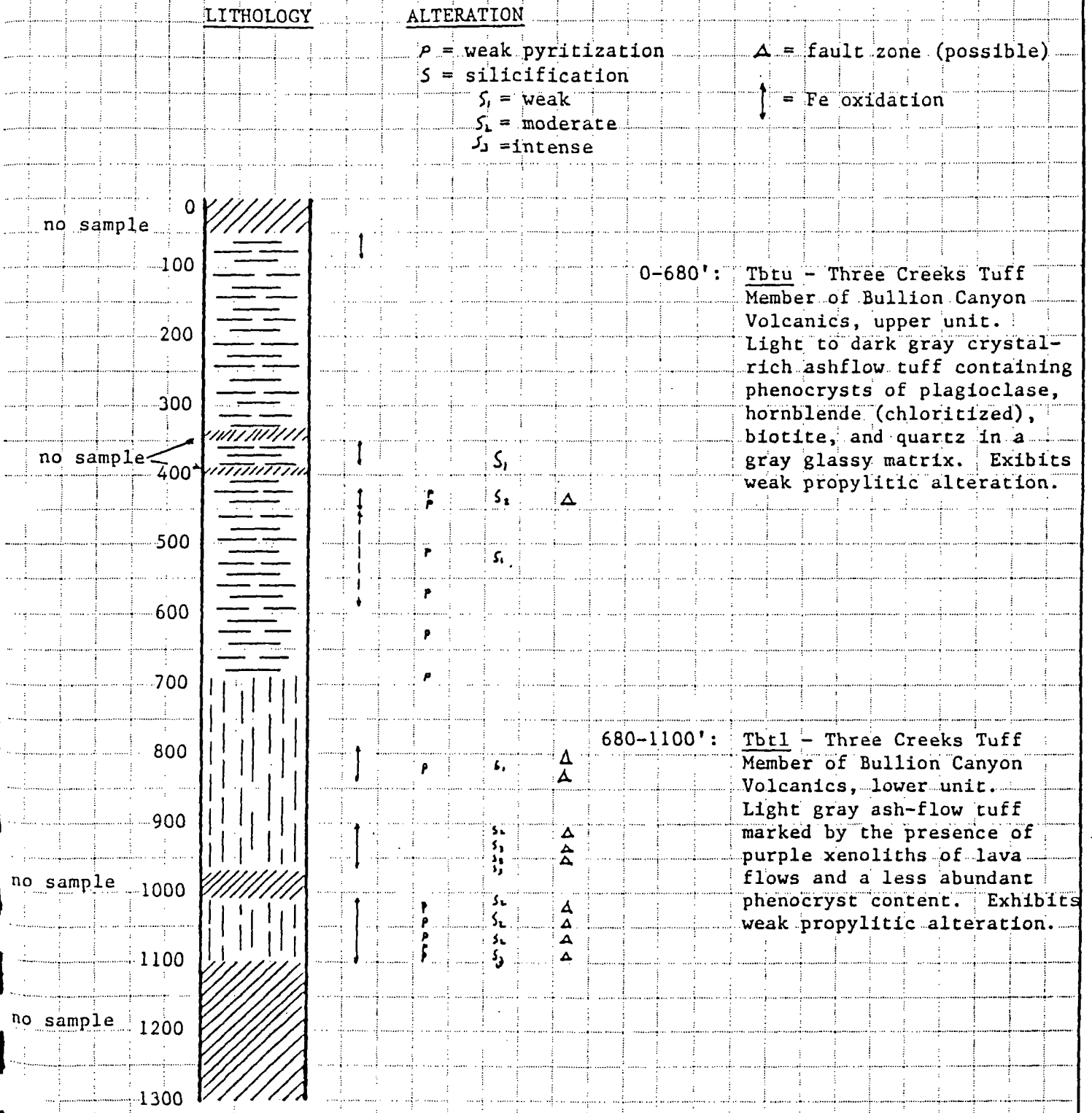
SHEET NO. 1 OF 1

CALCULATED BY KB & DAB DATE 3-9-85

CHECKED BY JAB DATE 3-11-85

SCALE 1"=400"

FIGURE #20



COVE FORT STRAT TEST

Well Plan Overview

Well: Cove Fort Strat Test
 Location: Beaver County, Utah

Depth	Hole Size	Mud System	Casing ¹	Cement ²	BOP Stack ³
0 ±250'	9 7/8"	Spud Mud Gel - Water	7"	Cement Slurry: Class "G" or "H" Cement	Reference Attachment
1500'	6 1/4"	Air, Foam, or Gel/H ₂ O/Polymer			

¹ 7" J-55 20# ST & C 8 rd. casing @ 350 degrees F;
 Burst= 2992 psi, Collapse= 1816 psi, Tension= 187,000#

² All Cement Jobs: TOC= ground level; Volume calculated with
50% to 100% excess in open hole.

³ All testing pursuant to GRO Order 2 with advance notice to
 BLM, Richfield, Utah, for witnessing.

PERTINENT DATA

Proposed TD : 1500'

Location :

Datum : All depths refer to KKB, unless otherwise indicated. KB height should be measured and reported on the first day of drilling.

Rig : Sierra Drilling Rig #

Estimated Cost : \$49,100

AFE # :

Objective : To obtain geological and temperature data.

Casing Program : +250' 7" J-55 20% ST&C 8rd. range 2 Surface casing.

Anticipated Problems :

1. Lost circulation anywhere below 1000'.
2. Possible H₂S (reference "H₂S Contingency Plan").

Pre-Spud Work :

1. Prepare location, build road, and dig reserve pit.
2. Modify 8" Starter Flange to fit 7" casing. The ID of the starter flange is 8.75". This must be done in such a way that collars will not hang on the edge of the starter flange as they enter the 7" casing, i. e., the top of the reducer must be beveled. It would also be desirable that the 7" casing enter the reducer only 4" and encounter a beveled reduction, so that it will sit level on top of the cut-off 7" casing while it is being welded (it needs to be beveled so that the 7" casing can be welded to it on top and the weld will not restrict the ID of the casing.) Be careful that the starter flange is welded perfectly true onto the reducer, so that the BOP stack will sit level. A 1/4" hole needs to be drilled 2" up from the bottom of the reducer so that a grease fitting can be installed to facilitate testing between the upper and lower welds. This hole should be threaded for 1/4" NPT. It would also be desirable for the reducer to be 14" in length so that 4" could be inserted into the starter flange, 4" could be slipped over the 7" casing, and this would leave 6" in the center. This would allow the boring of two 2" holes located

in the center of the reducer and spaced 180 degrees from each other. High pressure 2" LP collars could then be welded to the reducer over the 2" holes. These collars must have a working pressure of at least 1000 psi.. This would call for a reducer 14" in length, OD of 8 5/8", ID of 6 1/2" (bored to 7 1/8" for the bottom 4"), with the top of the 7 1/8" bore and the top of the 6 1/2" bore beveled.

- Environmental :
1. Line reserve pit to prevent seepage.
 2. Contain all drill cuttings and drilling fluids, as well as site drainage, to the reserve pit.
 3. Have H₂S absorbing drilling fluid products on hand (i.e., zinc carbonate and zinc chelate)(Sorb or H₂Less).
 4. If the reserve pit will be maintained for future purposes, then it should be fenced prior to rig release.
 5. Maintain enough fluid on hand (at least two hole volumes) and keep rig pump connected to the kill line during all drilling operations.
 6. Mud Engineer should be available at all times to help monitor for and control any threatened blow-out.
 7. Care should be taken that discharge from the blowout line, while air drilling, is never in the direction of any power lines.

- Notification of Authorities :
- Prior to the following activities:
1. Moving in (1 to 2 days in advance).
 2. Prior to Spudding (24 hours in advance).
 3. Major change in procedure, i.e., casing point (ASAP).
 4. Testing EOPs (24 hour advance notice).
 5. Serious accident/mishap (ASAP)

Notify the following;
State of Utah - Water Rights Division(One of the following);

XXXXXXXXXX	XXXXXXXXXXXX
Gerald Stoker	586-4231
Stanley Green	533-7164

Bureau of Land Management (one of the following);

Don Pendleton	(801) 896-8221
John Branch	896-8221

XXXXXXXXXXXX	XXXXXXXXXX
Forrest Service (one of the following);	
Del Randall	(801) 438-2436
Darwin Jensen	438-2436

Operations Manager : Jay C. Hauth (801) 263-8300 ofc.
268-9369 res.

MOTHER EARTH INDUSTRIES, INC.

COVE FORT STRAT TEST

March 27, 1987

SEQUENCE OF OPERATIONS

1. Prepare location and sump as per design drawings. (Must be oriented so that rig is at least the mast height plus 25' from any powerlines).
2. Move in and rig up rotary drilling rig.
3. Pick up 9 7/8" drilling assembly and drill out using mud. Drill 9 7/8" hole to a total depth of +250', depending on geology. Take directional surveys every 100'. Maintain hole as straight as possible. Maximum deviation at total depth to be 4 degrees. Maximum rate of change to be 1 1/2 degrees per 100'. Monitor flowline mud temperatures every 20 feet. Catch formation samples every 10'.
4. Circulate hole clean. Make wiper trip. Circulate and condition mud to run casing. POOH and lay down 9 7/8" drilling assembly. Rig up to run 7" casing.
5. Run 7" J-55 20% STAC, range 2, 8rd. surface casing to total depth and cement with API class "G" or "H" neat cement.
6. Install 7" X 8" ANSI 300 Series wellhead and 8" ANSI 300 series master gate (working pressure 680 psi at 300 degrees. Test pressure 1100 psi).
7. Nipple up blow out preventer stack and test same to 500 psi. with BLM representative present to witness test.
8. Pick up 6 1/4" drilling assembly and drill out 7" casing with 6 1/4" bit.
9. Drill 6 1/4" hole with air or mud to a total depth of 1500'. Take directional surveys every 100'. Maintain hole as straight as possible. Maximum rate of change to be 1 1/2 degrees per 100'. Monitor flow-line temperatures (both in and out) every 20' and log on Tour Sheet. Run maximum registering thermometers on each survey.
10. Lay down drill pipe and tools, nipple down BOPs, clean up location, rig down, and release rig.

COVE FORT STRAT TEST

March 27, 1987

SEQUENCE OF OPERATIONS

1. Construct location and sump as per attached design drawing.
2. Move in and rig up rotary drilling rig. Survey location with rig in place.
3. Mix spud mud as per attached drilling fluids program.
4. Visually inspect and note on tour sheet whether all drill pipe is white banded, specifying that it meets AAODC API Class II inspection as to the following;
 1. Electromagnetic inspection of tubes (Sconoscope or Scanalog).
 2. Wall thickness and cross sectional area (Ultrasonic or gamma ray).
 3. Tool joint inspection (Electronic or magnetic particle).Also check to see that all drill collar connections have been magnetic particle inspected and that all bottom hole assemblies have been magna-fluxed prior to delivery. Note condition on tour sheet.
5. Make sure 7" casing is on location and in position to run prior to spudding well. Make sure that all casing accessories, wellhead equipment, and circulating head are on hand.
6. Spud well with 9 7/8" bit and drill with mud to +250', depending on geology. Remove thread protectors, clean threads, drift and measure casing while drilling surface hole. Measure KB height and log on tour sheet. After casing point has been selected, drill any additional hole that might be required so that casing can be landed within 1' of bottom, and still space out correctly on surface. Maintain hole as straight as possible while drilling. Take drift shots every 100'. Run maximum registering thermometers on each survey. Maximum angle at total depth to be 4 degrees. Maximum rate of change to be 1 degree per 100'. Monitor and record flow line temperature every 20'. Catch 2 sets of formation samples every 10'.
7. Upon reaching desired depth, circulate and condition mud until shaker screen is clean and viscosity is less than 45 sec/quart. Make wiper trip. Check for fill. If hole is in good condition, circulate bottoms up, POOH, and lay down 9 7/8" drilling assembly. If tight hole was encountered on the wiper trip, then make another wiper trip. It may also be necessary to further condition the mud.
8. Rig up and run 7" casing to total depth (as per attached 7" casing program). Run in hole slowly to avoid breaking down the formation and losing circulation. Circulate past any bridges encountered. Use proper make-up torque on casing. Use a good quality geothermal casing dope on threads.

