### THE GEYSERS CORING PROJECT

On August 28, 1996, in Santa Rosa, California, the Office of Geothermal Technologies of the Department of Energy (DOE) sponsored a one-day research symposium on the DOE-industry collaborative Geysers Coring Project (GCP). This gathering provided a forum for the project's 30-member science team to communicate significant results of its research directly to those in the best position to utilize those findings: The Geysers steam field operators. Representatives of all the major operating companies -- Unocal Corporation, Calpine Corporation, and the Northern California Power Agency -- were in attendance, as were officials from the California Division of Oil, Gas, and Geothermal Resources.

The GCP was a direct outgrowth of a series of DOE-industry working groups convened by Phillip M. Wright to address the reservoir-pressure declines which The Geysers had begun experiencing in the late 1980's. Among the groups' most urgent recommendations: retrieval and thorough characterization of a significant length of continuous core from the reservoir, with the aim of improving understanding of the field's porosity and permeability controls and fluid content. The drilling phase of the project, funded jointly by DOE and Unocal Corporation (and corporate partners) was completed in late 1994, with drilling operations managed by Unocal; actual coring done by Tonto Drilling Services; routine core handling and processing by Epoch Well Log Services: and scientific coordination by the Earth Sciences and Resources Institute (ESRI) of the University of Utah. Two hundred thirty-seven m of continuous core were obtained, triple the amount retrieved from The Geysers during its 35 year history prior to the project. The GCP corehole, SB-15-D, penetrated the uppermost Geysers steam reservoir and the lower part of its relatively impermeable caprock. A special coring system allowed on-site sealing of selected cores to preserve contained fluids. Two of these cores were obtained at simulated reservoir pressures and immediately frozen in dry ice at the surface to immobilize the fluids in their initial configurations at retrieval.

The research team, drawn from universities, national laboratories, and the U.S. Geological Survey (USGS) has been conducting detailed research on the core in the two years since its retrieval. Results of these studies, presented at the symposium, have supplied valuable new information about reservoir porosity, permeability, remaining indigenous fluid saturation, and various chemical and physical rock properties. These variables are critical to the operators for improving forecasts of steam supply and quality well into the 21st century, and for designing water-injection strategies by which future steam production can be significantly enhanced. The core studies have also permitted the investigators to learn a great deal more about the particular mechanisms leading to creation of large vapor-dominated geothermal systems like The Geysers.

Industry and DOE geoscientists applied a number of new technologies, and new applications of existing technologies, in their GCP core research. Unocal used nuclear magnetic resonance imaging (NMRI) to measure the miniscule quantities of indigenous water trapped in the microscopic pores of the rock: maximum values of 3-13% of available porosity (1-5%) were calculated. Lawrence Berkeley Laboratory used a new gas-pressure-pulse-decay apparatus to show that permeabilities of the metamorphosed sandstone reservoir-rock matrix in the rocks penetrated by this corehole are as low as a few *nano*darcies. Lawrence Livermore National

Laboratory and Stanford University used two different types of computer-tomographic X-ray scanning (CT scanning) to evaluate water movement in the core. Stanford also showed that the adsorption characteristics of the penetrated rocks were in general slightly different than their counterparts deeper in the reservoir. Distinct correlations between the mineralogy of the core and its electrical and acoustical properties were demonstrated by New England Research. LLL likewise demonstrated a correlation between core resistivity and pore pressure. Scientists from the University of New Mexico, Los Alamos National Laboratory, and the USGS discussed fluid-rock interaction and  $CO_2$  generation in this sector of The Geysers. Those from ESRI presented evidence for hydrothermal influences in caprock formation; discussed the nature of porosity in fluid-transmitting and -storing fractures and veins; and integrated multiple mineral- and organic-based geothermometers to show that the penetrated steam-reservoir rocks have cooled from slightly more than 300°C to the currently estimated 230-235°C. The symposium's collected and edited research results will be submitted for publication in a special issue of the journal *Geothermics*.

The consensus of an open discussion following the formal presentations was that, following careful consideration by the operators of the reported results and their implications, there could be considerable merit in completion of another research corehole in The Geysers. This second hole, however, ideally would penetrate much deeper into the system than the uppermost steam reservoir tested by SB-15-D. The site for such a new corehole, and the full range of objectives to be addressed by its completion, would be debated during one or more DOE/industry workshops like those which led to completion of the current coring project. Proceedings of the August 28 symposium can be obtained by contacting Jeffrey B. Hulen, Earth Sciences and Resources Institute, 423 Wakara Way, Salt Lake City, UT 84108: (801)-581-8497; fax (801)-585-3540; e-mail jhulen@esrilan.esri.utah.edu.

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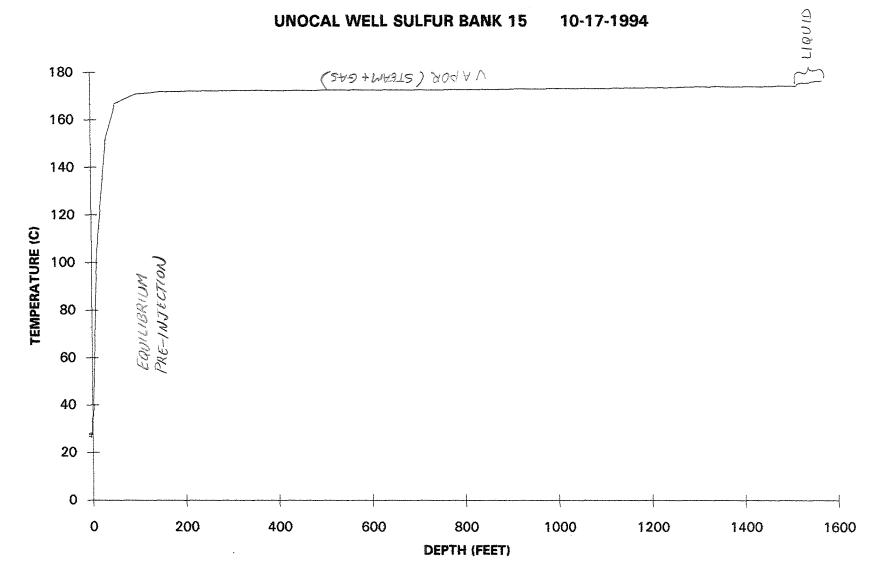
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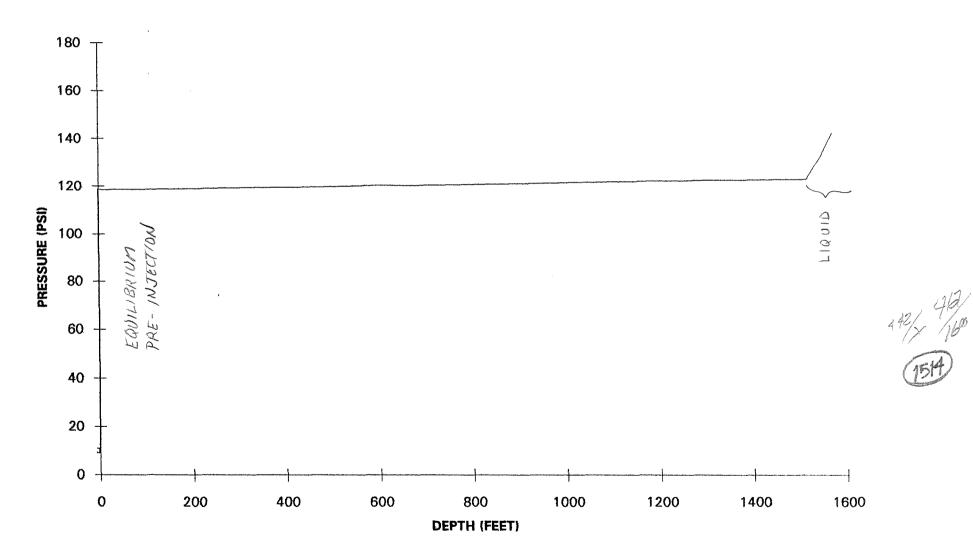
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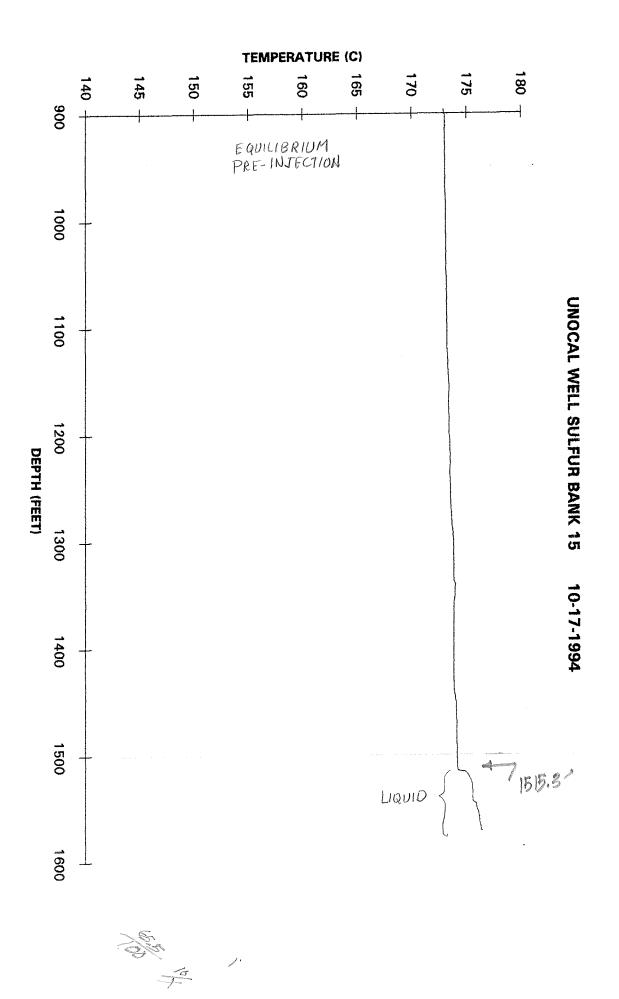
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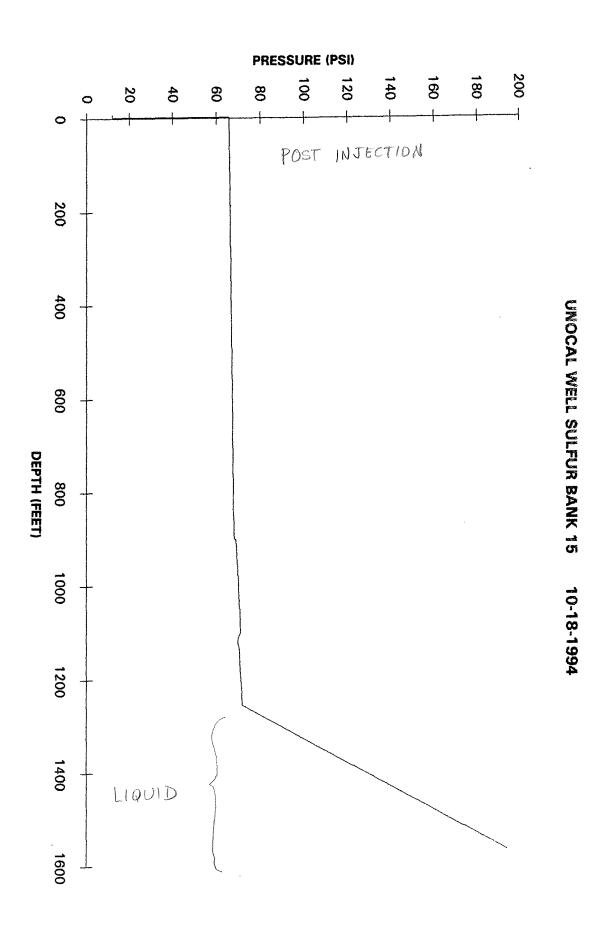