9. Once casing has been run to total depth, circulate hole clean, while reciprocating casing, with at least two full circulations. Circulate until hole is clean, mud is in good shape, and viscosity of mud is less than 45 sec/quart. Check bottoms up time to be sure that mud is not channeling.
10. When mud is in good shape, cement casing as per attached program. Monitor and record cementation data as per cementation program. Catch cement samples during cementation as requested. Continue to reciprocate casing while pumping cement. Land casing within 1' of bottom. Center casing in rotary table.
11. Wait on cement for 8 hours. (check samples to see if additional time is required). Monitor cement in annulus. If it falls back, bring it back to the surface with 1" pipe.
12. Land and cut off 7" casing. Weld on 7" X 300 SR Starter Flange. Test between welds. Check with level to be sure flange is on correctly. If flange is not equipped with 2" outlets on each side, then install two weld-on collars, two 6" X 2" Sch. 80 LP nipples and two 800 psi. valves below the flange.
13. Make sure that BOP equipment has been inspected by the manufacturer or an authorized agent prior to arrival and that all equipment is proper and in good shape. Nipple up blow out preventer equipment as per attachment. Test 7" casing and blow-out equipment to 500 psi. with BLM representative present to witness test. Log test data and representatives name on Tour Sheet.
14. Trip in hole with 6 1/4" mill tooth bit and tag cement. Log top of cement on Tour Sheet. Drill out baffle plate, cement and float shoe from 7" csg. with spud mud. Drill 10' of formation and then trip to pick up button bit or hammer and hammer bit. If the decision is made to air drill, run float in bit sub and unload mud out of hole with air on the trip back in. If the decision is made to drill with mud, then displace the spud-mud out of hole with the gel/water/polymer system when you reach bottom with the bit. See attached program for mud system.
15. Drill 6 1/4" hole with air, foam, or mud to 1500'. Operate BOP each trip out of hole and log on tour sheet. Maintain hole as straight as possible. Take drift shots every 100'. Run maximum registering thermometers on each survey. Maximum rate of change to be 1 degree per 100'. Monitor and record flow-line temperatures, both in and out, every 20'. Catch formation samples (2sets) every 10'.
16. Upon reaching total depth, circulate hole clean, lay down drill string, nipple down BOPs, clean location and release rig.

DRILLING FLUIDS PROGRAM

9 7/8" surface hole; 0 - ±250'

Mud System; Gel, lime, water, LCM (Spud Mud).
Mix 15 - 20 lb./bbl. bentonite in fresh water.
flocculate with lime.

Weight; As low as possible with mechanical solids control equipment.

Viscosity; 45 - 55 sec/qt or as needed to clean the hole.

Water Loss; NO Control

Total Hardness; NO Control

pH; Mix lime through chemical barrel to maintain 9.5 - 10.5 pH.

Comments; Lost circulation through this interval is possible. NO formation pressures are anticipated. Keep plastic viscosity down and yield point up. Run solids control equipment continuously. Break circulation slowly and trip slowly. Use Desco to thin mud if necessary.

6 1/4" Hole; ±250' - T. D.

Mud System; Polymer, gel, soda ash, Desco, high temp thinner. Drill out cement with Spud Mud and then dump Spud Mud. Build new system. Mud up in clean steel pits by mixing, with fresh water, 1/2 lb/bbl caustic soda and a ratio of 8 bentonite to 1 drispac regular. Mix bentonite first and then slowly add (30 min/sk) drispac. (Substitute a high molecular weight anionic liquid polymer such as Magcobars Rapid Mud for drispac if so desired.

Weight; As low as practical with water and mechanical solids control equipment.

Viscosity; 38 - 45 sec/qt with bentonite and drispac (8:1 ratio of bentonite:drispac) Stay on this ratio to maintain viscosity after mud-up.

Water Loss; NO Control

Total Hardness; Below 300 ppm with soda ash.

pH; 9.5 - 10.5

6 1/4" Hole; ±250' to r. D. (cont'd.)

Rheology; Control flow properties at reasonable levels with Desco thinner. If downhole temperatures increase to where Desco is not effective, then use high temperature thinner.

Torque, drag, hole stability, and high temp lubricant;

Add 2ppb Soltex additive as necessary.

Lost Circulation (Applies to depths from Surface to T₁);

The methods used to control lost circulation are as follows;

- 1; Lost circulation materials such as nut plug, cotton seed hulls, saw dust, medium Kwik-seal, etc.
2. Gunk Squeezes
3. Cement
4. Lighter than water drilling fluids.

Abnormal Pressure;

Weight material (Barite) should be on location at all times.

Corrosion;

Add corrosion inhibitors such as oxygen scavengers or scaling amines to control corrosion.

Stable Foam make-up;

Mix 1/2 - 2 ppb drispac in water

1 - 2 ppb soda ash

5 - 10 % foamer just before use (use alpha olefin sulfonate for high temp foamer.)

Air - Mud ratio required = 100:1 to 300:1

Hydrogen Sulfide Monitoring and Abatement;

Hydrogen sulfide monitoring should be maintained during the drilling of the well. Detectors should be placed on the rig floor, cellar area, and flowline region to detect and announce the presence of hydrogen sulfide. Hydrogen sulfide abatement equipment and materials, i.e., pumps, hydrogen peroxide, and caustic soda, should be maintained on location when drilling with lighter than water drilling fluids, ie, air or aerated mud systems. Escape breathing equipment, as well as resuscitators should be available on the site.

Special Considerations;

1. Drilling recorder to monitor rate of penetration.
2. Catch drill cutting samples(2 sets) every 10', to be cleaned and sacked.
3. All lost circulation zones encountered shall be recorded in Tour Book, recording both the depth at which the loss occurred, as well as the amount of fluid lost.
4. In and Out temperatures, both of mud and air, shall be recorded in the Tour Book every 20'.
5. Temperatures should be taken with every directional survey by running a maximum registering thermometer in the survey instrument.

CASING PROGRAM

7" Surface Casing: +250' X 7" J-55 20% ST & C Range 2 Casing

Torque; 3200 ft-lbs

Drift ID; 6.331

Strength Ratings;

Yield = 2992 psi

Collapse = 1816 psi

Tension = 187,200/lb

Accessories;

Float equipment - flapper type conventional float shoe on bottom of string and baffle plate installed one joint up from bottom.

Centralizers - 2 centralizers installed in the middle of the bottom 2 joints (7" X 9 7/8" Bow Type).

Wellhead Equipment - 7" X 300 SR weld-on starter flange for wellhead. 300 SR Gate Valve for master valve. (pressure rating 700 psi @ 560 degrees F.).

Instructions;- tackweld shoe; also, top and bottom of couplings on bottom three joints.

- Note:
1. Lower casing in hole slowly to avoid formation breakdown and lost circulation.
 2. Use geothermal grade thread dope on casing threads.

CEMENTING PROGRAM

+250' X 9 7/8" hole X 7" casing surface job;

Slurry description;

API Class "G" or "H"
cement mixed with 5.0
gal/sk water.

Requires;

.2301 sk/linear ft in
9 7/8" annulus.

.1976 sk/linear ft in
7" casing.

Slurry weight =

15.8 lbs/gal or 118 lbs/cu.ft.

Yield =

1.15 cu.ft./sk

Water requirement =

5.0 gal./sk or 0.67 cu.ft/sk

Pump time =

1 - 2 hours

24 hour compressive strength= 2915 psi.

7" J-55 20% ST & C casing displacement = .0404 bbls. per
linear feet or .2273 cu. ft. per linear feet.

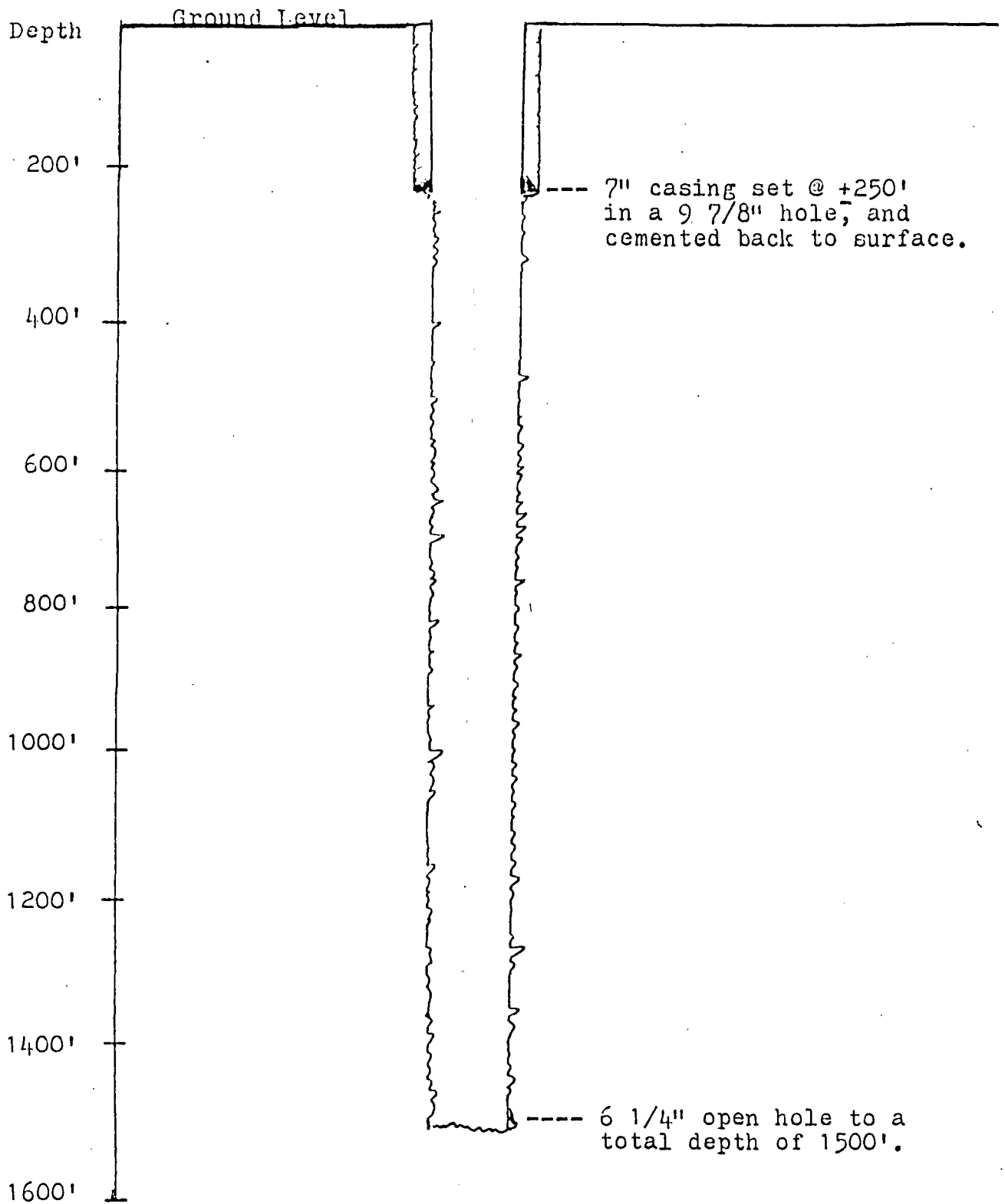
Note; Cement job should be calculated with 50% to 100% excess
in open hole.

CEMENTING PROGRAM (cont'd)

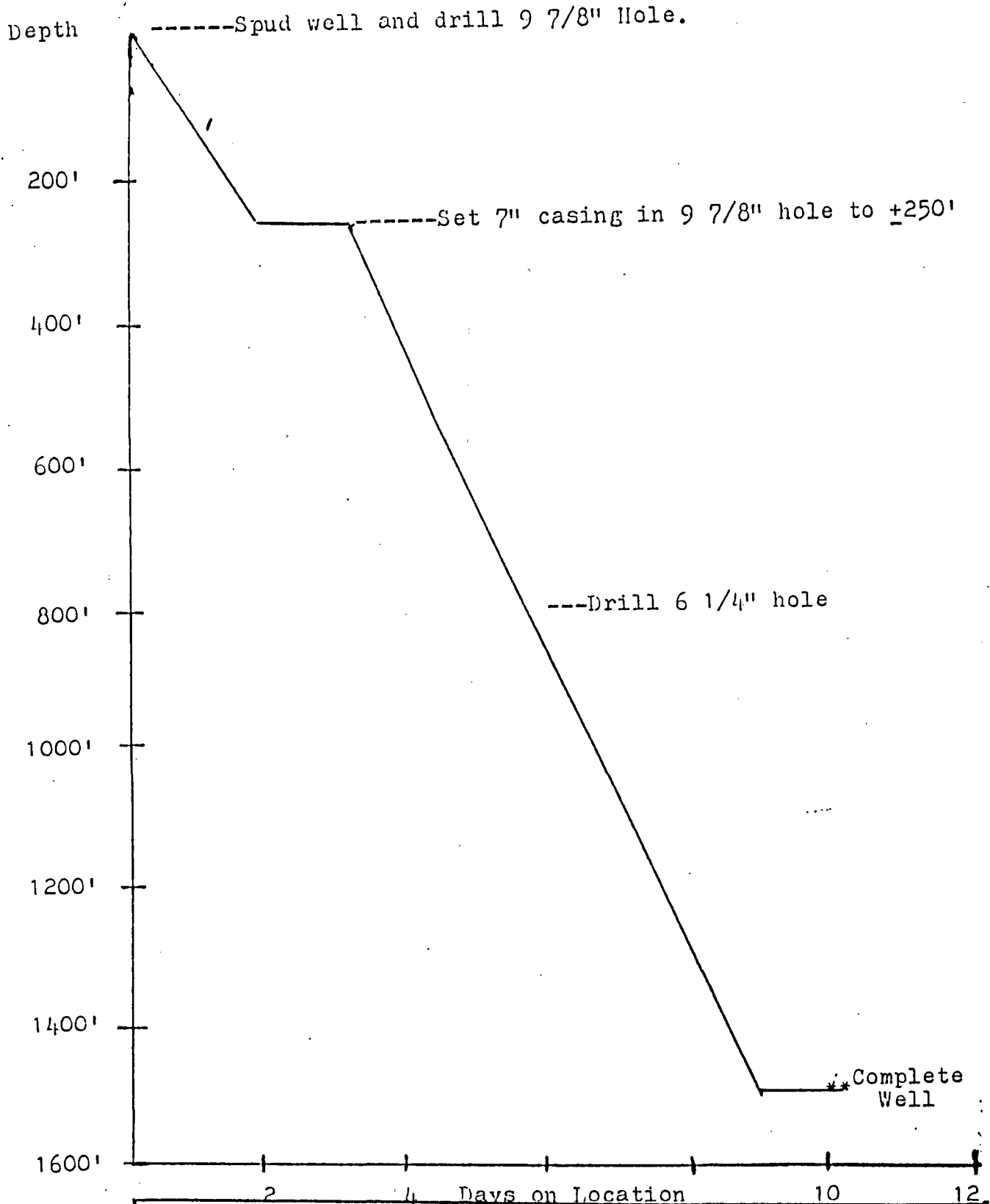
+250' X 9 7/8" hole X 7" casing surface job;(cont'd.)

Procedure;

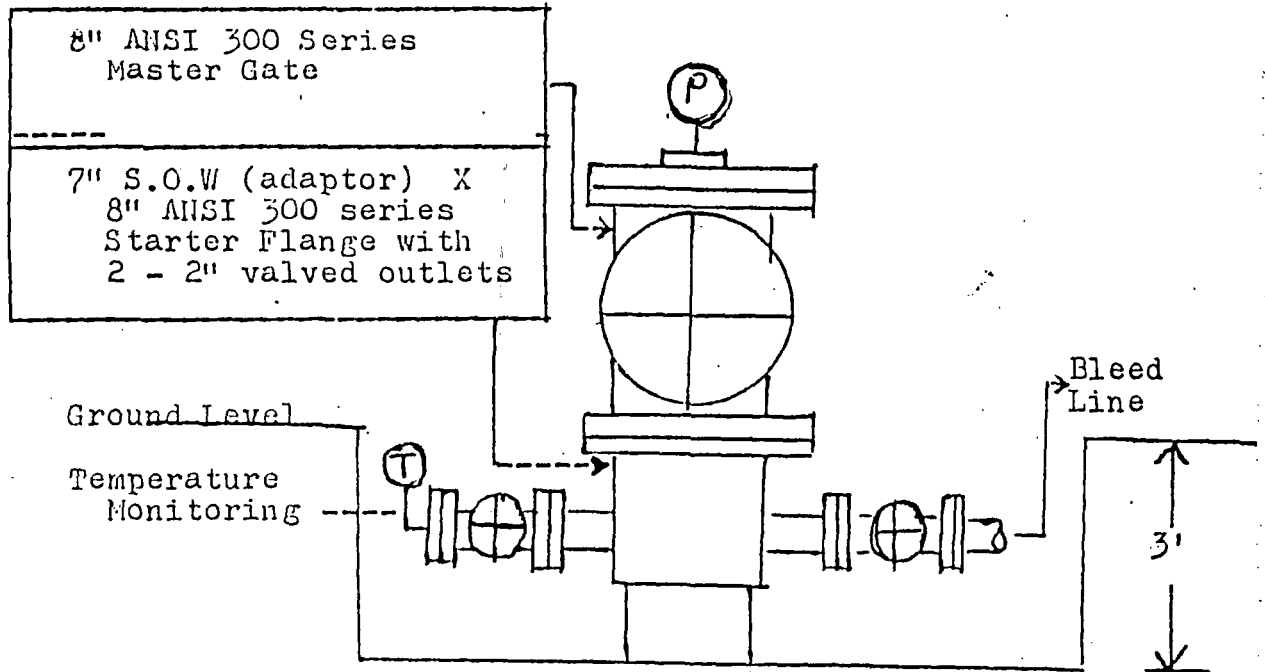
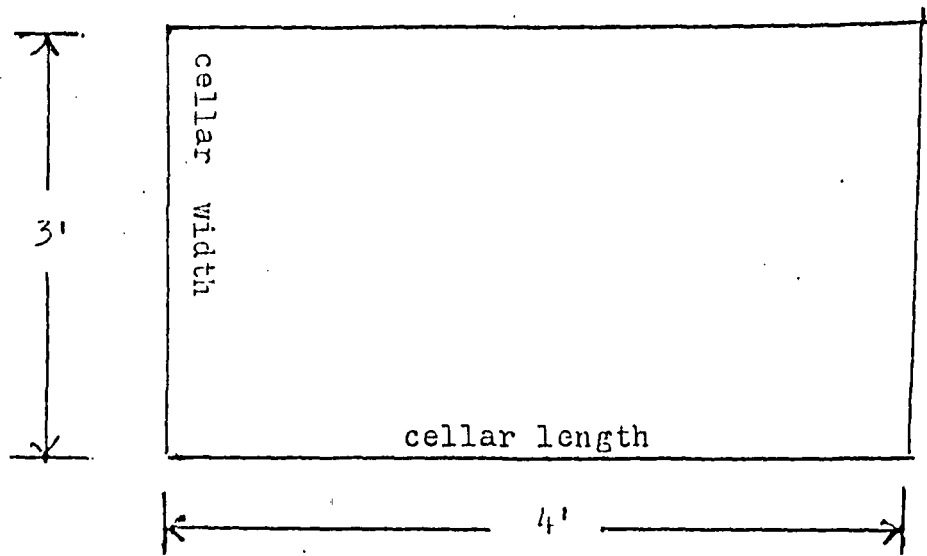
1. Make prior arrangements with Redi-Mix company to have required amount of class "G" or "H" cement on hand. Inquire as to how much notice they will require to load the cement and drive to the location. Advise them that you will need the truck clean and free of rocks or chunks of cement prior to loading. Tell them that you wish the cement loaded and hauled to the location dry, and that you will add the water on location just prior to pumping.
2. Make sure you have circulating head on location prior to running casing.
3. Call out Redi-Mix truck, giving required amount of advance notice, so that he will arrive on location before you are ready to cement.
4. While you are circulating, rig up 10 bbl. stock tank so that you can reach it with the rig pump suction and so that the Redi-Mix truck can unload into it. Have large mesh grating on hand so that you can screen out any large rocks from cement slurry prior to their reaching the rig pump suction.
5. When you are finished circulating and conditioning mud, rig up to cement, add the mixing water to the cement and mix up the cement slurry.
6. Pump 5 bbls. water down the 7" casing ahead of the cement. Start dumping the cement slurry from the Redi-mix truck into the stock tank (screening out large rocks with the grating) and begin pumping the slurry inside the 7" casing with the rig pump. Catch samples at various intervals.
7. When all the slurry has been pumped, drop the top plug and displace the slurry out of the 7" casing with mud. Bump the plug with 250 - 300 psi. Do not over-displace more than 1/2 the volume of the shoe joint to bump the plug. Note the following on the Tour Sheet;
 1. Time you began mixing cement.
 2. Time you began pumping cement.
 3. Time you began displacement.
 4. Time you received cement returns to the surface.
 5. Time the plug was bumped, or the time you finished displacing.Clean all cement out of rig pump, lines, and stock tank.
8. W. O. C. 8 hours. (check samples to see if extra time is required. Monitor the cement in the annulus. If it should fall back, bring same back to surface with 1" pipe.
9. Land 7" casing, cut off, weld on well-head, and start nipping up blow out equipment.



MOTHER EARTH INDUSTRIES, INC. COVE FORT PROJECT 6 1/4" open hole strat test drawing	DRAWN
	For : MEI
	By : BJ
	Date : 4/9/87
	Scale: 1"=200'
	Drawing No. 001

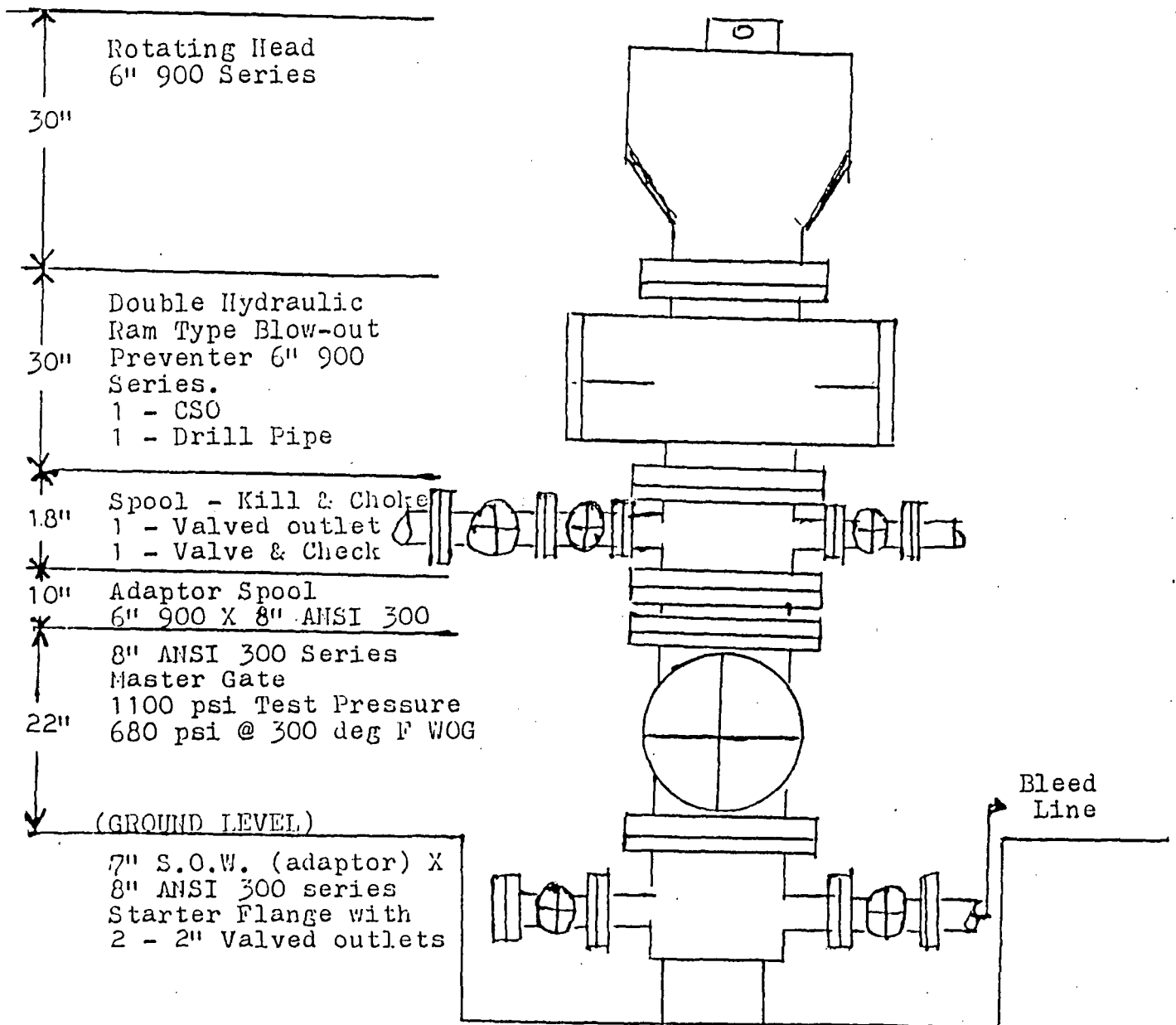


MOTHER EARTH INDUSTRIES, INC. COVE FORT PROJECT DRILLING CURVE	DRAWN
	For : MEI
	By : BJ
	Date : 4/9/87
	Scale: 1"=200'
Drawing No.	.002



MOTHER EARTH INDUSTRIES, INC. COVE FORT PROJECT	DRAWN
	For : MEI
WELLHEAD COMPLETION DRAWING and CELLAR DIMENSIONS	By : BJ
	Date : 4/9/87
	Scale: NA
	Drawing No. 003

Total Stack Height = 110" or 9'



1. All BOP equipment should be ordered with H₂S trim.
2. Ram rubbers and rotating head rubbers must be high temperature rated.
3. Need accumulator with sufficient capacity, high pressure back up system, and dual controls. One at the drillers station and one at least 50' from the well.
4. Lines must be steel with a minimum working pressure of 1000psi.