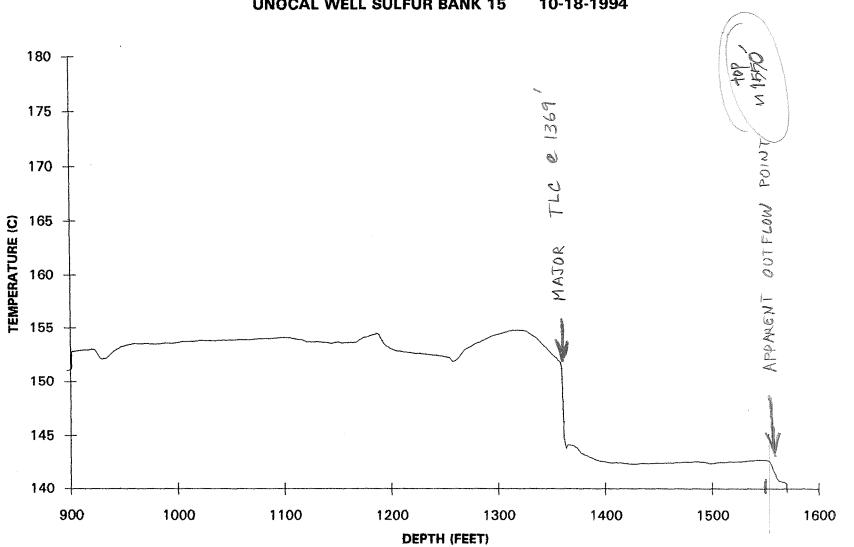
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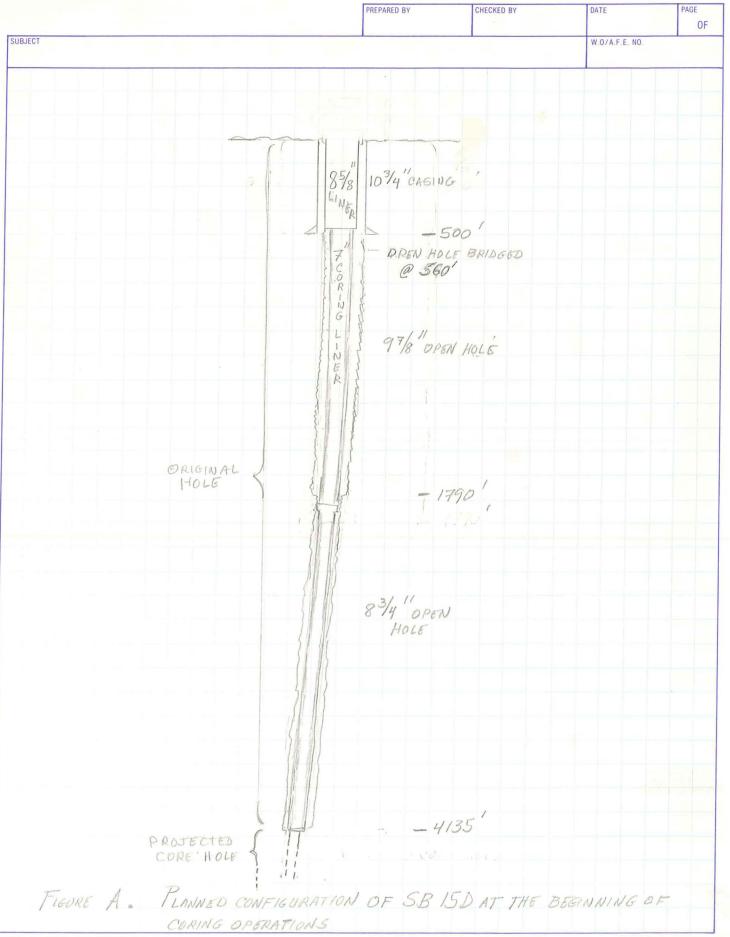


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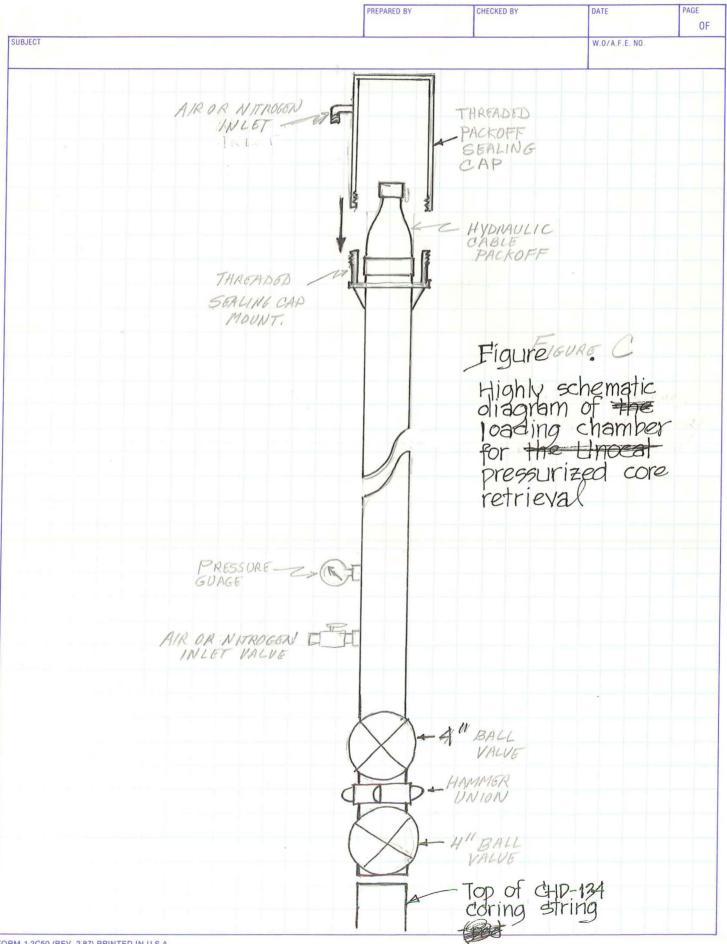
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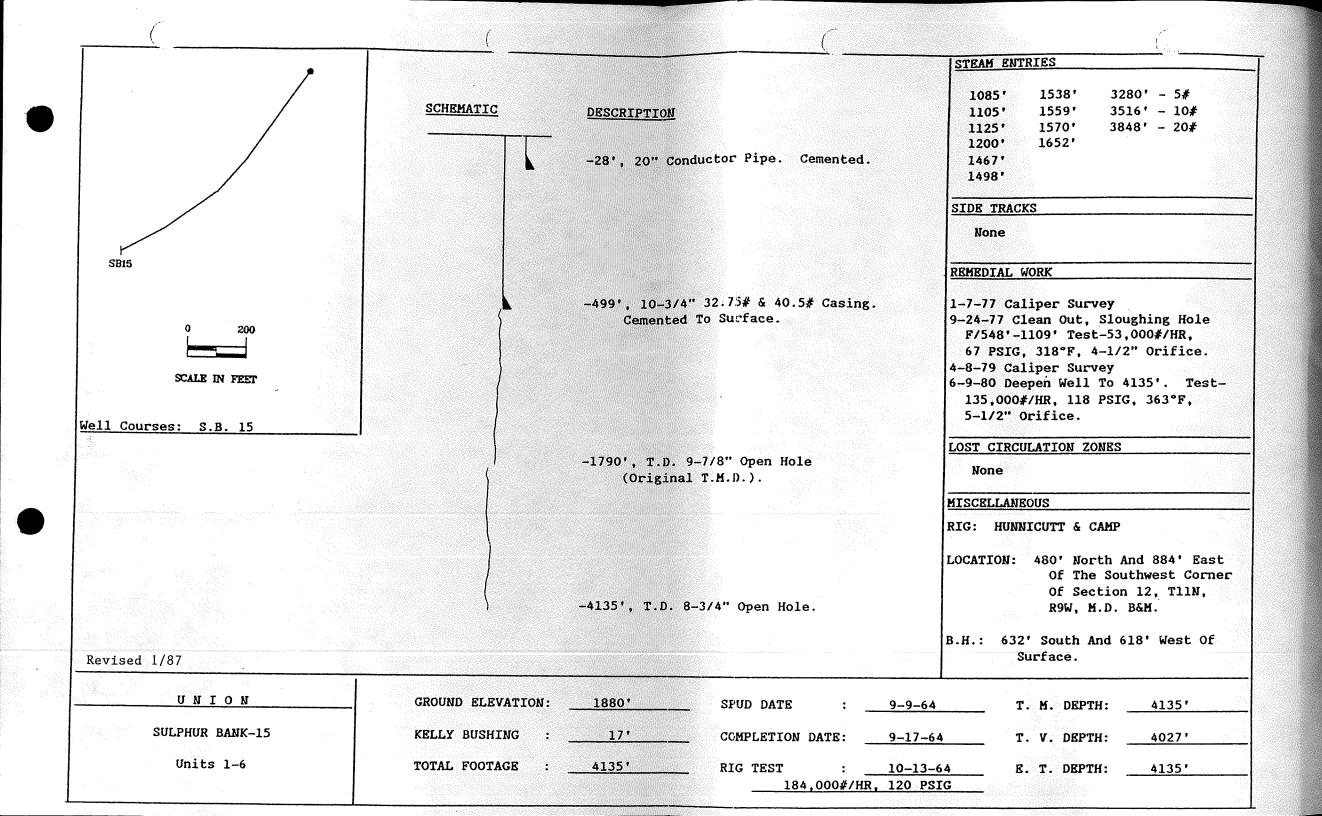
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Calculation Record w/stabilizer **UNOCAL**<sup>53</sup> 09/15/94 CHECKED BY PAGE PREPARED BY DATE OF SUBJECT W.0/A.F.E. NO. Option Tree continued to clean out side yes No run, Note will stay continue go to cure CHD-134 altempt. 44 no thro bad bittom avea pull 7" csng Drill 30-40' to make I sure we are sidetacked. (risking) more spen hole withead " sawtooth single" 73/4" hole can 7" caving ? be run. 0025330 -Cove mjection casing 1 71/2 " casing would 1695 need Hflush-joint csmg.

Sulphur bank 15 Coring / CTI Program

Casing Detail 20' 28' 10-3/4" 499'

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Open Hole 9-7/8" 1790' 8-3/4" 4135'

1. Perform U.T.I. on exposed surface casing and well head.

2. Run minimum I.D. from 700' to surface.

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- 3. Run 10-3/4" casing caliper from 480' to surface.
- 4. Move in and rig up coring rig.
- 5. Install and function test 10" 2M B.O.E. including double gate with pipe and blinds, annular, rotating head with flow line, and choke and kill lines.

5.1 Notify D.O.G. 24 hrs before function testing B.O.E.

- 6. Kill the well with water and R.I.H. with 6-1/4" Baker P.I.P.
  - 6.1 Set the P.I.P.in the bottom of 10-3/4" casing at 499'+ -.
  - 6.2 Place 25' sand and 50' cement on the P.I.P. plug.
  - 6.3 Using a 9-7/8" bit polish off the cement to 460' + leaving a minimum of 25' cement above the sand.
- .7. Rig, run and cement 8-5/8" 36# K-55 BTC SCC casing from the top of the cement plug at 460' + - to surface.
- 3. Remove the 10-3/4" casing head and install a 8-5/8" X 10" 400 casing head on the 8-5/8" casing.
  - 8.1 Install a 10" 400 donut hanger spool, a 10 400 WKM master valve and two 3-1/8" 2M wing valves.
- 9. Reinstall the B.O.P.E. and test the casing , well head and B.O.E. to 500 psi surface.

- 10. Using a 7-3/4" bit drill out the 8-5/8" casing, clean out the cement and circulate out the sand.
  - 10.1 P.O.H. and pick up the P.I.P. retrieving tool.

10.2 Run the retrieving tool and recover the 6-1/4" Baker P.I.P..

- NOTE: It may be necessary to continually pump water into the 8-5/8" casing to keep steam zones in well from flowing to surface.
- 11. R.I.H. with 7-3/4" bit on cleanout assembly to 4135'.