<p>MOTHER EARTH INDUSTRIES, INC.</p> <p>COVE FORT PROJECT</p> <p>BLOW OUT PREVENTER STACK</p> <p>to be installed on the 7" casing</p>	DRAWN
	For : MEI
	By : BJ
	Date : 4/9/87
	Scale : NA
	Drawing No. 004

RECOMMENDED BITS AND HYDRAULICS PROGRAM

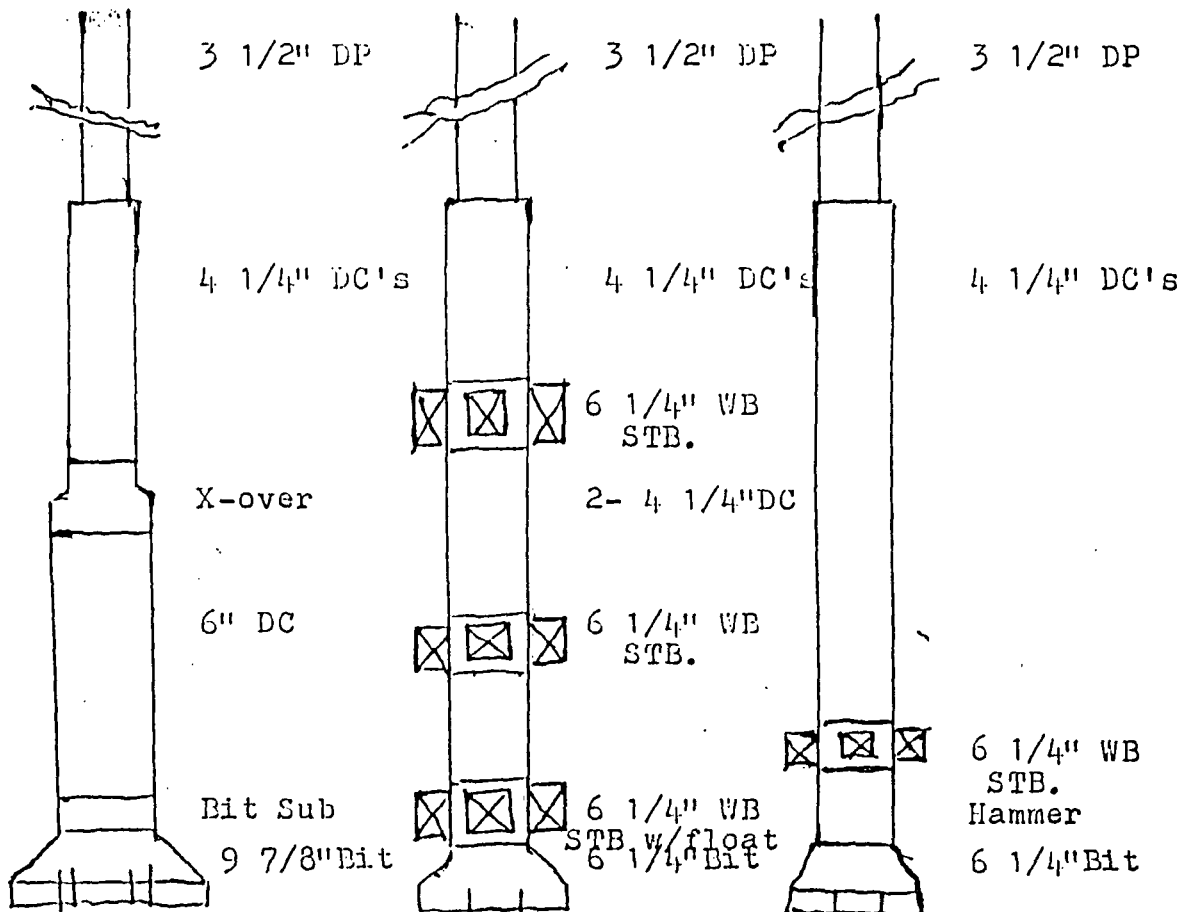
Depth	Hole	Type Bit	Jets	Pressure	GPM	WOB	RPM
0 +250'	9 7/8"	Mill Tooth	3 X 16	300	150	18-30	50-70
1500'	6 1/4"	Insert	Open	500	150	15-25	45-55

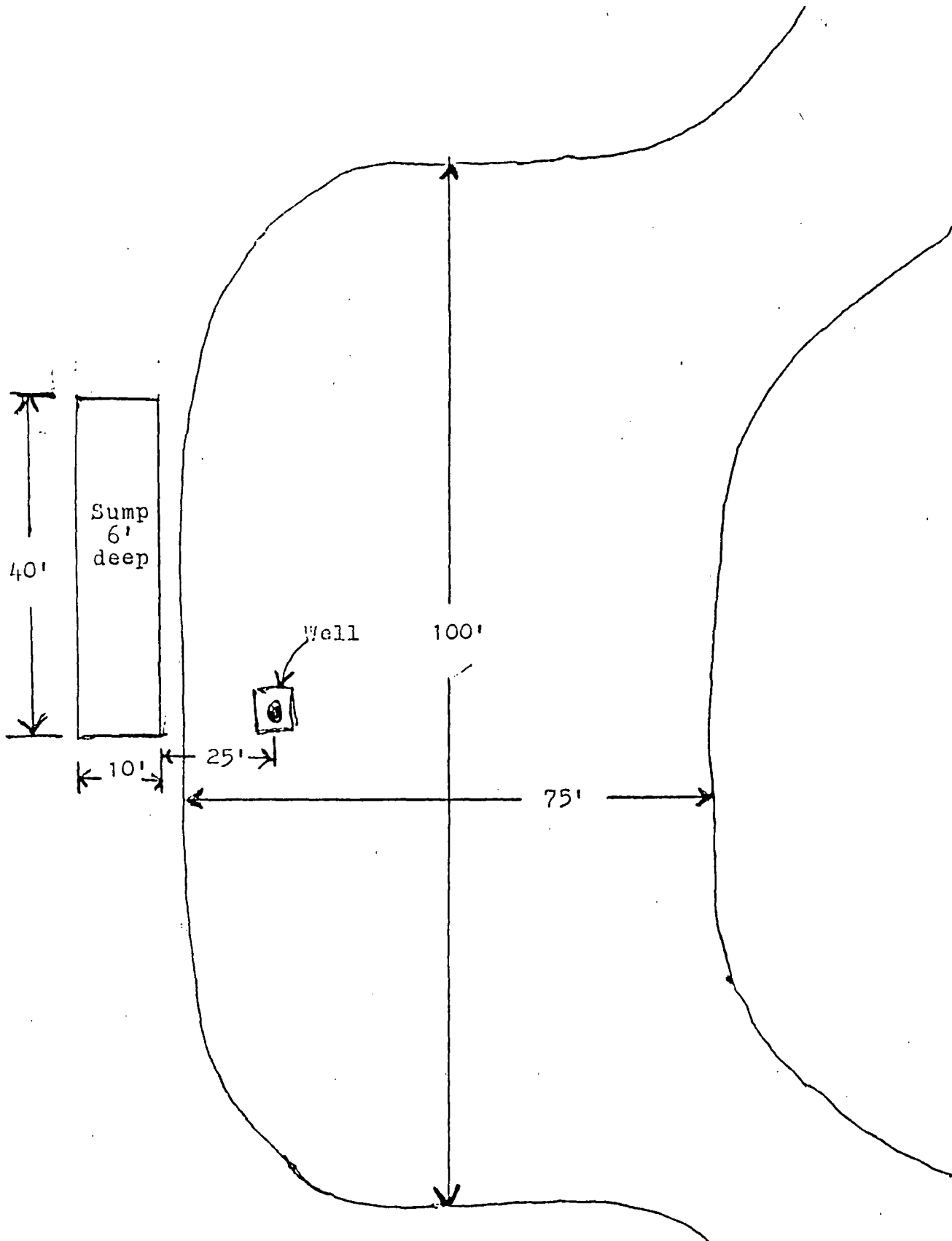
BOTTOM HOLE ASSEMBLY RECOMMENDATIONS

9 7/8" BHA

6 1/4" BHA

6 1/4" BHA (Hammer Drlg.)





<p>Sump should be lined to prevent seepage</p>	<p>DRAWN</p>
	<p>For : MEI</p>
	<p>By : BJ</p>
	<p>Date : 4/9/87</p>
<p>MOTHER EARTH INDUSTRIES, INC. COVE FORT PROJECT DRILL PAD</p>	<p>Scale : NA</p>
	<p>Drawing No.</p>
	<p>005</p>



Cove Fort-Sulphurdale KGRA Drilling Operations
Emergency Contingency Plan
June 18, 1986

NOTIFICATION/PHONE LIST ATTACHED

Prepared by: Jay C. Hauth
Operations Manager
Mother Earth Industries, Inc
3761 South 700 East
Salt Lake City, UT 84106

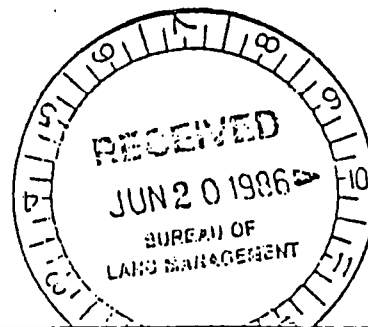
Introduction: This Emergency Contingency Plan is intended to replace and supercede section 5.0 of the "Plans of Operation of Geothermal Development", submitted March, 1985 by MEI. Certain information contained therein is updated in this document.

Policy: It is MEI's intent at all times to maintain strict standards of safety during all phases of drilling and field operations. It is recognized that unforeseen circumstances may occur requiring emergency action and/or notifications. In all cases, the priority of any action taken will be as follows:

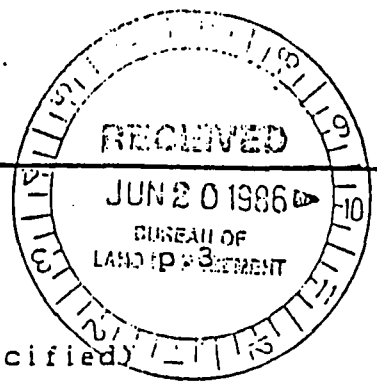
1. Situations in which any persons have been injured or injury is imminent.
2. Situations which may potentially lead to personnel injuries.
3. Situations in which environmental damage is occurring or is imminent.
4. Situations in which equipment may be damaged.

Prior to performing any potentially hazardous operations, a safety meeting will be held with all operations personnel, detailing each person's responsibilities and emergency actions.

In any emergency situation, maintain a calm alert attitude. In communicating with various parties, clearly state all pertinent details. When time permits, write down all details regarding "Who, what, when, where, how, why..."



(19)

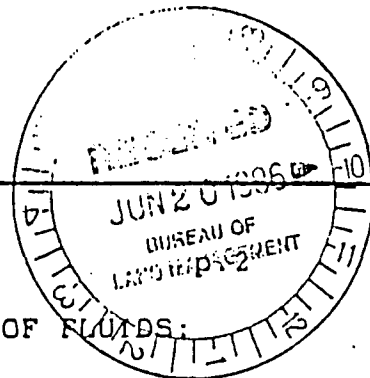


NOTIFICATION/PHONE LIST

(All numbers 801 area code unless otherwise specified)

Contact	Phone_#	Comments
Mother Earth Ind. Jay C. Hauth	263-8300	ofc
	268-9369	residence
Wayne Portanova	(602) 488-3588	ofc
	(602) 252-1411	residence
Beaver Valley Hospital	438-2416	Hosp. and ambulance
Fillmore Community Medical Ctr.	743-5591	
Delta Community Medical Ctr.	864-5591	
Beaver County Sheriff	438-2862	
Millard County Sheriff (Fillmore)	743-5302	Ambulance
Millard County Sheriff (Delta)	864-2755	Ambulance
Utah Highway Patrol (Cedar City)	586-9445	
Delano Development Corp. Tom Canada	(812) 334-2618	Fee land
BLM (Richfield) Don Pendleton John Branch	896-8221	
BLM (Fillmore) Gerald Muhlesteen	743-6811	
Forest Service (Beaver) Del Randall Darwin Jensen	438-2436	
Bell Safety (Evanston) John Richter	(307) 789-4013	H2S Safety
Fox Construction (Circleville)	577-2668	Heavy Equip.
RMICO (Milford) Dick Rollins	387-2451 387-2202	Equipment, welding, roustabout
Cudd Pressure Control (OK. City)	(405) 681-2328	Well fighting

POWER EARTH INDUSTRIES INC.



IN THE EVENT OF A BLOWOUT OR UNCONTROLLED RELEASE OF FLUIDS:

1. Administer first aid as required in case of personnel injuries. Arrange for transport to medical facilities by appropriate means. Notify medical facilities of situation details to allow for preparation of patient arrival.
2. If there may be a threat to local residents, contact the sheriff's office immediately.
3. If hydrogen sulfide release is suspected, immediately evacuate the location to an upwind area, and call out the H2S safety company. Have Scott Air Packs available and brief personnel on their use. (Air Pack training will be part of normal rig crew training)
4. Restrict access to affected area by unauthorized persons.
5. Notify appropriate managing agencies: Forest Service, BLM, Utah Division of Water Resources. Obtain from agencies recommendations and requirements regarding the situation. Follow up by filing appropriate accident reports. Notify fee land operator if affected.
6. Call out various equipment on an as-required basis: bulldozer, backhoe, grader, water trucks, pumps, etc.
7. If situation warrants, call out well-fighting company.
8. Attempt to control blowout with personnel and equipment on location at the direction of MEI or MEI drilling representatives. pressure and temperature, mud volumes and pressures, BOP fluid reserves and pressures, etc.
9. Attempt to contain fluid releases by constructing retainer dikes, diversion channels, as required to minimize environmental or property damage.
10. Maintain constant vigilance on location for potential new problem areas: erosion of rig supports, dike overflows, road washouts, etc.
11. Following control of the situation, initiate work to return any adversely affected areas to their normal condition: reseeding, road repairs, grading, etc. as recommended and approved by the surface manager (Forest Service)

(2#)

VENDOR CONTACTS AND PHONE NUMBERS

Sierra Drilling	(801) 586-0673
Western Air Drilling Services	(800) 525-0803
National Supply Co.	(805) 589-5755
L & L Ltd	(303) 245-7030
J. N. Redi-Mix	(801) 438-2865
Bell Safety	(307) 789-4013
MICO (Rollin's Machine Shop)	(801) 387-2451
Haus Vacuum Truck Service	(801) 259-5886
Northwestern Air Drilling Services	(303) 245-5610
Cilind	(307) 789-9791
H/L Baroid (Vernal)	(801) 789-1668
Texas Reamer	(307) 789-4045
Eastman Whipstock (Evanston)	(307) 789-5816
Wilson Downhole	(307) 789-4800
Burns Rathole (Evanston)	(307) 789-6678
DOTCO	(307) 789-8896
EJ Hughes	(303) 245-2906
The Dia-Log Company	(307) 789-0028
CRC-BICO Rental	(303) 858-3645
Gil Field Rental Tool Company	(307) 789-4491
Hughes Tool Company	(307) 789-6490
William H. (Bill) Jackson	(801) 254-2568

MOTHER EARTH INDUSTRIES
 COVE FORT GEOTHERMAL
 VENDOR LIST - BY NUMBER

<u>P.O. #</u>	<u>Company</u>	<u>Contact</u>	<u>Telephone</u>	<u>Vendor #</u>
Contract	Loffland Bros.	Dewey Milner	805-327-4695	015
Contract	ThermaSource, Inc.	Louis Capuano	707-523-2960	016
	L & H Trucking	Willard Lypscomb	707-987-2754	017
	Sullivan Rathole Drilling		307-382-6667	018
	Anatec Lags	Greg Anderson	707-526-7200	019
	Bill's Tong Service	Bill Cates	916-743-5225	020
	Dimitt Directional	Dave Dimitt	707-528-7988	021
	Geothermal Services, Inc. (formerly Dub's Welding)	Dub Hargis	707-433-6713	022
	Grant Oil Tools	Jim Hansen	707-433-6969	023
	H & H Oil Tools	Jim Turk	707-374-6493	024
	BJ Services	Joe Thomas	505-327-6288	025
	Thermchem	Paul Hirtz	707-575-1310	026
	L & L Muds, Inc.	Lad Lohrer	303-434-5527	027
	Midway Fishing Tools	Darrell Swisher	707-585-1457	028
	Nidway Wellheads		805-327-4471	029
	National Supply	Floyd King	805-589-5755	030
	Schlumberger Well Service		801-789-3392	031
	Tillett Tools & Supplies	George Tillett	707-523-1166	032
	W-K-M Division	Roger Bastian	707-838-4439	033
	Western Air	Craig Schweider	800-525-0803	034
	Wilson Supply	Larry Sutton	213-990-6355	035
	Continental Mfg. Inc.			036
	William Reed Welding	William Reed	801-489-7431	037
	NL Acme Tools			038
	J.R. Ready Mix		801-438-2865	039
	Ryerson & Son		415-653-2933	040
	Schaefer Valve		805-834-4738	041
	Bell Safety	John	307-789-4013	042
	Forminco Inc.	Gordon Ford	801-438-5693	043
	Jake's Crane & Rigging		702-736-4082	044
	O.K. Kile		805-324-4046	045
	Dresser Industries	Ken Deaking (Air)	707-433-6553	046
	RMICO (Rollins Machine)		801-387-2451	047
	Independent Pipe	Bruce Houpp	805-325-0398	048
	Cinco Pipe & Supply	Richard Slane	805-323-5464	049
	Delano Development Corp.	Steve Maycock	801-438-5569	050
	M & M Roust-A-Bout		801-759-2464	051
	Shurtleff & Andrews Corp.		801-973-9096	052
	Lor, Inc.		713-999-8111	053
	Northwest Tool Company		707-374-5105	054
	R.W. Jones Trucking Co.		801-789-1231	055
	Erickson's Distributing Co.		801-438-5083	056
	Oilwell (Casing Purchase)	Dale Bingham	415-331-0555	057

MOTHER EARTH INDUSTRIES
COVE FORT GEOTHERMAL
VENDOR LIST - ALPHABETICALLY

<u>P.O. #</u>	<u>Company</u>	<u>Contact</u>	<u>Telephone</u>	<u>Vendor #</u>
	Anatec Labs	Greg Anderson	707-526-7200	019
	Bell Safety	John	307-789-4013	042
	Bill's Tong Service	Bill Cates	916-743-5225	020
	BJ Services	Joe Thomas	505-327-6288	025
	Cinco Pipe & Supply	Richard Slane	805-323-5464	049
	Continental Mfg. Inc.			036
	Delano Development Corp.		801-438-5569	050
	Dimitt Directional	Dave Dimitt	707-528-7988	021
	Dresser Industries	Ken Deakins (Air)	707-433-6553	046
	Dub's Welding (see Geothermal Services Inc.)			
	Erickson's Distributing		801-438-5083	056
	Forminco Inc.	Gordon Ford	801-438-5693	043
	Geothermal Services Inc.	Dub Hargis	707-433-6713	022
	Grant Oil Tool	Jim Hansen	707-433-6969	023
	H & H Oil Tools	Joe Turk	707-374-6493	024
	Independent Pipe	Bruce Houp	805-325-0398	048
	J.R. Ready Mix		801-438-2865	039
	Jake's Crane & Rigging		702-736-4082	044
	R.W. Jones Trucking Co.		801-789-1231	055
	L & H Trucking	Willard Lypscomb	707-987-2754	017
	L & L Muds, Inc.	Lad Lahrer	303-434-5527	027
	Loffland Bros	Dewey Milner	805-327-4695	015
	Lor, Inc.		713-999-8111	053
	M & M Roust-A-Bout		801-759-2464	051
	Midway Fishing Tools	Darrell Swisher	707-585-1457	028
	Midway Wellheads		805-327-4471	029
	National Supply	Floyd King	805-589-5755	030
	NL Acme Tools			038
	Northwest Tool Company	Orville Neal	707-374-5105	054
	Oilwell	Dale Bingham	415-331-0555	057
	O.K. Kile		805-324-4046	045
	William Reed Welding	William Reed	801-489-7431	037
	RMICO (Rollins Machine)		801-387-2451	047
	Ryerson & Son		415-653-2933	040
	Schaefer Valve		805-834-4738	041
	Schlumber Well Service		801-789-3392	031
	Shurtleff & Andrews Corp.		801-973-9096	052
	Sullivan Rathole Drlg.		307-382-6667	018
	ThermaSource, Inc.	Louis Capuano	707-523-2960	016
	Thermochem	Paul Hirtz	707-575-1310	026
	Tillett Tools & Supplies	George Tillett	707-523-1166	032
	W-K-M Division	Roger Bastian	707-838-4439	033
	Western Air	Craig Schweider	800-525-0803	034
	Wilson Supply	Larry Sutton	213-990-6355	035

RIG SPECIFICATIONS

- Type : Forta-drill TKT or equivalent
- Mast : 100,000 lbs. capacity, capable of standing 1500 ft. of 3 1/2" drill pipe in 40' lengths.
- Substructure : 100,000 lbs. capacity, and giving a clearance under the rotary table of 9', w/ catwalk.
- Air Compressor : Capable of delivering 1200 SCFM at 800psig
- Mud pumps : Two 5X7 Gardner Denver or equivalent.
- Mud pit (steel) : To be provided by MEI
- Drill String : Square kelly for use in rotating head while air drilling. (4 1/4")
2000' of 3 1/2" grade E drill pipe (inspected prior to arrival).
15- 4 1/4" drill collars (inspected and with thread protectors installed).
1 - 6" drill collar (inspected and w/protector)
Bit subs (bored for float) and all other necessary subs. Also, float for bit sub.
Mission Mega-drill hammer for drilling in 6 1/4" hole.
String float sub with float.
Lower Kelly Cock Valve, with wrench
All tools to handle the above, i.e., lift subs, chain tongs, safety clamps, elevators, slips, tongs with torque indicator and correct heads, spinning chain, etc.
- lighting : Generator and sufficient vapor proof lights to light up the entire work area.
- Piping : 1 joint of 10 3/4 csg. for use as riser and conductor while drilling 9 7/8" hole.(need only 15'.)
All necessary piping to hook up from stand-pipe to pump and air compressor, pump to pits, BOP to pits, kill line to pumps, and pumps to mixing facilities.
- ROPE : 6" 900 series hydraulic actuated double gate BOP with csg ram, 3 1/2" DP ram, ~~with high temp rubbers.~~
6" 900 series rotating head (capable of passing 6 1/4" bit)with 3 1/2" high heat rotating head rubbers.
6" 900 series mud cross with one two inch valve on each side and a check valve on the kill line side.
One 2" choke manifold, and piping.
Accumulator with dual stations and piping to rig it up 50' from the well.
One 6" API 900 series X 8" ANSI 300 series adaptor spool.

Water truck : 60 bbl. water truck with pump to load and unload.

Water Storage : Will be provided by H&I.

Bit breakers : For 9 7/8" and 6 1/4" bits.

Pipe dope : For drill pipe, collars, and casing.

Recorders : Geolograph for recording penetration rate.

Instruments : Potco w/ heat shield and sub for maximum registering thermometer (6 and 12 degree instruments).

Mud mixing : High pressure hopper, or centrifugal pump to operate the low pressure system of H&I's.

Solids control equip : Desander and desilter. (shale shaker to be provided by H&I, but will need screens.) Need centrifugal to operate H&I's des. and des.

Mud checking equipment : Vis cup and funnel. Mud scale.

Measurement : Steel tenths tape for measuring casing. Caliper for checking OD and ID.

Marking : Faint stick.

Fork lift : To be provided by H&I.

Fuel and fuel storage : to be provided by contractor.

Tools : Chain tongs, casing tongs, slips, spider, elevator, and links for 7" casing.

Equipment and supplies :

2 rubbers for rotating head	-----	\$1000
366' of 7" 20# ST&C surface csg.		
@ 9.50 per/ft.	-----	2850
6 1/4" and 9 7/8" rerun button bits	-----	1750
Cement shoe, baffle plate and plug	-----	250
2 - 7" X 9 7/8" low type centralizers		
Sample bags.		
Spare 3 1/2" ram rubber for EOP		
Drilling products (mud)	-----	2000
Surface casing cement	-----	2000
Gas detection equipment	-----	200
8" ANSI 300 series starter flange and adaptor to 7" casing	-----	1000
8" ANSI 300 series master gate	---	1350
2 - 2" X 6" sch 80 nipples	-----	
2 - 2" gate valves (800 psi)		

Wind sock & air packs : H&I would provide wind sock and 5 air packs.