11.1 Clean out bridges or fill with coring fluid.

11.1.1 See coring mud program.

- 11.1.2 A high volume pump may be needed to effectively clean out to T.D.
- Note: Running of the 7" liner may be postponed if a pressure core is required. Check with the Domestic B.U. office before starting step 12..
- 12. Rig and run 7" 20# K-55 LTC SCC liner from 2000' to T.D. at 4135' + .
  - 12.1 Use a float type guide shoe and pump down the 8-5/3" casing while running the 7" liner.
  - 12.2 Land the casing on bottom using a left hand release thread on top of 10' X 7-5/8" stab-in receptacle.
- 13. Run the 7" hang down casing with S.C.couplings from surface to the top of the 7" liner at  $2000' \div -$ .
  - 13.1 Use a 7" float insert valve above the stab-in mandrel for well control and pump down the 8-5/8" casing while running the 7" casing.
  - 13.2 Engage the 7" liner at 2000' + while hanging the 7" casing from the 10" donut hanger.
  - 13.2 Use 7" pup joints to space the stab-in mandrel in the middle of the stab-in receptacle.
- 14. Using a 6-1/8" milltooth bit drill out the float insert in the 7" hangdown and shoe of the 7" liner and drill five foot of new hole.

15. P.O H. and rig for coring operations.

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- 16. Core with CHD 134 rods and 5.625" core bit from existing T.D. until hole problems or approved funding require termination of coring operations.
- 17. Remove the 7" hang down casing string.
  - 17.1 Before pulling the 7" hangdown install a wireline plug in the bottom on the 7" hangdown casing.

17.2 Keep well dead by pumping down the 7" X 8-5/8" annulus.

18. Install a bridge on top of the 7" liner at 2000' + - .

18.1 Place 50' of cement on established bridge.

18.2 Confirm the top of the cement plug.

- 19. Rig and run 500' 7" perforated SCC casing and 1500' + 7" SCC blank casing to 50' above the cement plug at 1950'+ -.
  - 19.1 Use safety subs while running the 7" injection liner.
  - 19.2 Pump down the 8-5/8" X 7" annulus while running the injection liner.
  - 19.3 Land the 7" casing hang down in the 10" hanger spool. and secure the well.

19.2 Check and tighten all W.H.E.

20. Rig down, release and move the rig.

flw/6-17-94

\*

OEDP-Open-ended drill pipe BPM-Barrels per minute CIP-Cement in place

8. Remove the 10-3/4" casing head and install a 8-5/8" X 10" - 400 casing head on the 8-5/8" casing.

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- 8.1 Install a 10" 400 donut hanger spool, a 10 400  $Z(\mathcal{R})$  (WKM) master value and two 3-1/8" 2M wing values.
- 9. Reinstall the B.O.P.E. and test the casing , well head and B.O.E. to 500 psi surface.
- 10. Using a 7-3/4" bit drill out the 8-5/8" casing, clean out the cement and circulate out the sand.

I PULL OUT

6K 10.1 P.O.H. and pick up the P.I.P. retrieving tool.

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- 11.1.2 A high volume pump may be needed to effectively clean out to T.D.
- Note: Running of the 7" liner may be postponed if a pressure core is required. Check with the Domestic B.D. office before \*? starting step 12..
- 12. Rig and run 7" 20# K-55 (LTC) SCC liner from 2000' to T.D. at  $\#^{2}$  4135' + -.
  - 12.1 Use a float type guide shoe and pump down the 8-5/8" casing while running the 7" liner.
  - 12.2 Land the casing on bottom using a left hand release thread on top of 10' X 7-5/8" stab-in receptacle.

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<sup>10.2</sup> Run the retrieving tool and recover the 6-1/4" Baker P.I.P..

- 13. Run the 7" hang down casing with (S.C. couplings from surface to the top of the 7" liner at  $2000^{-4} + -$ .
  - 13.1 Use a 7" float insert valve above the stab-in mandrel for well control and pump down the 8-5/8" casing while running the 7" casing.

#2

- 13.2 Engage the 7" liner at 2000' + while hanging the 7" casing from the 10" donut hanger.
- 13.2 Use 7" pup joints to space the stab-in mandrel in the middle of the stab-in receptacle.
- 14. Using a 6-1/8" milltooth bit drill out the float insert in the 7" hangdown and shoe of the 7" liner and drill five foot of new hole.
- 15. P.O H. and rig for coring operations.

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- 16. Core with CHD 134 rods and 5.625" core bit from existing T.D. until hole problems or approved funding require termination of coring operations.
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  - 17.2 Keep well dead by pumping down the 7" X 8-5/8" annulus.

18. Install a bridge on top of the 7" liner at 2000' + - .

18.1 Place 50' of cement on established bridge.

18.2 Confirm the top of the cement plug.

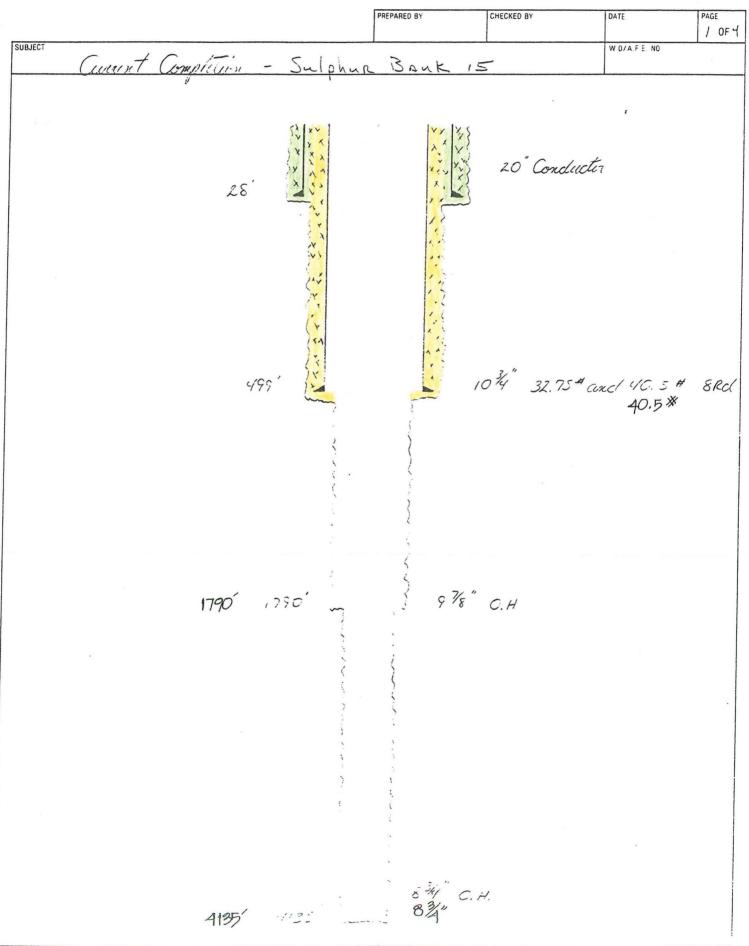
- 19. Rig and run 500' 7" perforated SCC casing and 1500' + 7" SCC blank casing to 50' above the cement plug at 1950'+ -.
  - 19.1 Use safety subs while running the 7" injection liner.
  - 19.2 Pump down the 8-5/8" X 7" annulus while running the injection liner.
  - 19.3 Land the 7" casing hang down in the 10" hanger spool. and secure the well.

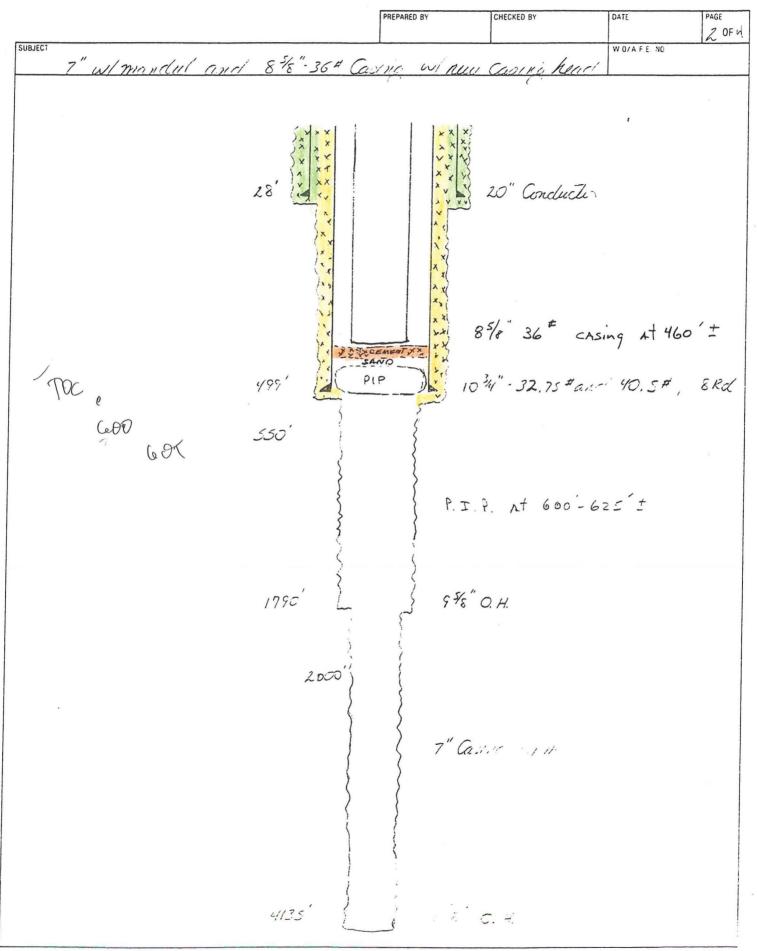
19.2 Check and tighten all W.H.E.

20. Rig down, release and move the rig.

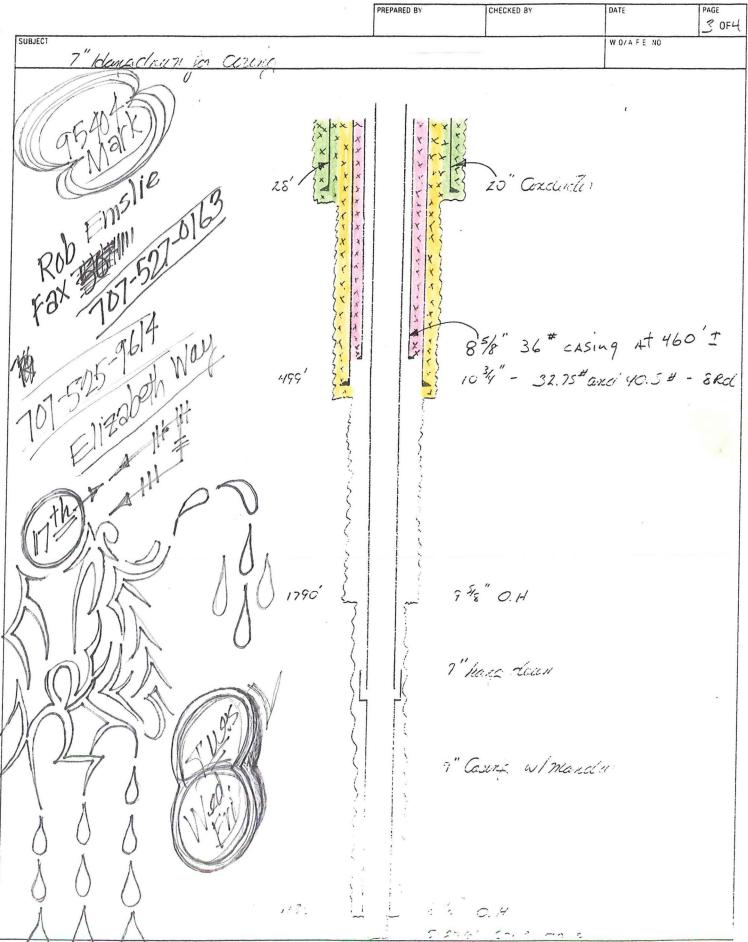
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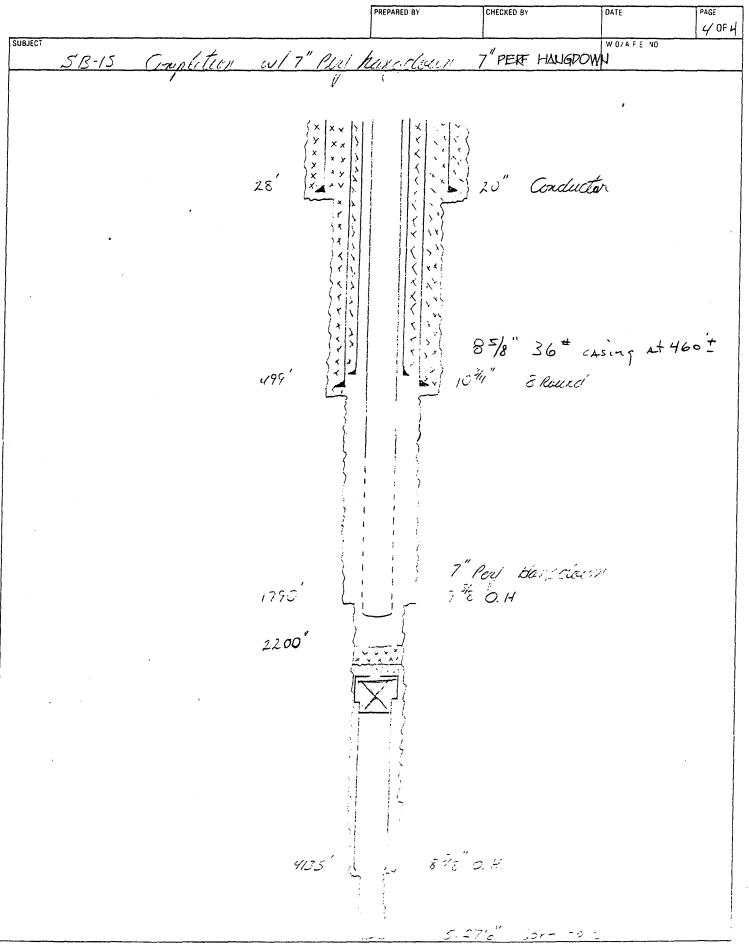
## UNOCAL®