A LITHOLOGIC EVALUATION OF CUTTINGS FROM WELLS

S-87-1 AND S-87-4

J.N. Moore

Sept. 1987

SUMMARY AND CONCLUSIONS

S-87-1 and S-87-4 penetrated variably altered and faulted ash-flow tuffs belonging to the Three Creeks Tuff Member of the Bullion Canyon Volcanics. The ash-flow tuffs can be separated into two distinct stratigraphic units in S-87-1. The upper unit is characterized by coarse phenocrysts of biotite, quartz and andesine. The lower unit is finer grained but mineralogically similar. Only the upper unit was penetrated in S-87-4.

Steam production in S-87-4 appears to be controlled by the intersection of two distinct fault zones. The oldest of these fault zones is characterized by strong silicification and argillic alteration. Geologic relationships suggest that this fault zone is a steeply dipping, pre-geothermal structure that is disconnected from the underlying geothermal reservoir. Thus, this fault zone cannot represent the primary conduit that feeds the shallow portions of the steam cap. Instead, this fault zone may form a shallow steam trap where recent fracturing of brittle rocks has resulted in locally increased permeabilities. North trending faults bounding the eastern margin of the Sulphurdale pit are more likely zones of upwelling. These faults are younger than the gravitational glide blocks and control the present surface expression of the geothermal system at Sulphurdale.

Mercury surveys may provide additional information on the locations of these young fault zones. This technique may be particularly effective since reconnaissance studies of drill hole cuttings have shown that anomalous concentrations of mercury are

associated with geothermal alteration at Cove Fort and Sulphurdale (Ross and others, 1982). Exploratory holes drilled along these fault zones and at their intersections should, if possible, be planned to penetrate the base of the glide blocks (approximately 2000 feet) and the underlying reservoir.

STRATIGRAPHIC RELATIONSHIPS

The rocks penetrated in drill holes S-87-1 and S-87-4 consist entirely of the Three Creeks Tuff Member of the Bullion Canyon Volcanics. Within the Cove Fort-Sulphurdale area, the Three Creeks Tuff overlies a heterogeneous sequence of locally derived lava flows, flow breccias, and minor ash-flow tuffs. The Three Creeks Tuff is in turn overlain by silicic ash-flow tuffs and intruded by latite to quartz-monzonite dikes and stocks.

The Three Creeks Tuff was erupted from a caldera located in the southern Pavant Range 27 m.y. ago (Steven and others, 1977). Within the source caldera, the tuff can be divided into three cooling units which differ primarily in the degree of welding they exhibit. The lower and upper units consist of red to gray densely welded ash-flow tuff. The middle unit is poorly welded and white in color. The oldest unit is the most widely distributed and the only one recognized in the Cove Fort-Sulphurdale area (Ross and Moore, 1985).

The lower cooling unit penetrated in the wells consists of approximately 50% phenocrysts of andesine (33%), biotite (10%), quartz (5%), and minor hornblende, sphene, and magnetite in a

matrix of densely welded shards and ash. Near Sulphurdale, the lower cooling unit of the Three Creeks Tuff can be further divided into two parts. The upper part is dark gray when fresh and is characterized by plates of biotite up to several millimeters across, and euhedral quartz crystals with beta morphology. The lower part ranges from gray to red-brown in color, is much finer grained, more variable in the degree of welding (moderate to densely welded), and commonly contains numerous lithic fragments. The contact between the upper and lower units was encountered at a depth of 780 feet in S-87-1. Only the upper unit was encountered in S-87-4.

HYDROTHERMAL ALTERATION

The alteration in S-87-1 and S-87-4 is similar to that occurring in wells 42-7, 34-7 and 34-7B. Weak to moderate argillic alteration is the most common alteration type encountered in the wells. The rocks in these intervals are characterized by partial to complete replacement of the feldspar phenocrysts by clay minerals and carbonate, alteration of hornblende to chlorite and carbonate, and minor alteration of biotite to hematite and clays. More intense argillic alteration is characterized by the replacement of biotite by pyrite and clays. Increasing argillic alteration is typically accompanied by a progressive bleaching of the matrix of the ash-flow tuffs.

Silicified and in places, brecciated ash-flow tuff is associated with the argillically altered rocks between 100 to 170

and 440 to 900 feet in S-87-4 and between 140 to 290 and 640 to 650 feet in S-87-1. In addition, intensely silicified breccias occur in the lower 40 feet of both wells and between 440 and 460 feet in S-87-4. With the exception of the interval between 440 and 460 feet in S-87-4, the silicified cuttings are characterized by variable quantities of pyrite (up to approximately 5%) and the complete replacement of all primary minerals by quartz. In contrast, the silicified cuttings from 440 to 460 feet in S-87-4 are characterized by strong hematite development which give the samples a deep red color. *derived from pyrite?*

Veins and aggregates consisting of variable proportions of carbonate + hematite + chlorite and quartz + pyrite + hematite + chlorite + carbonate occur in trace amounts throughout both wells. The aggregates of these minerals are interpreted as vein fragments. Textural relationships at the base of S-87-1 suggest that carbonate veining in these rocks in part postdates the silicification. Here, silicified fragments containing pyrite occur in a matrix consisting dominantly of carbonate.

SIGNIFICANCE OF THE SECONDARY MINERAL ASSEMBLAGES

Temperature and Age Relationships

Geologic mapping and analyses of cuttings from wells in the Sulphurdale area suggests that the hydrothermal alteration of the Three Creeks Tuff is controlled primarily by two factors, the temperature of the fluids during alteration and the distribution of faults and fractures (Moore and Samberg, 1979, Ross and Moore,

1985, Moore, unpub. rept. to MEI). In addition, Moore and Samberg (1979) recognized two distinct periods of hydrothermal alteration of the Three Creeks Tuff. The earliest alteration occurred approximately 24 m.y. ago and accompanied the intrusion of quartz-monzonite stocks beneath the Sulphurdale area. Alteration related to this thermal event is characterized by quartz-sulfide mineralization. More recent alteration, related to the present geothermal system is characterized by surficial acid alteration and possibly the formation of anhydrite in 42-7. Significantly, it has not yet been demonstrated that a high-temperature brine related to the present geothermal system ever reached the surface in the Sulphurdale area.

The hydrothermal alteration documented in S-87-1 and S-87-4 is typical of moderate to high-temperature thermal regimes. The presence of clays and chlorite, and the absence of epidote in these rocks suggests that temperatures were probably in the range of 175 to 250°C during alteration. Similar alteration assemblages, associated with base metal sulfides and fluorite, have been observed in 34-7 and 34-7B. While these observations indicate that high-temperature liquids circulated throughout this area in the past, the incompatibility of these assemblages with the modern, shallow thermal regime suggest that the alteration occurring the geothermal wells is related to the emplacement of the quartz-monzonite and not to the present geothermal system. Nevertheless, the association of steam with silicified zones in 34-7, 34-7B and S-87-4 demonstrates that zones of intense

silicification act as important conduits for the steam in the glide blocks capping the deeper portions of the geothermal reservoir.

Structural Relationships

Previous geologic and geophysical studies have demonstrated that the strongly silicified and argillically altered fault zones near Sulphurdale are steeply dipping and that the intensity of the alteration decreases with distance from the major fault planes (Moore and Samberg, 1979; Ross and Moore, 1985, Moore, unpub. rept to MEI). Although the number and directions of the faults encountered in S-87-1 and S-87-4 cannot be uniquely defined from an analysis of the cuttings, several inferences can be made with respect to their distribution, thickness, and direction of movement. The widespread occurrence of silicified cuttings and moderate to strong argillic alteration in S-87-4 suggest that the well closely followed a major, nearly vertical fault zone. The fault planes encountered within this zone are marked by silicified breccias. These breccias were intersected at depths of 150 to 160 feet, 430 to 460 feet and below 910 feet. Furthermore, the stratigraphic relationships in S-87-1 and S-87-4 indicate that S-87-4 penetrated a block that is downdropped relative to S-87-1. It is likely that this fault zone is part of the east-west trending zone of structures that is prominently developed near the production wells.

handwritten notes:
...
...
...

Hydrothermal alteration of the rocks in S-87-1 is significantly less intense, suggesting that the well was drilled primarily through the footwall of the fault zone penetrated by 34-7 and 34-7B. The only major fault planes penetrated in this well occur below a depth of 1050 feet.

H F

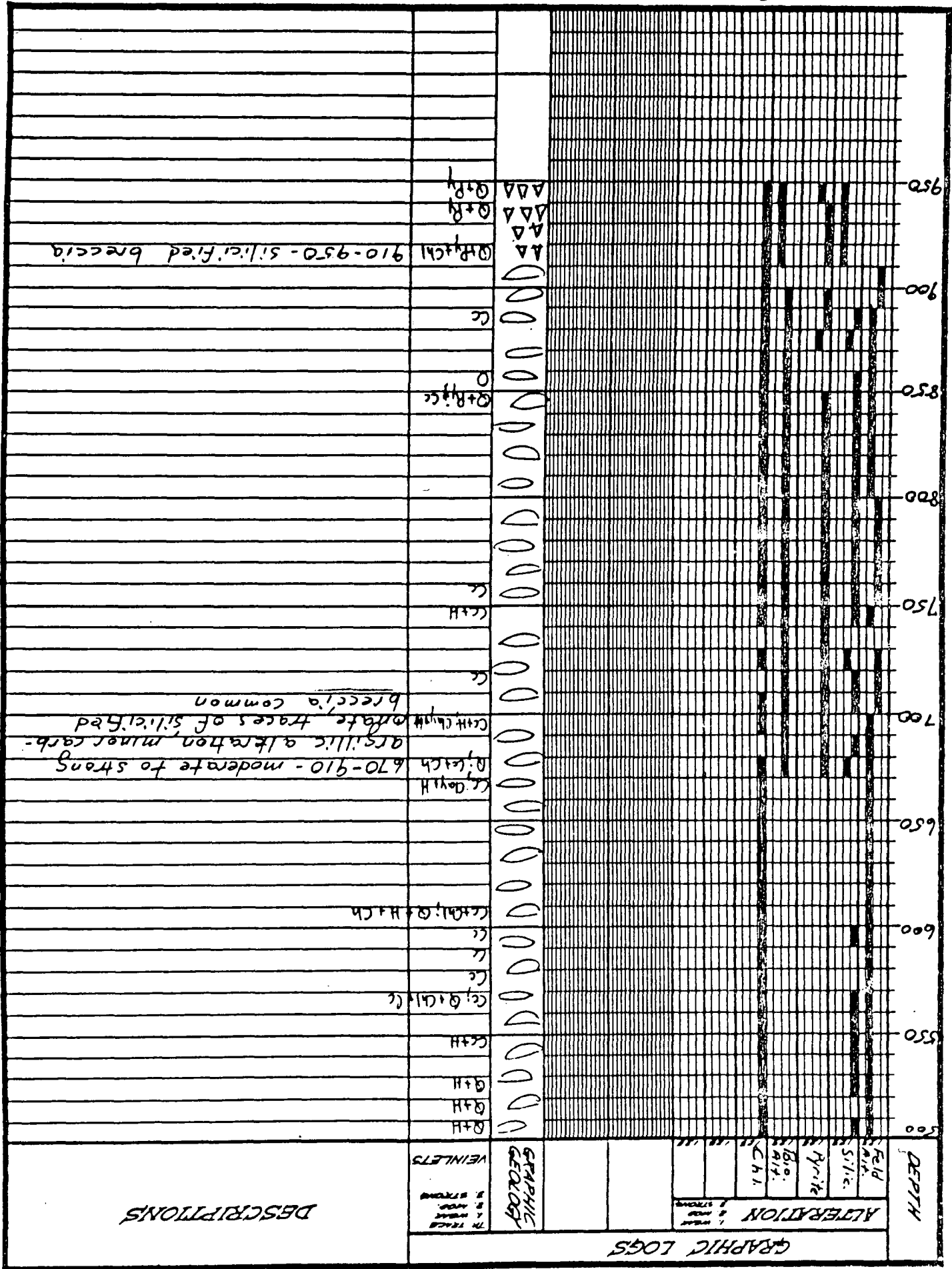
REFERENCES

- Moore, J.N., and Samberg, S.M., 1979, Geology of the Cove Fort-Sulphurdale KGRA: Univ. of Utah Res. Inst. Rept. 18, 44p.
- Ross, H.P., and Moore, J.N., 1985, Geophysical investigations of the Cove Fort-Sulphurdale geothermal system, Utah: Geophysics, v. 50. p. 1732-45.
- Ross, H.P., Moore, J.N., and Christensen, O.D., 1982, The Cove Fort-Sulphurdale KGRA-a geologic and geophysical case study: Univ. of Utah Res. Inst. Rept. 90, 47p.
- Steven, T.A., Cunningham, C.G., Naeser, C.W., and Mehnert, H.H., 1977, Revised stratigraphy and radiometric ages of volcanic rocks and mineral deposits in the Marysvale area, west-central Utah: U.S.G.S. Open-File Rept. 77-569, 45 p.