**UNOCAL** 





rnds - 127 mm 1/2 CHP hole 1 5,5/11 PO Size Care 134 mm D. Nielson-NEE MEETING W/TOHTO 08/05/93 L. P. sto G. McClare M. Pordee Universal 5000' Phi/lipines pric - leved to 2700 Ev / day core to 500. ) Same FL15 3/2" tool could get 1 1500 ft of PQ core ( under ideal ideal inter ideal interview) small annules. Anormal inner tuke prepared with caps vi \$ 10000/per tyle tracer in drilling mod? to

duest much (split tube) > stanless = \$366 Avansfer to Luck for fluid preservation. Air coring ? can it be done? roght fler L'Circ. --- clean hale increase cost can change veadily. Marsh Pardee - aluminum liners (trible type) w/O-ring caps "\$ 50 for 5-footer



MEMO TO: GEYSERS COREHOLE PARTICIPANTS

FROM: MIKE WRIGHT

SUBJECT: MEETING ON 26 MAY 1993

May 24, 1993

The main purpose of this meeting will be to explore options for preservation of and measurements on the core that we plan to obtain in The Geysers reservoir rocks. Results of the meeting will be used to help pull together the science plan for the core. This science plan must be solidly based with specified objectives, approaches and potential benefits so that those who will make commitments for in-kind contributions will be able to justify their efforts. Each of you should come to the meeting ready to talk about specific recommendations for the science plan.

A drilling plan will be needed as well as a science plan. Since the hole will be on Unocal property, the bulk of the drilling plan and the bulk of the in-kind contribution to the coring will fall to them. The drilling plan will form the basis for a proposal to the Geothermal Drilling Organization, which Sandia will use to contract with Unocal. DOE's contribution, \$400K, is in the Sandia program, and it is my understanding that this amount will be available for coring.

We will have one day to get a lot done. Let's make it happen!

EHOLE MEETING/ SANTA ROS Measurement Questions 1. Saturation (weight) - Paul Variation? "air" time? Score preservation? 2. Heterogeneity CAT? Brian who? photos? CD? 3. Visual logging - Jeff lab? \$? 9. k, &, P.Q room temp Marcoab? \$? 5. k, A, P@ reservoir T, P 6. kr @ reservoir T,P\_ lab? \$? sampler? lab? 7. Fluid samples f/hole 8. Electric logging of hole - Colin " Core Jeff 9. 40 10 **B4** 7/12/93 10. TPS survey of hole - Bill 11. Fluid samples floore - Budget. - Timing/drkg 12. Leachable salts f/core - Bob - Vendors/sup 13. Rock geochem. - Jeff - Pre-Test. 14. Petrography (fluid inclusions, etc.) - Joff - Description of work. - Current 15. Adsorption - Roland Practice 16. Core Preservation Wike - Deliverables Drilling plan - Mitch



MEMO TO: GEYSERS WORKING GROUPS

FROM: MIKE WRIGHT

SUBJECT: NOTES FROM GEYSERS COREHOLE MEETING

June 9, 1993

As you know, the Geology Working Group at The Geysers has recommended coring in reservoir rocks as a means of obtaining rock samples for measurement of parameters of interest in better understanding and simulating the reservoir. On May 26, 1993, a meeting of a group working on this recommendation was held at the Unocal offices in Santa Rosa. Attached is a copy of notes from this meeting.

:28

In summary, the current status of this project is as follows: (1) The \$400,000 that DOE will contribute to the coring project will come through the Geothermal Drilling Organization via an agreement between Unocal and Sandia; (2) The project will require scientific and drilling plans, which are being worked now and will be completed around the first of August, with drilling starting as soon as practical after that; (3) More conventional geological, geochemical and geophysical measurements on the core will be obtained by DOE researchers but also by outside contractors; (4) One important objective of the coring project will be to test methods of obtaining information on the reservoir liquid saturation, which will require core preservation.

We intend to hold another meeting of the coring group in late July to discuss progress on the scientific and drilling plans and fine-tune them.

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#### GEYSERS CORE HOLE MEETING

### 26 MAY 1993

### UNOCAL OFFICES, SANTA ROSA, CA

A meeting of the working group interested in coring at The Geysers field was held in the Unocal offices in Santa Rosa, CA on 26 May 1993. Those in attendance are shown in Appendix 2.

#### **Miscellaneous** Notes

Mitch Stark is taking responsibility on behalf of Unocal for working with Bill Smith in selecting the well to be used for coring. Mitch stated that the final selection has not been made, although a good candidate has been identified -- well LF-1. It has limited production with a steam entry at 5,249 ft, and is currently used as a producer. It has 9 5/8" casing to 2,700 ft, 7" cemented liner to 3,542 ft and 8 3/4" open hole to TD at 5,570. Other wells may also be available. Coring in LF-1 would start near the top of the hornfels zone may be able to reach the felsite with the available money.

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A question was raised about the original idea of coring graywacke reservoir rocks. Jeff Hulen noted that the difference between normal reservoir graywacke and hornfels is that in the graywacke the vein calcite has been dissolved, whereas in the hornfels it has been converted to calc-silicate minerals. Ben Barker stated that the main objective should be to get core out in usable condition, with the rock type being secondary. Bob Fournier said he would like to see at least two rock types. Paul Kasameyer suggested that someone should see if there are chips from LF-1, and if so, they should be logged.

The meeting then began to focus on the types of measurements that would be made on the core and on getting the science plan written. It is important that the scientific work is well planned to ensure success of the project in terms of helping the operators to understand the reservoir better, and because the in-kind contribution that Unocal will make, for permitting and supervising the drilling as well as the use of a production well, will be substantial.

It was agreed that we should focus on trying to develop innovative ways of determining in-situ (reservoir) liquid saturation levels, and porosity and permeability values for the core. In order to do this, we will have to take a careful look at the options for preservation of the core, either downhole before retrieval, or at the surface. More conventional geological, geochemical and geophysical measurements would also be made on the core, but will not be so dependent on preservation. We felt that core could be obtained --

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from depth in about 20 minutes through wireline retrieval. LLNL will use some of their simulation capabilities to determine the preservation requirements once the core reaches the surface. They will also look into the types of core barrels available for core preservation. UURI will independently work on methods of core preservation.

Mark Walters suggested that we may want to look into use of aluminum core barrels that could be sealed immediately upon arrival at the surface. Jeff Hulen stated that for the Valles Caldera coreholes, they sealed the core will beeswax at the surface. Mark said that Rob Emslie had successfully drilled with plastic liners in deep coring in the British nuclear repository. The group agreed that we probably only have enough money to preserve selected samples, and that most of the core would have to be retrieved in the usual way at the surface.

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6.2.

Brian Bonner submitted an outline of some of the measurements LLNL may be able to make and the expected results (Appendix 1). Brian noted that they will try some of the LLNL CAT-scan x-ray techniques, using high-powered equipment previously classified, on NEGU-17 core to see how well a CAT-scan maps the internal systematics of core. If successful, LLNL could potentially build a vessel to CAT-scan core at Geysers reservoir temperature and pressure.

Brian also discussed the electrical tomography being developed by Bill Daley at LLNL, and its application to core studies at Yucca Mountain. In one test, core was dried, then instrumented, measured and resaturated while further measurements were being made. It was found that the water migrated first into the pores, not into a major fracture that ran through the piece of core.

Bob Fournier suggested that we could dope the drilling fluid with something detectable with x-rays. If we find that the core is well penetrated by the doped drilling fluid, we may conclude that the rock was not saturated in the reservoir.

Ben Barker emphasized that we need to know the length of time we have to work with core at the surface before all traces of reservoir saturation are erased.

Joe Beall pointed out that if the coring hits a steam entry, the core tube will be pushed up and jammed, with the result that no core will be obtained from the entry.

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#### Plans

In order to expedite the project, it was decided that Jeff Hulen would be responsible for putting the science plan together. The schedule was established as follows:

Deadline	Event
1 July 1993	Written material for science plan to Hulen.
7 July 1993	Material assembled at UURI and mailed out to committee.
23 July 1993	Draft science plan assembled by UURI.
27-30 July 1993	One- or two-day meeting of core committee in Santa Rosa to discuss and fine-tune science plan and discuss drilling plan.
6 August 1993	Science plan finalized and distributed.

The material to be delivered to Hulen by 1 July 1993 include (1) statement of work, (2) pre-testing needed or pre-testing results, (3) current practice (state of the art), (4) budget requirements (5) timing relative to drilling, (6) proposed vendors/suppliers, and (7) deliverables.

Table 1 summarizes the potential measurements to be made on the core, the priority, the questions each measurement will help answer and the person(s) responsible for furnishing material to UURI by 1 July 1993.

### Table 1 POTENTIAL CORE MEASUREMENTS

MEASUREM	EIN I	PRIORITY	QUESTIONS	<b>RESPONSIBLE PARTY</b>
<ol> <li>Liquid satura heterogeneit</li> </ol>		1	Reservoir liquid saturation and its variations. "Air" time, and core preservation requirements, methods.	Bonner - LLNL
2. Core preserv	vation	1	Options, cost	Wright - UURI
3. Visual loggir	ıg	1	Description, who does it, photos, video	Hulen - UURI
4. k, Ø, Pc @ ro k, Ø, PC @ r kr @ reservo	eservoir T, P	1	Who does it, costs	Lippmann - LBL
5. Adsorption		1	Can it be done on whole core	Horne - Stanford
б. Electric logg	ing of hole	2	Who does it, costs	Williams - USGS
7. Electric logg	ing of core	2	Who would do it, costs	Kasameyer - LLNL
8. TPS survey o	of hole	2	Who would do it, costs	Smith - NCPA
9. Fluid sample	es from core	2	Who would do it, costs	Moore - UURI
0. Leachable sa	lts from core	2	Who does it, costs	Fournier - USGS
1. Rock geoche	m	2	Who would do it, costs	Hulen - UURI
2. Petrography Inclusions	and fluid	2	Write-up needed	Hulen - UURI
3. Downhole fl	uid samples	3	-	-
4. Drilling Plan	f	1	- · · · · · · · · · · · · · · · · · · ·	Stark - Unocal

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**APPENDIX I** 

BNAN Bonnor 26 May 93

### **Draft--Science Plan--The Geysers Corehole**

General Objective--To understand the storage and transport of water in-situ

#### **Rapid Core Recovery**

#### **Core Preservation**

1 9

Objective--Screen suitable jacketing materials.

test several high temperature polymers (Viton and Kalrez) for durability as high temperature jackets for use at the corehole.

### FOR A 'FEW' SAMPLES

<u>Physical Chemistry of 'intrinsic' water storage</u> (Ramey / Horne - Stanford)

Drilling Simulation Experiments in the Laboratory

Objective--address the question of fluid movement during coring and core recovery

Run pre-corehole experiments to determine if saturation can be determined with this method. Focus on:

Fluid storage in fractures Mud infiltration Fluid loss

Saturate samples of NEGU-17 (or other suitable proxy) material at reservoir conditions to determine sensitivity of the CAT scan

CAT Scans of recovered (from lab and then field) core

### FOR 'MANY' SAMPLES FROM THE COREHOLE

Jacket in the field measure water content by weight loss; resaturate to determine the porosity Do "Porosity and Permeability' on plugs

#### ADDITIONAL MEASUREMENTS ON RECOVERED CORE

#### Impedance Tomography of fluid movement in fractured core

Objective --observe fluid movement from matrix to fracture at the core scale

#### Other Relevant LLNL capabilities

Seismic properties- velocities and attenuation; now underway Schatz model Q(f) for fractures

#### **Transport properties**

flow models/reactive flow Nitao / Wang improved double porosity model? <u>Experimental validation / perm and closure</u> <u>measurements</u>

Reactive flow code

Knapp code in place

Experimental validation / high pressuretemperature flow, profiling before and after

Geochemistry of fluids modeling and laboratory

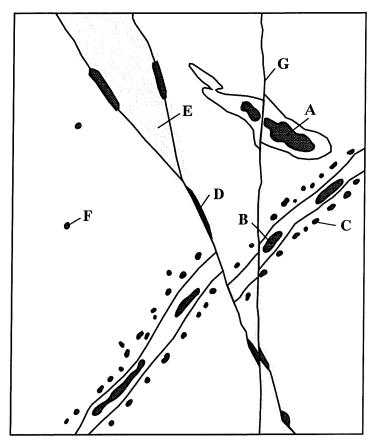


Figure 1 - Schematic diagram of "matrix" porosity in The Geysers normal graywacke reservoir. A is pore space created by dissolution of Franciscan calcite in discontinuous pods. B is pore space formed form dissolution of calcite in quartz + calcite veins. C are pores marginal to the quartz + calcite veins. D is porosity in small, partially sealed fractures, and E represents the porosity between and adjacent to these young fractures. F represents isolated pores. G are unmineralized fractures that are the youngest in the field. (Nielson et al., 1992; modified from Gunderson1990).

#### GEYSCORE.MS

#### Core Imaging and Data Archiving

Core, by its very nature, is difficult to handle and few people look at it in detail. Researchers often have to travel long distances to inspect the core, and hours of characterization are often required prior to sampling. When data is accumulated on the core, it is either not availabel or difficult to retrieve. It is our objective to make the core and scientific data available to companies and research organizations in a comprehensive and convenient to use format.

The core will be slabbed and then imaged at a resolution comparable to photography. These images will form the basis of a Geographic Information System data base. Additional data from researchers will be added to the data base as it becomes available. This will include the digital well logs, lithologic logging, fluid inclusion images and data, thin section images and data, alteration mineralogy, chemical analyses, radiometric dates, and drilling information.

This data base will be copied onto CD-ROM and made available to operating companies in The Geysers and research organizations. Thus it will be possible to easily inspect the core images and accumulated data base using a personal computer.

#### Imaging Logs

Imaging logs are proposed here to solve two principal problems: 1. to evaluate how representative a sample of the reservoir the core actually is, and 2. to determine the character and orientations of fractures intersected by drilling.

Companies have collected a number of cores from the Geysers reservoir. Core recovery is often poor, and the core retrieved is often broken into small pieces with milled ends. Since one would expect recovery to be poor within fractured areas, it is quite likely that the core provides an incomplete representation of the reservoir. Imaging of the borehole walls, using Schlumberger's Formation Microscanner (FMS) tool, will determine the character of the zones that are lost during the coring process. The FMS images rock based on constrasts in electrical resistivity. The principal difficulty in using the tool at The Geysers is that a fluid-filled hole is required for the tool to function.

Imaging tools are the only practical means for determining the orientations of fractures within the well. Core collected by conventional and wire-line means rotates within the barrel, and the collection of oriented core is tedious, prone to error, and has temperature limitations. Fracture orientation is of obvious importance to companies for determining the most advantageous direction for wells to be deviated. It is also a significant factor in planning and evaluation of water injection to maintain the life of the reservoir.

It is proposed that the candidate well be filled with water and the open-hole portion of the well logged, using the FMS imaging technique, through the reservoir prior to initiating the coring program.

During or following the completion of the coring, additional imaging can be done using the slim-hole version of the FMS tool. This is provided that the hole can hold water and that the hole is sufficiently wide and straight to admit the logging tool.

### Sulphur Bank 15 Drilling Review

#### **Original Drilling Plan**

- Set a packer and cement plug at 540'
- Install 8 3/8" Liner and New Wellhead
- Drill out cement and retrieve packer
- Set bottom 2000' of 7" liner
- Set top 2000' of 7" liner
- Core using 7" casing to support CHD 134 drill string

#### **Problems and Solutions**

• Packer moves downhole

Multiple recovery attempts

• Severe hole sloughing at 638', and hole sloughing at 1134'

Set cement plug from 776' to 663', and a second cement plug from 663' to 526'

• Hole sidetracks

Drill 7 3/4" hole to 823' and begin CHD-134 coring

#### **Final Completion**

8 3/4' liner to 394'

7 3/4" hole to 823'

CHD-134 core hole to 1600°

4 1/2" liner to 1590'

### Summary

Project near failure

Flexibility accomodates changing conditions

Adversity turns to opportunity

Nearly 800' of core recovered

Two pressurized cores retrieved

Well completed for injection

- 0
  - A well behind city hall, used by the Modoc Lumber Company for makeup water to a boiler, increased in temperature by 5 °C, from 18 °C to 23 °C after the earthquakes.
  - The Conger well field, near Link River, is used by the city as supply wells. After the earthquakes, these cold-water wells had a water-level increase of approximately 2.1 m.
- In late July and early August, wells in an area about 25 km southeast of Klamath Falls smelled and tasted "bad". In the same area, the Jim Moore well suddenly began producing 49 °C water, estimated at 15 °C before.
- On 20 September, between 4:00 p.m. and 5:00 p.m. and before the earthquakes, water changed at the Gordon Aires well, about 11 km south of the epicenter. The water was whitish-gray, with a tremendous amount of gas that had a strong hydrogen-sulfide odor. Others in the Keno area noticed similar changes in their wells. This area is southeast of the West Klamath Lake Fault Zone, along its structural trend.

#### Geysers Coring Project

#### — Marcelo Lippmann, Earth Sciences Division, Lawrence Berkeley Laboratory

The Geothermal Division of the U.S. Department of Energy (DOE), with support from *Unocal Geothermal Division* and other field operators at The Geysers, are unning the drilling of a deep core hole in this vaporuominated geothermal system. The main objectives of the project are: (1) to obtain continuous core from the hydrothermally altered graywacke hosting the "normal" steam reservoir; (2) to measure in the laboratory and field the porosity, permeability, and other physical characteristics of these reservoir rocks; (3) to improve estimates of the nature, amount, and availability of liquid water reserves in the field; and (4) to investigate potential sources of chloride and noncondensable gases in the produced steam.

The preliminary plan calls for deepening an existing *Unocal* well in the Sulphur Bank area of The Geysers. Tentatively, an interval of up to 700 m might be cored continuously, starting at about 1,400 m depth, bottom of the present well. Initially, CHD-134 core (85-mm diameter) will be obtained.

A group of engineers and scientists from industry and DOE-supported organizations are finalizing the drilling and coring plans for this project, as well as a program of related studies. Scientists who might be interested in participating in the project, using their own funding, should contact Jeff Hulen, scientific coordinator of The Geysers Coring Project. His address is: University of Utah Research Institute, 391

tipeta Way, Suite C, Salt Lake City, UT 84108-1295, U.S.A.; Tel.: 801-584-4446, Fax: 801-584-4453.

### UPCOMING EVENTS

- Symposium on New Developments in Geothermal Measurements in Boreholes, Potsdam, Germany, 18–23 October 1993. Convenor: Eckhart Hurtig, GeoForschungs Zentrum Potsdam; Tel.: 49-331-310-347, Fax: 49-331-310-610.
- 11th IGA Board of Directors Meeting and Annual General Meeting, Auckland, New Zealand, 8 and 9 November 1993. Contact: IGA Secretariat, LBL 50E, Rm. 143, One Cyclotron Road, Berkeley, CA 94720, U.S.A.; Tel.: 1-510-486-4584, Fax: 1-510-486-4889, e-mail: igasec@lbl.gov.
- 15th New Zealand Geothermal Workshop, Auckland, New Zealand, 10–12 November 1993. Theme: Long term use of geothermal resources: Problems and Solutions. Manuscripts to be published in the Workshop Proceedings had to be received by 18 August 1993 at the Geothermal Institute, University of Auckland, Private Bag 92019, Auckland, New Zealand; Fax: 64-9-373-7346.
- 2nd Tianjin Geothermal Workshop, Tianjin, China, 22–25 November 1993. Location: Tianjin Geothermal Research & Training Center, Tianjin University, China. Topics: Geothermal geology, geophysics, geochemistry, resource assessment, reservoir engineering, monitoring systems, drilling technology, politics of geothermal development, international geothermal performance, dry rock research, and information exchange. Proceedings will be published. Contact: Information Group, Tianjin Geothermal Research & Training Center, Tianjin, 300072, China.
- 26th General Assembly of the International Association of Seismology and Physics of the Earth's Interior (IASPEI), Wellington, New Zealand, 10–24 January 1994.

IASPEI/IHFC Symposium: Geothermal Aspects of Lower Crustal Structure, Petrology and Rheology. Convenors: Vladimír Čermák, Geophysical Institute, Czech Acad. Sci., Praha 141-31, Czech Republic; Tel.: 42-2-76-4539, Fax: 42-2-761549. D.M. Fountain, Dept. of Geology and Geophysics, Univ. of Wyoming, Laramie, Wyoming, U.S.A., 82071; Tel.: 1-307-766-6299, Fax: 1-307-766-6679, e-mail: Fountain@uwyo.edu. Rick Allis, DSIR Geology and Geophysics, P.O. Box 30368, Lower Hutt, New Zealand; Tel.: 64-4-569-9059, Fax: 64-4-569-5016.

IHFC Workshop: *Heat Flow and Hydrothermal Circulation*. Wednesday, 19 January 1994. Convenors: Ladislaus Rybach, Institute of Geophysics, ETH Hönggerberg, 8093 Zürich, Switzerland; Tel.: 41-1-377-2605, Fax: 41-1-371-2556. David S. Chapman, Dept. of Geology and Geophysics, Univ. of Utah, SaltLake City, UT, U.S.A., 84112; Tel.: 1-801-581-6820, Fax: 1-801-581-7065. Valiya M. Hamza, Institute of Astronomy and Geophysics, University of Sao Paulo, C.P. 9638, 01050 Sao Paulo SP, Brazil; Fax: 55-11-815-4272.

19th Annual Workshop on Geothermal Reservoir Engineering—Stanford University, Stanford, California, 18– 20 January 1994. Contact: Jean Cook, Geothermal Program Manager, Petroleum Engineering Department, Green Building, Stanford, CA 94305-2220, U.S.A.; Tel.: 1-415-723-4745, Fax: 1-415-725-2099.

#### 5. DEEP WELL CONTINUOUSLY CORED THROUGH THE GEYSERS RESERVOIR

#### Background-

In order to improve the ability to predict future reservoir performance at The Geysers, and the further changes that will occur in steam quality, far more complete determinations need to be made of specific reservoir parameters for the full vertical extent of the "typical" dry steam reservoir. And to the extent practical, these determinations need to be extended deeper into that reservoir section than present development exists, in order to determine if the underlying high temperature-high chloride-high NCG ("HTR") reservoir of the Northwest Geysers is also beneath the main part of the field.