DEPTH	ALTERNATION				VEINLETS	DESCRIPTIONS
	1. SAND	2. SILT	3. CLAY	4. GRAVEL		
10-950					N.S.	Three Gracilis Tuft: upper part of lower cooling unit: crystal rich containing 50% phenocrysts of andesine, biotite (1.2mm across) quartz (beta morphology), hornblende
10-60						weak to moderate argillitic alteration, matrix bleached
40-60					cc+chl+H	sample contaminated with gravel
80-190					gr+H	moderate to strong argillitic alteration, matrix bleached, partial to complete destruction of biotite, minor carbonate, minor silicification
190-430					gr+cc+H	weak to moderate argillitic alteration, minor carbonate
250-300					cc+H	
300-350					cc+chl+H	
350-400					cc+H	
400-450					cc+H	
450-460					cc+H	silicified, hematite stained
460-670					cc+H	weak to moderate argillitic alteration, minor carbonate, traces of silicified breccia common
500						

GRAPHIC LOGS



GRAPHIC LOGS

DESCRIPTIONS

GRAPHIC
GEOLOG

VEINLETS
1. WEAK
2. MODERATE
3. STRONG

ALTERATION
1. WEAK
2. MODERATE
3. STRONG
Pyrite
Silic.
S.A.P.
Chl.
Ib. 10.
Ib. 10.
Chl.

ADHER EARTH INDUSTRIES INC.

Appendix D-1
SLC

April 27, 1987

Donald L. Pendleton
District Manager
United States Department of the Interior
Bureau of Land Management
150 East 900 North
Richfield, UT 84701

Re: Submittal of Geothermal Drilling Permits

Dear Don:

Submitted for your approval are two GDP's for exploration wells that MEI intends to drill as part of our 1987 exploration program. These wells are intended as observation wells relatively close in with existing production. MEI's intent is to ascertain that there are steam entries at these locations before a large-diameter production well is drilled. The estimated cost of each of these wells is \$40,000 compared with \$200,000 for the production wells. The information from these wells will lend itself to more detailed design of the larger wells, and will help us avoid drilling more dry holes.

We would like to start drilling during May, 1987 pending application approvals. If BLM or Forest Service personnel would like a site visit, please contact me by phone as I can schedule such a visit very quickly. If there are any questions or further information is needed, please let me know, and I will respond as soon as possible. Thank you for your consideration of these GDP's.

Sincerely,

- *Dry by J.C.H.*

Jay C. Hauth
Operations Manager

cc: Wayne A. Portanova
JCH/

MOTHER EARTH INDUSTRIES INC.

May 5, 1987

Mr. Stanley Green
Utah Division of Water Resources
1636 West North Temple
Salt Lake City, UT 84116

Re: Geothermal Drilling Permit applications, S-87-1 and S-87-2, Cove Fort-Sulphurdale KGRA, Sec 7, T26S, R6W SLB&M, Beaver County UT

Dear Stanley:

Attached for your approval are Geothermal Drilling Permits and associated drilling program including BOP configuration for two wells. These wells are intended to be slim-hole exploratory/observation wells drilled into an anticipated production zone in the vicinity of MEI's two production wells, 34A-7 and 34B-7. These wells will not be produced other than for reservoir pressure testing and chemical sampling purposes. The program calls for 7" J-55 csg set to 250", and 6 1/4" open hole to TD of 1500'.

Although I missed the conference last month in Santa Rosa, I have heard a number of positive comments regarding your presentation and the conference in general. I really wanted to go, but I had too much work going on. Maybe next time!

MEI hopes to start drilling in late May, 1987, as the drilling company has already been contracted. Thanks for your review of these permits and the program. If there are any questions or comments, please call.

Sincerely,



Jay C. Hauth
Operations Manager

cc: Wayne A. Portanova
JCH/

MOTHER EARTH INDUSTRIES INC.

Donald L. Pendleton
District Manager
United States Department of the Interior
Bureau of Land Management
150 East 900 North
Richfield, UT 84701

June 16, 1987

Re: Cove Fort-Sulphurdale KGRA transmittals

Dear Don:

Attached for review/approval are the following items:

1. Proposed casing plan change for well S-87-1. The only change is the addition of 40 feet of 13 3/8" conductor pipe to be cemented with ready-mix. A correction is made to my letter to you dated 5/24/87. That letter requests separate approval of S-87-2 prior to S-87-1. The correct situation is as follows:

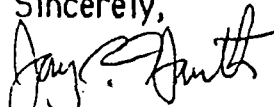
S-87-1 location is on previously disturbed land, and MEI requests approval of this primary target location. S-87-2 location is on undisturbed land, and MEI will submit a location drawing showing topsoil stockpiles, cuts/fills, etc., if this location becomes a priority again. Currently, S-87-2 is a low priority for MEI.

2. Geothermal Drilling Permits for two new wells: S-87-3 and S-87-4. These wells have an identical drilling program to S-87-1, including the 40' of 13 3/8" conductor. The locations for these wells were inspected by Toby Manzanara/BLM and Fred Fuller/FS on June 4, 1987.

3. Submittal of data recorded from temperature gradient holes drilled this spring.

If there are any questions, please call. Thanks for your considerations of these GDP's.

Sincerely,



Jay C. Hauth
Operations Manager



United States Department of the Interior

BUREAU OF LAND MANAGEMENT
RICHFIELD DISTRICT OFFICE
150 EAST 900 NORTH
RICHFIELD, UTAH 84701

IN REPLY
REFER TO:

3260
U-29551
(U-052)

June 26, 1987


Mr. Jay Hauth
3761 S. 700 E., Suite 200
Salt Lake City, Utah 84106

Re: Approval of Geothermal Drilling Permit S-87-1
Geothermal Lease U-29557
T. 26 S., R. 6 W., Sec. 7: SE1/4NW1/4

Dear Mr. Hauth:

Enclosed is your approval copy of the above-referenced geothermal drilling permit. Your cooperation in following all conditions of approval in the Plan of Operations and Geothermal Drilling Permit will be appreciated.

Sincerely,


Donald L. Pendleton
District Manager

Enclosure:
Geothermal Drilling Permit, Well 8-87-1

cc.
U-922 w/enclosure
WSRA w/enclosure
USFS w/enclosure (excluding confidential information)

Conditions of Approval
Geothermal Observation Well S-87-1
Geothermal Lease U-29557
T. 26 S., R. 6 W., Sec. 7

1. All operations must be conducted in accordance with the Geothermal Steam Act of 1970, as amended; applicable regulations, Geothermal Resources Operational Orders (GROs); special lease stipulations and approved plans of operation.
2. A qualified H₂S safety company shall be on-site and rigged up with standard equipment and procedures during the drilling of these wells. The BLM shall be notified at least 24 hours prior to the BOP test (see updated phone numbers of BLM personnel to notify).
3. Should it be necessary to excavate areas for grading of drill sites or for construction of mud pits, the top 8 inches of topsoil will be removed and stockpiled for use in reclaiming the disturbed areas.
4. Should it be necessary to deviate from the defined area previously cleared for cultural resources, a cultural resource investigation will be conducted prior to disturbance.
5. A detailed drawing for the proposed reconstruction of the existing well pad shall be prepared and submitted in triplicate to the District Manager, BLM. This drawing shall indicate the perimeter of the existing pad, the location of Well Site S-87-1, any new cuts and fills and the location of topsoil storage areas.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY, CONSERVATION DIVISION

Form Approved
Budget Bureau No.

GEOTHERMAL DRILLING PERMIT

Geological Survey requires this form or other Supervisor approved form to be prepared and filed in accordance with requisite attachments with the Supervisor. The Supervisor must approve this permit prior to use.

WORK: DRILL NEW WELL REDRILL () DEEPEN () PLUG BACK () DIRECTIONALLY DRILL () OTHER ()

TYPE: PRODUCTION () INJECTION () HEAT EXCHANGE () OBSERVATION WATER SUPPLY () OTHER ()

WELL STATUS: To be Drilled

NAME OF LESSEE/OPERATOR

Mother Earth Industries, Inc

ADDRESS OF LESSEE/OPERATOR

3761 S. 700 E.

LOCATION OF WELL

Surface \approx 2160' S., 1600' E. from NW Cor Sec 7, T26S, R6W, SLB+M
Proposed prod. zone Same

DISTANCE FROM PROPOSED LOCATION TO NEAREST PROPERTY OR LEASE LINE

\approx 480' S. to E.S. / Fee Boundary

DISTANCE FROM PROPOSED LOCATION TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR ON THIS LEASE

\approx 150 SW to well 34B-7, Sec 7, T26S, R6W, SLB+M

DRILLING MEDIA AND CHARACTERISTICS: AIR
MUD FOAM Other ()

19. PROPOSED DEPTH

MEASURED: 1500 \pm
TRUE VERTICAL: 1500 \pm

20. ELEVATIONS: ESTIMATED FINAL ()

6300
REFERENCE DATUM: GR () MAT DP () KB () RT ()
CASINGHEAD FLANGE ()

EXISTING AND/OR PROPOSED CASING AND CEMENTING PROGRAM (List existing program first, followed by proposed program, and separate by a sufficient space to clearly distinguish the two programs)

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	COUPLING (Collars & Threads)	GRADE	SETTING DEPTH		QUANTITY OF CEMENT
					Top	Bottom	
7 7/8"	7"	20 ppf	ST+C	J-55	0	250 \pm	80 Ft ³
6 1/4"	Open Hole	-	-	-	-	250 \pm / 1500 \pm	-
17 1/2"	13 3/8"	61 ppf	TST+C	J-55	0	40 \pm	28 Ft ³

PROPOSED WORK SUMMARY

MEI proposes to change this casing program (previously submitted) to include 40 \pm feet of 13 3/8" conductor. No other changes are proposed.

(Use additional space on reverse side of form)

J. C. Smith
OPERATED BY

Operations Manager
TITLE

6-16-87
DATE

(Space for Federal use)

APPROVED BY *[Signature]*

Assoc. Dir. Dist. Office
TITLE

6-26-87
DATE

CONDITIONS OF APPROVAL, IF ANY:

CONDITIONS OF APPROVAL ATTACHED TO OPERATOR'S COPY (#3-5)

permit is required by law (30 U.S.C. 1023); regulations: 30 CFR 270.71; Federal Geothermal Lease Terms and Stipulations and other regulatory requirements. The United States Criminal Code (18 U.S.C. 1001) makes it a criminal offense to make a willfully false statement or representation to any Department or agency of the United States as to any matter within its jurisdiction.

(See instructions on reverse side)

UT-050-87-040

GEOTHERMAL DRILLING PERMIT

The U.S. Geological Survey requires this form or other Supervisor approved form to be prepared and filed in late with requisite attachments with the Supervisor. The Supervisor must approve this permit prior to lease operation.

1. TYPE OF WORK: DRILL NEW WELL REDRILL () DEEPEN () PLUG BACK () DIRECTIONALLY DRILL () OTHER ()

1b. WELL TYPE: PRODUCTION () INJECTION () HEAT EXCHANGE () OBSERVATION WATER SUPPLY () OTHER ()

2. WELL STATUS: To Be Drilled

3. NAME OF LESSEE/OPERATOR
Mother Earth Industries, Inc

4. ADDRESS OF LESSEE/OPERATOR
3761 S. 700 E. SLG, UT 84106

5. LOCATION OF WELL
At surface * 2150' South, 1500' E. from NW Corner, Sec 7, T26S, R6W, SLB+M
At proposed prod. zone Same

6. DISTANCE FROM PROPOSED LOCATION TO NEAREST PROPERTY OR LEASE LINE
400' SW ~ 480' South to F.S./Fee Boundary

17. DISTANCE FROM PROPOSED LOCATION TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR ON THIS LEASE
~ 150' SW To well 34B-7, Sec 7, T26S, R6W, SLB+M

8. DRILLING MEDIA AND CHARACTERISTICS: AIR
WATER MUD FOAM Other ()

19. PROPOSED DEPTH MEASURED: 1500
TRUE VERTICAL: 1500

20. ELEVATIONS: ESTIMATED FINAL ()
6300'
REFERENCE DATUM: GR () MAT DP () KB () RT ()
CASINGHEAD FLANGE () OTHER ()

9. EXISTING AND/OR PROPOSED CASING AND CEMENTING PROGRAM (List existing program first, followed by proposed program, and separate by a sufficient space to clearly distinguish the two programs)

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	COUPLING (Collars & Threads)	GRADE	SETTING DEPTH		QUANTITY OF CEMENT
					Top	Bottom	
9 7/8"	7"	20 ppf	ST+C	J-55	0	250±	80 Ft ³
6 1/4"	Open Hole	-	-	-	250	1500±	-

22. PROPOSED WORK SUMMARY
See Attached program, incl. BOP configuration.

* * Kettelman System nos. will be provided ~~at~~ on request.