BILL 5M

Throughout The Geysers the dry steam reservoir typically begins at depths of from 3,000 to 5,000 ft, with production wells commonly extending downward through an interval thickness of 5,000 ft to an average total depth of about 9,000 ft. The produced steam comes from both fluid-filled fractures and from reservoir rock matrix, but their relative storage capacities still remain very uncertain because typical fracture investigative tools, such as down-hole televiewers, are inoperative in these wells incapable of being filled with water, and because the samples of reservoir rock normally obtained during drilling are completely disaggregated by the air drilling process. Some core samples have been obtained from within The Geysers reservoir section, but to date they collectively total only between 150 and 200 ft. These cores represented about 20 discontinuous intervals from as many scattered wells. Consequently, less than 4% of the reservoir interval has ever been core sampled, and little of that material now remains for examination.

#### Proposal-

A deep investigative well needs to be drilled in the Central Geysers region to acquire the information necessary to achieve improved forecasts of future reservoir performance. This well should be drilled to the top of the cap rock, which occurs at a depth of about 4500 ft, and then continuously cored through that cap rock and through the typical reservoir section to a depth of at least 9000 ft. Such a program will provide a continuous sampling of the total lithologic section present, from cap rock, through both the normal metagreywackes and progressively increased hornfelsic units, and then into the upper portions of the felsite intrusive. Continuing to a depth of 12,000 ft will characterize the reservoir section to the present limits of resource development, and deepening the well to 15,000 ft will reach the maximum suspected reservoir depth (based on seismicity data), while testing for the presence of a HTR in the area.

The wide range of specific scientific studies that can subsequently result only from having undertaken this proposed well program include a vertically continuous description of the following:

A. Reservoir physical properties: porosity, permeability, water saturation, density, velocity, and thermal conductivity.

B. Reservoir chemical properties: bulk, isotopic, fluid inclusion and pyrolysis-derived gas compositions of core materials, compositions of the various fluids recovered.

C. Mineralogical/hydrothermal variations, internal fluid saturations, leaching and solution history, and a description and dating of the felsite intrusion(s) that furnish the heat that sustains The Geysers.

D. Particular attention will focus on the distribution, orientation, relative age and hydrothermal histories of the reservoir fractures encountered.

E. In addition to simultaneously logging down-hole pressure/ temperature/flow rate (spinner) measurements, other logging tools can be utilized to the extent that their size and temperature limits permit.

#### Estimated Costs-

The proposed program to drill and set 4-1/2" casing to 4,500 ft and then continuously core a 4" diameter well through the Geyser reservoir to a minimum depth of 9000 ft is estimated to cost \$1,395,000. As shown below, extending the well to a total depth of 12,000 ft to 15,000 ft is estimated to cost an additional \$495,000 to \$1,105,000.

	Prop	osed Well Dept	chs
	9,000'TD	12,000'TD	15,000'TD
Site Preparation	\$41 <b>,</b> 000	\$41,000	\$41,000
Rig Costs @ \$5100/day	510,000	760,000	1,020,000
Drilling Costs (bits, rentals, etc)	262,500	349,000	541,000
Cement, Mud, and Outside Services	\$ 432,500	567,000	701,000
Casing Costs	120,500	144,500	168,500
Valves, Wellhead, etc	28,500	28,500	28,500
Total Estimated Costs	\$1,395,000	\$1,890,000	\$2,500,000

#### Anticipated Schedule Requirements-

The time needed to accomplish the basic elements of the proposed drilling/coring project can be summarized as follows:

Define Detailed Program, Site Selection, Negotiate Contracts, Prepare Location	120 days
Drill and core 4" hole to 9,000' (115 days)	235 days
continue coring 3" hole to 12,000' (35 days)	270 days
continue coring to 15,000' (50 days)	320 days

#### ABBREVIATIONS AND ACRONYMS

Bbl. BHC BOP BT&C CDL Chl. circ. Cmt. CN compl. csg. cu. ft. DC	barrel (42 gallons) bore hole compensated blow out preventer buttress threaded and coupled compensated density log chlorides circulate cement compensated neutron log completed casing cubic feet drill collar	max. MI min. ml. MOR MR OD POOH PPCo. ppm prep. psi psig	maximum move in minute milliliter move out rotary rig maximum reading outside diameter pull out of hole Phillips Petroleum Co. parts per million prepare pounds per square inch pounds per square inch guage
deg. displ. DDNLL	degrees displace dual detector neutron lifetime log	PV RKB rmd.	plastic viscosity Kelly bushing reamed
DP drlg. EUE °F FC GL GR hr. IEL jts. KB	drill pipe drilling external upset end degrees Farenheit filter cake ground level gamma ray hour induction electric log joints Kelly bushing	rpm RUR sec. sd sx. TD temp. thds. TV vis WL	revolutions per minute rig up rotary equipment second sand sacks total depth temperature threads true vertical depth viscosity water loss (mud filtrate)
LASL	Los Alamos Scientific Laboratory	WOC	waiting on cement (to set)
LCM LT&C	lost circulation material long threaded and coupled	YP	yield point

4

#### STATEMENT OF WORK

#### **UNOCAL** Geothermal

November 3, 1993 PR #AI-8115

#### CORING IN THE GEYSERS GEOTHERMAL FIELD

The Geothermal Research Department, Organization 6111, is supporting the Department of Energy/Geothermal Division in a diamond-coring operation to be conducted in The Geysers Geothermal Field located about 100 miles north of San Francisco. The Geysers field is in jeopardy since its pressure is declining at about 10% per year. This decline is due to a loss of working fluids (primarily water), and it is an issue of concern to the geothermal industry

because The Geysers Field is one of the prime examples of geothermal development in the United States.

The DOE/GD has supported work in The Geysers for several decades, and recently Joint Industry/DOE Teams (Geysers working group) have been formulated to address the pressure-decline problem. These teams recognized that the pore structure of Geysens rocks may provide an untapped source of fluids. To study this possibility, pristine specimens of reservoir material are needed for laboratory analysis, and this material may be obtained by deepening an existing well using diamond coring techniques. The DOE/GD has placed \$400K into the FY94 budget at Sandia to support coring operations.

The purpose of this purchase requisition is to enable the coring operations by allowing up to \$400K to be spent by UNOCAL Geothermal, the operator of the existing well-of-interest. Day-to-day management of the coring will be under the directions of UNOCAL. Scientific direction for the project will come from the Joint Teams, and it will be transmitted to UNOCAL. Sandia will assist the Joint Teams in transmitting the scientific direction to UNOCAL. as necessary.

The specific tasks to be undertaken by UNOCAL are:

- 1. Initiate diamond coring operations from the bottom of an existing hole, and continue until the funds allowed by Sandia are depleted. The coring operations should start at as large a diameter as possible commensurate with hole conditions and with the scientific goals determined by the Joint Teams that oversee the project. If hole conditions become difficult, or if scientific priorities indicate, the hole diameter may be decreased. In the eventuality that hole conditions become very difficult, operations may be ceased at any time by UNOCAL, Sandia and the Joint Teams in mutual consultation, before all allowed funds are spent. In any case, UNOCAL will have the final say regarding issues of safety and concerns by regulatory bodies.
- 2. Release recovered core to Sandia and to other institutions at the advice of the Joint Teams. The ultimate disposition of the core will be determined by the Joint Teams.
- 3. Provide information on operation costs, rate of hole advancement, and percent of core recovery to Sandia on a daily basis. These data will be used to allow a cost forecasting of the operation.
- 4. Provide a summary report on drilling conditions, problems encountered, solutions employed, and engineering practices and innovations used to complete the project,
- 5. Provide information on the drilling muds and other engineering data that may cause perturbations to the Science Plan developed by the Joint Teams.
- 6. Arrange for subcontracts pertinent to the coring operations. The main coring subcontractor is to be decided upon jointly with Sandia, but details of the subcontract remain the purview of UNOCAL.
- 7. Make provisions with the drilling subcontractor for normal on-site processing and preservation of the core. Input on processing and preservation will be provided by Sandia and the Joint Teams.
- 8, Submit subcontractor involces to Sandia on a monthly basis for payment.
- 9. Limit the cost of the coring operations to \$400K.





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				AILY TOTAL JMULATIVE AFE TOTAL		23453.00 455387.50 559000.00

UNOCAL

### Unocal Energy Resour( 3 UNOCAL® Geothermal Resources and Power Generation



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### UNOCAL®



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ppg sec cc 8.40 33 20.00 Temperatures: Flowlin Mud Pumps Manufacturer Bits Last Bit: Flow Rate:	2/Ck p 32nd* 0 0.0 \$ ne: 0.0 Model	9.30 0.0 Suction:	ppm 0 1000 0.0 Max: Sik I	phsf cp 4.00 4.0 0.0 deg_F iner SPM 0.0 psi	10 Sec pl 0,00 Eff	: 10 Min. nsf 1.00 Cooling To	% 0.00 wer: N > 1	%	lbm/bbl pp	om Ibm/bbl
ppg sec cc 8.40 33 20.00 Temperatures: Flowlin Mud Pumps Manufacturer Bits Last Bit: Flow Rate: No. Bitsize in	2/Ck p 32nd* 0 0.0 § ne: 0.0 Model 0.0 gpn	9.30 0.0 Suction:	ppm 0 1000 0.0 Max: Sik I	phsf cp 4.00 4.0 0.0 deg_F iner SPM 0.0 psi	10 Sec pl 0,00 Eff 	: 10 Min: 1sf 1.00 Cooling To	% 0.00 wer: N > 1	% 0.00	lbm/bbl pp	om Ibm/bbl
ppg sec cc 8.40 33 20.00 Temperatures: Flowlin Mud Pumps Manufacturer Bits Last Bit: Flow Rate: No. Bitsize in 5 5.500	2/ Ck p 32nd* 0 0.0 S ne: 0.0 Model 0.0 gpn Serial # L31623	9.30 0.0 Suction: 1 Pi MF-Typ LY S6 Drilled	ppm 0 1000 0.0 Max: Sik I 	phsf cp 4.00 4.0 0.0 deg_F 	10 Sec pl 0.00 Eff 	: 10 Min. nsf 1.00 Cooling To	% 0.00 wer: N > 1 0 0	% 0.00 FA n2 0.000	Ibm/bbl pp	om Ibm/bbl
ppg     sec     cc       8.40     33     20.00       Temperatures: Flowlin       Mud Pumps       Manufacturer       Bits       Last Bit: Flow Rate:       No.     Bitsize in       5     5.500       No.     Depth In       No.     Depth In	2/ Ck p 32nd* 0 0.0 S ne: 0.0 Model 0.0 gpn Serial # L31623	9.30 0.0 Suction: 1 Pi MF-Typ LY S6	ppm 0 1000 0.0 Max: Sik I	phsf cp 4.00 4.0 0.0 deg_F iner SPM 0.0 psi A D C < 0	10 Sec pl 0.00 Eff 	: 10 Min. nsf 1.00 Cooling To	% 0.00 wer: N > 1 0 0	% 0.00 FA n2	Ibm/bbl pp	om Ibm/bbl
ppg sec cc 8.40 33 20.00 Temperatures: Flowlin Mud Pumps Manufacturer Bits Last Bit: Flow Rate: No. Bitsize in 5 5.500 Yo. Depth In De ft	2//Ck p 32nd* 2 0 0.0 5 ne: 0.0 Model 0.0 gpn Serial # L31623 pth:Out ft 836.0	9.30 0.0 Suction: 1 Pi MF-Typ LY S6 Drilled Distance	ppm 0 1000 0.0 Max: Sik I 	phsf         cp           4.00         4.0           0.0         deg_F           iner         SPM           0.0         psi           0         WOB           Min/Max         Min/Max	10 Sec pl 0.00 Eff Eff 32r 0 0 0 RPM Min/Mi	. 10 Min. nsf 1.00 Cooling To Cooling To Ide Ide Ide Ide Ide Ide Ide Ide Ide Ide	% 0.00 wer: N > 1 0 0	% 0.00 FA n2 0.000	Ibm/bbl pp	om Ibm/bbl
ppg     sec     cc       8.40     33     20.00       Temperatures: Flowlin       Mud Pumps       Manufacturer       Bits       Last Bit: Flow Rate:       No:     Bitsize in       5     5.500       No:     Depth In       Main     Depth In       Deft     5       Solution     Hole Assemb	2/ Ck p 32nd* 2 0 0.0 5 10 0.0 5	9.30 0.0 Suction:	ppm 0 1000 0.0 Max: Sile I ressure: se I Hours	phsf         cp           4.00         4.0           0.0         deg_F           .iner         SPM           0.0         psi           0.0         psi           0.0         psi           0.0         psi           0.0         psi           0         0           WOB         Min/Max           kip         No	10 Sec pl 0.00 Eff Eff 32r 0 0 0 RPM Min/Mi rpm	. 10 Min. nsf 1.00 Cooling To Cooling To Ide Ide Ide Ide Ide Ide Ide Ide Ide Ide	% 0.00 wer: N > 1 0 0	% 0.00 PA n2 0.000 B G	O.O	om Ibm/bbl 0 0.0
ppg     sec     cc       8.40     33     20.00       Temperatures: Flowlin       Mud Pumps       Manufacturer       Bits       Last Bit: Flow Rate:       No.     Bitsize in       5     5.500       No.     Depth In Deft       5     825.0       Bottom Hole Assemb	2//Ck p 32nd* 2 0 0.0 5 ne: 0.0 Model 0.0 gpn Serial # L31623 pth:Out ft 836.0	9.30 0.0 Suction:	ppm 0 1000 0.0 Max: Sile I ressure: se I Hours	phsf         cp           4.00         4.0           0.0         deg_F           .iner         SPM           0.0         psi           0.0         psi           0.0         psi           0.0         psi           0.0         psi           0         0           WOB         Min/Max           kip         No	10 Sec pl 0.00 Eff Eff 32r 0 0 0 RPM Min/Mi rpm	. 10 Min. nsf 1.00 Cooling To Cooling To Ide Ide Ide Ide Ide Ide Ide Ide Ide Ide	% 0.00 wer: N > 1 0 0	% 0.00 FA n2 0.000	0.0 0	om Ibm/bbl 0 0.0
ppg     sec     cc       8.40     33     20.00       Temperatures: Flowlin       Mud Pumps       Manufacturer       Bits       Last Bit: Flow Rate:       No.     Bitsize in       5     5.500       No.     Depth In Deft       5     825.0       Bottom Hole Assemb	2/ Ck p 32nd* 2 0 0.0 5 10 0.0 5	9.30 0.0 Suction:	ppm 0 1000 0.0 Max: Sile I ressure: se I Hours	phsf         cp           4.00         4.0           0.0         deg_F           .iner         SPM           0.0         psi           0.0         psi           0.0         psi           0.0         psi           0.0         psi           0         0           WOB         Min/Max           kip         No	10 Sec pl 0.00 Eff Eff 32r 0 0 0 RPM Min/Mi rpm	. 10 Min. nsf 1.00 Cooling To Cooling To Ide Ide Ide Ide Ide Ide Ide Ide Ide Ide	% 0.00 wer: N > 1 0 0	% 0.00 FA n2 0.000 B G Length:	0.0 0	om Ibm/bbl 0 0.0





Well Name: Sulpher Bank	15 Core	Report: 22 Date: 09/17/1994	Page: 2
Torque/Drag		Drill Pipe	
Check Torque Depth On Off	< String Weight> RTY PU SO	Join O.D. G S @La	nts Joints cation to Repair
Fuel on Hand: Daily Cost	Fuel Used:		
Supv & Misc H2S/Noise Abatement Location Rig Rig Move Bits/Reamers Well Control Parts Mud & Chemicals Fuel Equipment Rentals	$\begin{array}{c} 0.00\\ 110.00\\ 0.00\\ 6187.00\\ 0.00\\ 2000.00\\ 0.00\\ 1316.00\\ 2161.00\\ 480.00\\ \end{array}$	Cement & Services Air Compressors Directional Services Fishing Tools & Svcs Outside Labor & Svcs Transportation Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking	$\begin{array}{c} 0.00\\ 0.00\\ 0.00\\ 0.00\\ 1470.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 1008.00\\ \end{array}$
	Ċ	DAILY TOTAL CUMULATIVE AFE TOTAL	14732.00 422213.50 559000.00

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Well Name: Sulp	her Bank-	15 Core		Ren	ort: 2	1 r	late: 09/1	6/1994		Pan	e; 1
Sidetrack: AFE Number: Supervisor: Rig Contractor: Rig Name:	0 0 0 0 0 0 342002 Tomas/B	undy filling Co.				Size in 20.000 10.750 8.62		Top ft 0.0 0.0 -3.1		Bottom ft 28.0 499.0 394.0	
Hours Drilled: Hours Tripped: Hours Repair: Hours Other:	$\begin{array}{c} 0.00 \\ 0.00 \\ 0.00 \\ 24.00 \end{array}$					7.00	)	21.1		816.0	
Rig Days: 21 Drig Days: 17	Hours: Hours:	0 2	Depth @ 2400   Footage:	Hours:	823.0 0.0	) ft ) ft	TVD: ETD:	823.0 823.0			
Current Formation: Accidents - LTA: N 24 Hour Comments	OSHA:	N	Safety Me	etings:							
Made wiper tr back in hole. 3' of fill on Reamed and wa wiper tirp. drilling asse #/ft, K-55, S cross overs a starting from down. Made u Unable to was Released casin hanger spool. <b>00:00 To 06:00 Com</b> Laid down land with 6" bit. POH. <b>Surveys</b>	Worke bottom shed to No tigh mbly. FJ casi nd butt 633' and butt 633' and 1 and 1 and n fill ng with ments	d on le . Made . 750'. Rigged ng, 10 ress puj nd had ng join by circu shoe a	dge at 633' 2nd wiper Continued and no fill up to run 7 joints of 7 o joint. N to circulat t and ran c ulating ins t 816', top	. Contir trip. Er RIH to bot on botto " casing. " 20#/ft, et Lengtf e inside asing to ide casir of buttr	nued f ncount ottom Dm. f Rar CK-5 casir botto lg. L ress c	RIH to tered OH. n in 1 55, ST 04.58' ng and om. H Laid o casing	820'. restric culatec Laid dc 0 joint C 8Rd c 8Rd c . Hole worked ad 7' c ut 1 pu collar	Clean ction a bwn 4- cs of f casing tight pipe of fill p join is 2	at 730 de 3ro 3/4" 7" 23 going t going t. ' belo	9'. 1 9	
Planned Azimuth MD Angle	Azm	Tmp	TVD V	*****	Clos istance	sure> Azm		Total Coo (N/-S)			DLS
Mud Water L Wi Vis APIWL		IS pHF	Ci+ Y	P PV	Gel Su 10 Sec.	rength 10 Min.	Sand	Solid	MBT	Ca .	XLime
Temperatures: Flowline		Suction:	Max:		(	Cooling To	wer:				]
Mud Pumps Manufacturer	Model		Sik Line	r SPM	Eu						
Bits Last Bit: Flow Rate: No. Bitsize S	Serial #	Pro MF-Type	essure: e I A	D C <	Jet Si	Zes	> T	FA			
No. Depth In Dep	th Out	Drilled Distance	1000 L. (1000 000 000 000 000 000 000 000 000 0	OB n/Max	RPM Min/Ma	x 1 (	DDE	B G	O R		



# Unocal Energy Resour( 3 UNOCAL® Geothermal Resources and Power Generation



Well Name: Sulpher Bank1	5 Core	Report: 21 Date: 09/16	/1994 Page: 2
Bottom Hole Assemblies			
BHA #			Length: Weight:
BHA #			Length: Weight:
Torque/Drag		Drill Pipe	
Check Torque Depth On Off	< String Weight> RTY PU SO	O.D. G S	Joints Joints @Location to Repair
Fuel on Hand:	Fuel Used:		
Daily Cost			
Supv & Misc H2S/Noise Abatement Location Rig Rig Move Bits/Reamers Well Control Parts Mud & Chemicals Fuel Equipment Rentals	$\begin{array}{c} 0.00\\ 110.00\\ 0.00\\ 5967.00\\ 0.00\\ 0.00\\ 0.00\\ 654.00\\ 0.00\\ 1056.00\\ \end{array}$	Cement & Services Air Compressors Directional Services Fishing Tools & Svcs Outside Labor & Svcs Transportation Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking	$\begin{array}{c} 0.00\\ 0.00\\ 0.00\\ 0.00\\ 6491.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 347.00\\ \end{array}$
	C	DAILY TOTAL CUMULATIVE AFE TOTAL	14625.00 407481.50 559000.00

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## Unocal Energy Resour s UNOCAL®



Well Name:Sulpher Bank15 CoreSidetrack:0 0 0 0 0 0AFE Number:342002Supervisor:Tomas/BundyRig Contractor:Tonto Drilling Co.Rig Name:U 500 020-500Hours Drilled:10.50Hours Tripped:2.00Hours Repair:0.00Hours Other:11.50	Size         Top         Bottom           in         ft         ft           20.000         0.0         28.0           10.750         0.0         499.0           8.625         -3.1         394.0
Hours Tripped: 2.00 Hours Repair: 0.00	
Rig Days: 20 Hours: 0 Depth @ 2400 Hours: Drlg Days: 16 Hours: 2 Footage:	: 823.0 ft <b>TVD</b> : 823.0 ft 33.0 ft <b>ETD</b> : 823.0 ft
Current Formation: Accidents - LTA: N OSHA: N Safety Meetings:	
24 Hour Comments Continued drilling 7-3/4" sidetracked hole returns. Bit torqued up. POH. Changed by assembly. Encountered bridge/ledge at 633 650'. RIH to 661'. Reamed and washed to 6 washed hole to 803'. Drilled 7-3/4" hole to Circulated. Laid down excess CHD 134 rod to to shoe.	3'. Reamed and washed hole to 671'. RIH to 750'. Reamed and to 823' with full mud returns.
00:00 To 06:00 Comments	
Made wiper trip to shoe and laid down exces back in hole. Worked on ledge at 633'. Co 3' of fill on bottom. At 0600 hrs, making	ess CHD 134 rod on derrick. Ran Continued RIH to 820'. Cleaned out 2 2nd wiper trip.
Surveys	
Planned Azimuth MD Angle Azm Tmp TVD V.Sect	< Closure> Total Coordinates Distance Azm (N/-S) (E/-W) DLS
Mud	
Water Loss Wt Vis APIWL/Ck pH S pH FI Cl- YP ppg sec cc 32nd ppm phsf	Gel Strength PV 10 Sec. 10 Min. Sand Solid MBT Ca XLime cp phst % % lbm/bbl ppm lbm/bbl
8.69 46 30.00 3.0 10.20 0.00 700 26.00	6.0 17.00 24.00 1.00 0.00 15.0 280 0.0
Temperatures: Flowline: 128.0 Suction: 0.0 Max: 0.0 d	deg_F Cooling Tower: N
Mud Pumps	
Manufacturer Model Sik Liner S	SPM Eff
Bits	
Last Bit: Flow Rate:     0.0 gpm     Pressure:     0.0       No.     Bitsize     Serial #     MF-Type     I     A: D: C       in     I     I     I     I     D: C	.0 psi < Jet Sizes> TFA 32nd* in2
4 7.750 E8208 SM DTJ	3 32 0 0 0 0 0 0 2.356
Drilled WOB No. Depth In Depth Out Distance Hours Min/Max ft ft ft kip	
4 526.0 790.0 264.0 0.00 3.0 6.0	) 70 80 5 5 WT A 8 2 CT HR