* Exact Wellhead location will be surveyed on installation of casing head, and the plats submitted (Use additional space on reverse side of form)

23. SIGNED Jay C Smith TITLE MEI Operations Manager DATE 4/27/87

APPROVED BY [Signature] TITLE Associate Dist. Mgr. DATE 6-26-87

CONDITIONS OF APPROVAL, IF ANY: **CONDITIONS OF APPROVAL ATTACHED TO OPERATOR'S COPY**

This permit is required by law (30 U.S.C. 1023), regulations, (30 CFR 270.71), Federal Geothermal Lease Terms and Stipulations and other regulatory requirements. The United States Criminal Code (18 U.S.C. 1001) makes it a criminal offense to make a willfully false statement or representation to any Department or Agency of the United States as to any matter within its jurisdiction.

(See instructions on reverse side)

UT-050-87-040

INTERSEARCH

International Learning & Research, Inc.

Archeological Consultants

July 21, 1987

Dr. Richard Thompson,
President

Georgia Beth Thompson
Vice President - Administration

Barbara A. Walling
Vice President - Field Operations

Mr. John Branch
Richfield District
Bureau of Land Management
150 East 900 North
Richfield, UT 84701

(Note: S87-1 location
was entirely on 34B-7
wellpad - all disturbed area)

Dear Mr. Branch:

This letter summarizes the results of an archeological survey of two small drill sites located in the Mother Earth Geothermal Lease Tract near Sulphurdale, Utah in Beaver and Millard Counties. The project was authorized by BLM Antiquities Permit No. 87-UT-54955 and Utah State Antiquities Permit No. U-87-IG-259f. The field work was carried out by Barbara A. Walling while Richard A. Thompson was Principle Investigator for the project.

The two drill sites, designated 87-3 and 87-4, are plotted on the enclosed map. Both are found in the NW $\frac{1}{4}$ of Sec. 7, T26S, R6W (SLM) in Beaver County. A records search, conducted by the State Historic Preservation Office showed that no sites had previously been recorded within the two project areas.

Site 87-3 lies in the NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ of Sec. 7, T26S, R6W and is found just west of a dirt road on ground that has been substantially disturbed. The actual drill point is set only 5 meters from the existing road in a small dump of burned wood and ash. To the north and south of the drill point the surface drops down to a damp area that appears to have been impacted by livestock grazing and an old temperature gradient hole. North of the drill point, the ground rises slightly, moving up into a stand of pinon and juniper. The greater part of the ground cover is, however, composed of grass. A ten acre tract, approximately 110 meters on a side, was surveyed by walking a series of contiguous transects, each 15 meters wide, until the entire drill site had been examined.

Site 87-4 lies in the SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ of Sec. 7, T26S, R6W just east of the existing dirt road on a slope of from 5 to 15°. The vegetation consists of an overstory of juniper and pinon while some grass grows between the trees. The drill point is 10 meters east of the road on a relatively level area. A short access road, contained within the 10 acres, will provide access to the drill point. The 10 acres again measured 110 meters on a side and the area was surveyed by walking a series of contiguous transects each 15 meters wide, until the entire area was examined.

The survey of both parcels of land failed to identify evidence of prehisotirc or historic occupation or sue. Thus no cultural resources are endangered by the proposed drilling.

Sincerely,

Richard A. Thompson
Richard A. Thompson

MOTHER EARTH INDUSTRIES INC.

October 2, 1987

Donald L. Pendleton
District Manager
United States Department of the Interior
Bureau of Land Management
150 East 900 North
Richfield, Utah 84701

Re: Transmittal of Location Drawings for wells S87-1 and S87-4

Dear Don:

Attached for file/information are well location and wellhead survey drawings for the referenced wells. Included as required are surveyed casing head locations, topsoil stockpiles, and cut/fill contours.

MEI is now using the following uniform basis for survey coordinates:

The basis for all bearing coordinates is North $00^{\circ}54'14''$ East between the Southwest and Northwest Corners of Section 7, Township 26 South, Range 6 West, Salt Lake Base and Meridian.

SW Corner= 44703.67042 N
49916.43333 E

NW Corner= 50000.00000 N
50000.00000 E

The coordinates for the new wells are as follows:

S87-1: 47793.90393 N
51682.29962 E

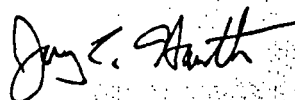
S87-4: 47420.77242 N
51333.86176 E

and additionally,

24-7: 47862.71492 N
50867.94752 E

MEI's commitment earlier this year to compiling a uniform data base for field survey data is now starting pay off. If there is a desire for different types, sizes, or configurations of drawings, please let me know and I will try to accommodate.

Sincerely,



Jay C. Hauth
Operations Manager

JCH/

GEOHERMAL WELL COMPLETION REPORT

U.S. Geological Survey requires this form or other Supervisor approved form to be prepared and filed in date with requisite attachments with the Supervisor within 30 days after completion of permitted operation.

1a. WELL TYPE: PRODUCTION () INJECTION () DISPOSAL () WATER SUPPLY () OBSERVATION (X)
COLD () HEAT EXCHANGE () OTHER ()

1b. COMPLETION: NEW (X) WORKOVER () DEEPENED () PLUGBACK () REDRILL ()
RECOMPLETED () DRILLED & ABANDONED () OTHER ()

2. NAME OF LESSEE/OPERATOR
Mother Earth Industries, Inc

3. ADDRESS OF LESSEE/OPERATOR
3761 S. 700 E. SLE, UT 84106

18. LOCATION OF WELL
At Surface: *2207 ft SOUTH, 1682 ft east of NW COR. SEC 7 T26S, R6W SLB#4*
At Top of Production Zone: *- N/A*
At Total Depth: *SAME*

19. TOTAL DEPTH
Measured: *1175.5 ft* True Vertical: *1175.5 ft*

20. PLUGBACK TOTAL DEPTH
Measured: *960 ft* True Vertical: *960 ft*

21. ELEVATION: ESTIMATED () FINAL (X) *6320'*
REFERENCE DATUM: GR () NAT (X) OF () KB () RT () CASINGHEAD FLANGE () OTHER ()

22. DRILLING MEDIA: AIR () WATER (X) MUD (X) FOAM (X) OTHER ()
List Characteristics: *BARITE, GEL, LCM - AV. WT 8.2 #/gal MUD
FOAM: Detergent
AIR: 50-300 psi*

23. LOG TYPE & INTERVALS
N/A

4. LEASE SERIAL NO.
U-29557

5. SURFACE MANAGER: BLM () FS (X)
Other ()

6. UNIT AGREEMENT NAME
N/A

7. WELL NO. *5-87-1* 8. PERMIT NO. *UT-050-87-040*

9. FIELD OR AREA
CFS KGRA

10. SEC. T., R., S. & M.
SEC 7 T26S, R6W SLB#4

11. COUNTY
Beaver

12. STATE
Utah

13. SPUD DATE *June 28 1987* DATE T.D. REACHED *July 13 1987*

14. COMPLETION DATE (Ready to produce)
N/A

15. DIRECTIONALLY DRILLED INTERVALS
N/A

16. SURVEYED INTERVALS
N/A

17. CORE SIZE AND INTERVALS
N/A

CASING RECORD

Size	Weight	Grade	Collars & Threads	Depths Set		Hole Size	Cementing Record (slurry volume)
				Top	Shoe		
<i>13 3/4</i>	<i>61.0</i>	<i>J-55</i>	<i>BT#C</i>	<i>0</i>	<i>10'</i>	<i>17 1/2"</i>	<i>70 ft³</i>
<i>7"</i>	<i>20</i>	<i>J-55</i>	<i>ST#C</i>	<i>0</i>	<i>254</i>	<i>9 3/8"</i>	<i>80 ft³</i>
<i>6H</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>254</i>	<i>1175.5</i>	<i>6 1/4"</i>	<i>-</i>

LINER RECORD

Size	Weight	Grade	Collars & Threads	Top	Bottom	Perforated Intervals	Cementing Record (slurry volume)
<i>NONE</i>							

26. TUBING RECORD

Size	Weight	Grade	Depth Set	Packer Depth
<i>NONE</i>				

27. CEMENT SQUEEZE, ACID, FRACTURE, ETC. (detail type, amount, intervals)

NONE

28. PERFORATION RECORD

Type	Total No.	Density (No./ft)	Size	Intervals
<i>NONE</i>				

29. ATTACHMENTS & PREVIOUS SUBMITTALS: List all reports, surveys, tests and logs, not listed in item 23, which have resulted from drilling and completion operations. List relevant previously furnished data with date of submittal referenced.
NONE

30. WELL STATUS: PRODUCING () SHUT-IN (X) SUSPENDED () INJECTION () DISPOSAL () HEAT EXCHANGE () ABANDONED () WATER SUPPLY () OTHER ()

31. DO YOU CONSIDER THE WELL TO BE COMMERCIAL? *NO* EXPLAIN: *NO Geothermal resource discovered.*

32. I hereby certify the information on this report and the attached information is complete and accurate according to the best of my knowledge.

SIGNED: _____ TITLE _____ DATE _____

This report is required by law (30 U.S.C. 1023); regulations: 30 CFR 270.37, 30 CFR 270.73; Federal Geothermal Lease Terms and Stipulations and other regulatory requirements. Failure to report in a timely prescribed manner can result in shutting down operations, suspension and or recommendation of cancellation of lease (30 U.S.C. 1011, 30 CFR 270.80, 43 CFR 3244.3). The United States Criminal Code (18 U.S.C. 1001) makes it a criminal offense to make a willfully false statement or representation to any Department or Agency of the United States as to any matter within its jurisdiction.

INSTRUCTIONS

GENERAL: This form is designed for submitting a complete and accurate geothermal well completion report, and should be accompanied by a detailed chronological history of well operations and final copies of the results of any logs, surveys or tests performed on the well, which have not previously been submitted. The report shall be submitted within 30 days after the date of completion of continuous well activities, as determined by the District Geothermal Supervisor. The completion date in many cases will be the day the drilling rig is released. The Supervisor may postpone the required report submittal date if adequate justification is presented by the lessee.

ITEM 18: Show the surface location coordinates from the nearest section corner or tract line. Show production zone and total depth coordinates if surface location if the well is directionally drilled.

ITEM 14: If the well is immediately placed into operation without testing, this section should reflect the first month's production data.

ITEMS 35 & 36: Indicate the depth(s) of subsurface pressure and temperature measurement, and include the reference datum.

33. WELL TEST	
TEST DATE N/A	PRODUCTION METHOD: FLOWING () PUMPING () - include size, type, intake depth, etc. OTHER ()

34. PRODUCTION				
HOURS TESTED 1.5 3	PRODUCTION DURING TEST			ENTHALPY (Btu/lb) 48
	TOTAL LIQUIDS (lb) 56,362	STEAM (lb)	WATER (lb) 56,362	

35. STATIC TEST DATA				
DEPTH SWL = 260'	SURFACE PRESSURE (psig) 0	SUBSURFACE PRESSURE (psig) 303 psig.	SUBSURFACE TEMPERATURE (°F) 92°F	WATER ANALYSIS
				Total Dissolved Solids —
				PH 7.0

36. FLOWING TEST DATA						
SURFACE PRESSURE		SUBSURFACE PRESSURE	SURFACE TEMPERATURE	SUBSURFACE TEMPERATURE	AVE. TOTAL MASS FLOW RATE PER HOUR	
WELLHEAD: SEPARATOR: N/A		at _____ feet		at top of perf.	TOTAL (lb/hr)	STEAM (lb/hr)
					WATER (lb/hr)	

37. **SUMMARY OF POROUS ZONES:** Show all important porous zones and contents of each; cored intervals with recoveries, drill stem or formation tests with depth of interval tested, time open, cushion used, and flowing and shut-in pressures, temperatures and recoveries.

38. **GEOLOGIC MARKERS (TOP)**

FORMATION	TOP	BOTTOM	DESCRIPTION OF DETAILS	NAME	MEASURED DEPTH	TRUE VERTICAL DEPTH
T6t	780	Below 1175	fine grained, grey welded buff. locally silicified, brecciated and/or irregularly altered.	T6t - upper + lower unit T6t lower + lower unit	0 780	780 ft > 1175 ft