Vell Name: Sulpher Bank Bottom Hole Assemblies	10 Core	Report: 20 Date: 09/15/	1994	Page: 2
BHA # 2 BIT-IBS-BS-XO-1	90.7DC	······	Length:	199.00 ft
			Weight:	9.9 kip
BHA #			Length: Weight:	ft kip
forque/Drag		Drill Pipe		
iheck Torque Depth On Off	< String Weight> RTY PU SO	O.D. G S	Joints @ Loca	
uel on Hand:	Fuel Used:			999-999-999-999-999-999-999-999-999-99
laily Cost				
Supv & Misc H2S/Noise Abatement Jocation Rig Bits/Reamers Vell Control Parts Aud & Chemicals Luel Aujpment Rentals	$\begin{array}{c} 0.00\\ 110.00\\ 0.00\\ 6000.00\\ 0.00\\ 0.00\\ 0.00\\ 215.00\\ 0.00\\ 1556.00\\ \end{array}$	Cement & Services Air Compressors Directional Services Fishing Tools & Svcs Outside Labor & Svcs Transportation Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking		$\begin{array}{c} 0.00\\ 0.00\\ 0.00\\ 0.00\\ 912.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 284.00\\ \end{array}$
	D2 CU	AILY TOTAL MULATIVE AFE TOTAL		9077.00 392856.50 559000.00





C	ulpher Bank1	5 Core		Report: 20		9/21/1994		ige: 1
Sidetrack: AFE Number: Supervisor: Rig Contractor: Rig Name:	0 0 0 0 0 0 342002 Tomas/Bund Tonto Drilli U 500 020-5	ng Co.			Size in 20.000 10.750 8.625	Top ft 0.0 0.0 -3.1	Bottom ft 28.0 499.0 394.0	
Hours Drilled: Hours Tripped: Hours Repair: Hours Other:	0.00 0.00 0.00 24.00				7.000	21.1	816.0	
Rig Days: 26 Drig Days: 22	Hours: 0 Hours: 2		2400 Hours:	1125.0 69.0	ft <b>TVD</b> : ft <b>ETD</b> :	1125.0 1125.0	ft ft	
Current Formatio Accidents - LTA: 24 Hour Commen	N OSHA: N		ety Meetings:					
		with 5-1/2" n survey at	core bit 1094' = 7	from 105 deg. S 4	56' to 112 10 W, BHT	5' with a = 268 deg	30% J. F.	
Core #	Depth	Footag	le %R€	ecovery	Remai	rks		
29 10 30 10 31 10 32 10 33 10 34 10 35 11	056.4 - 1064 064.4 - 1069 069.6 - 1077 077.6 - 1084 084.0 - 1094 094.0 - 1099 099.0 - 1109 099.0 - 1115	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	5.2 8.0 6.3 10.3 5.0 10.0 6.0	$ \begin{array}{r} = 100 & \% \\ = 100 & \% \\ = 100 & \% \\ = 99 & \% \\ = 103 & \% \\ = 100 & \% \\ = 100 & \% \\ = 100 & \% \end{array} $		1 1 1 1		
	115.0 - 1125	5.0 10.0	10.0	= 100 %	;	I		
00:00 To 06:00 Co Continued cu returns, RC		with 5-1/2" Flowline Te	core bit mp. = 156	from 112 deg. F.	5' to 1154	' with 8	30% mud	
38 1	Depth 125 - 1134 134 - 1144 144 - 1154	Footag 9.0 10.0 10.0	10 10	overy 0% 0% process	Remar Graywa of retriev	icke	. )	
Surveys			,	•		U		
Planned Azimuth MD Angle	Azm 7	'mp TVD	V.Sect	< Clos Distance	ure> Azm	Total Coo (N/-S)	rdinates (E/-W)	DLS
Mud								
	r Loss /L/Ck pH S : 32nd*	pH FI Cl- ppm		Gel Str V 10 Sec. p ph	10 Min. Sand		MBT Ca Ibm/bbl ppm	XLime lbm/bbl
8.40 32 24.0 Temperatures: Flowl	00 0.0 0.00 ine: 156.0 Suc	8.50 1200 tion: 0.0 Mi		3.0 0.00 _F C	0.00 0.00 ooling Tower: N	1.00	0.0 160	0.0
Mud Pumps							<u> </u>	
Manufacturer	Model	Sik	Liner SP)	M Eff				
Bits								
Last Bit: Flow Rate: No. Bitsize in	40.0 gpm Serial #	Pressure: MF-Type	100.0 I A D C	psi < Jet Siz 32nd		TFA in2		
6 5,500	L31622	LY S6		0 0 0 0	0 0 0 0	0.000		





fo. Depth In Depth Out ft ft	Drilled Distance ft	Hours	WOB Min/N kip	fax	RPM Min/N rpn	Max I O D	LBGO	R
1006.9 1125.0	118.1	38,75	3.0	5.0	150	200		
ottom Hole Assemblies HA # 3 CB-CBL-DP		·····					Length:	14.00 ft
HA# 3 CB-CBL-DP							Weight:	0.0 kip
HA #							Length: Weight:	ft kip
orque/Drag						Drill Pipe		
heck Torque epth On Off	< Strin RTY	g Weighi> ?U	so			0.D. G	Joints S @ Locati	Joints on to Repair
uel on Hand: aily Cost	Fuel Us	ed:					_,	
ipv & Misc 2S/Noise Abatement	<del></del>	( 16'	0.00	C A	Cement Vir Com	& Services pressors	<u></u>	0.00 0.00
ocation ig		( 7347	).00 7.00	F	ishing (	pressors nal Services Fools & Svcs		0.00 0.00
ig Move its/Reamers		(	).00 ).00	C T	Jutside Transpor	Labor & Svcs		750.00 0.00
ell Control Parts and & Chemicals		1081		C P	asing & roducti	Accessories on Equipment		0.00 0.00
iel quipment Rentals		80	).00 ).00	T V	ool/Equ	Trucking	E	0.00 0.00
			г	DAILY	TOTA	L		9423.00
			Ĉ	UMUI	LATIVI TOTA	Ξ		474763.50 559000.00
	,							

## **UNOCAL®** (Unocal Energy Resources and Power Generation



Well Name: Sult	oher Bank	-15 Core		Report: 25	Date: 09/2	0/1994	Page:	1
Sidetrack: AFE Number: Supervisor: Rig Contractor: Rig Name:	0 0 0 0 0 342002 Tomas/Bu Tonto Drii U 500 020-	lling Co.		i 20. 10. 8.	ize n 000 750 625	Top ft 0.0 0.0 -3.1	Bottom ft 28.0 499.0 394.0	
Hours Drilled: Hours Tripped: Hours Repair: Hours Other:	0.00 3.25 0.00 20.75			7.	000	21.1	816.0	
Rig Days: 25 Drig Days: 21	Hours: Hours:		oth @ 2400 Hours: itage:	1056.0 ft 55.4 ft	TVD: ETD:	1056.0 ft 1056.0 ft		
Current Formation: Accidents - LTA: 1 24 Hour Comments	V OSHA:		Safety Meetings:	Proper core ha	ndling			
mud returns. check bit. E out 6" of fil	Rate of Sit was w l on bot	penetrat orn out. tom. Con	1/2" core bit ion slowed dow Made up new 5 tinued cutting at 1052' but r core from 1052	n to .3 fee -1/2" core core from	t per ho bit. RI 1006' to	ur. POH H. Clean 1052' wi	to ed th	
22 1006 23 1006 24 1016 25 1026 26 1036	Depth .6'-1006 .9-1016 .6 -1026 .2- 1036 .4- 1046 .4- 1056	.9 .3' .6 9.8 .2 9.6 .4 10.2 .4 10.0	$ \begin{array}{rcrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	very 0% 0 % 8 % 0 % 1 % 0 % 2 %	Gray	Formation vacke vacke		
00:00 To 06:00 Con Continued cut		e with 5-	1/2" core bit	from 1056'	to 1078'	with 80%		
returns. ROP	= 3.6'/1	nr, Flow	line Temp. = 1	48 deg. F.				
Core # 28 105	6.4 - 106	54.4	8.0 8.0'	ecovery = 100 %	Remark Graywad			
29 106 Surveys	4.4 - 106	69.6	5.2 5.2	= 100 %	- 11			
Planned Azimuth MD Angle	Azm	Tmp 7	VD V.Sect	< Closure Distance A:	> m	Total Coordina (N/-S)	ates (E/-W) DL:	s
Mud								
Water I Wi Vis APIWL ppg sec cc		S pH Fl	CI- YP P' ppm phsf cp	******		Solid MBT % lbm/		me /bbl
8.40 33 20.00				.0 0.00 0.0		1.00 0.0	80 0	.0
Temperatures: Flowline	e: 143.0 Si	iction: 0.0	Max: 152.0 deg	r Cooling	g Tower: N			]
Mud Pumne				r				
Mud Pumps Manufacturer	Model	S	ik Liner SPN	1 Eff				
	Model	S	ik Liner SPN					
Manufacturer Bits Last Bit: Flow Rate:	40.0 gpm	Pressur	e: 100.0 p					
Manufacturer Bits Last Bit: Flow Rate: No. Bitsize in			e: 100.0 p I A D C -			FFA in2 0.000		



# UNOCAL® Unocal Energy Resoures UNOCAL® UNOCAL®



Well Name: Sulpher Bank	15 Core		Report: 25	Date: 09/2	0/1994		Page: 2	
No. Depth In Depth Out ft ft	Drilled Distance Hours ft	WOB Min/Max kip	RPM Min/Max rpm	I O D	LBG	D R		
5 825.0 1006.9 6 1006.9 1056.0	181.9 58.00 49.1 17.75	3.0 5.0 3.0 5.0	150 200 150 200	6 5 SS	A 5   N	NO PR		
Bottom Hole Assemblies								
BHA#3 CB-CBL-DP	<u></u>		<u></u>		Length: Weight:	14.00 0.0	ít kip	
BHA #					Length: Weight:		ft kip	
Torque/Drag			Drill	l Pipe				
Check Torque Depth On Off	< String:Weight> RTY PU	so	O.D.	G S	Joint S @ Loc		oints Repair	
Fuel on Hand:	Fuel Used:							
Daily Cost								
Supv & Misc H2S/Noise Abatement Location Rig Rig Move Bits/Reamers Well Control Parts Mud & Chemicals Fuel Equipment Rentals	16 707 136	0.00 5.00 0.00 5.00 0.00 0.00 0.00 0.00	Cement & Ser Air Compress Directional Se Fishing Tools Outside Labor Transportatio Casing & Acca Production Ec Tool/Equipme Vacuum Truck	ors ervices & Svcs r & Svcs n essories juipment ent Maint			$\begin{array}{c} 0.00\\ 0.00\\ 0.00\\ 926.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 347.00\\ \end{array}$	
	,	CUM	ILY TOTAL IULATIVE FE TOTAL			46	9953.00 5340.50 9000.00	

# **UNOCAL** Unocal Energy Resour



Wallillamay	1 D 1 10			Donosti De	Data	. 00/10/100		Dener	
Sidetrack: AFE Number: Supervisor: Rig Contractor:	her Bank15 0 0 0 0 0 342002 Tomas/Bundy Tonto Drillin	g Co.		Report: 24	Size in 20.000 10.750			Page: Bottom ft 28.0 499.0	<u> </u>
Rig Name: Hours Drilled: Hours Tripped: Hours Repair: Hours Other:	U 500 020-500 0.00 0.00 24.00	)			8.625 7.000		3.1 L.1	394.0 816.0	
Rig Days: 24 Drig Days: 20	Hours: 0 Hours: 2	Depth @ 1 Footage:	2400 Hours:	1000.6 92.0			0.6 ft 0.6 ft		
Current Formation: Accidents - LTA: N 24 Hour Comments		Safe	ty Meetings:						
Continued cut mud returns.	ting core v	with 5-1/2"	core bit	from 908	6.6 to 1	000.6' w	ith 90	%	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	th - 918.3 - 928.3 - 938.0 - 948.0 - 957.7 - 965.7 - 975.6 - 985.6 - 985.6 - 990.6 - 1000.6	Footage 9.7 10.0 9.7 10.0 9.2 8.0 9.9 10.0 5.0 10.0	% Reco 10.2 = 10.0 = 10.3 = 10.3 = 10.3 = 10.3 = 10.3 = 10.3 = 10.3 = 10.0 =	verv 105 % 100 % 103 % 103 % 108 % 103 % 103 % 103 % 100 %	From 60% G Argil 934' with ceous to 100	arks/For 908'to raywacke lite, fr is 80% G 20% blac shale, 20.6'ha and 25%	931', h and 40 om 931' raywack k carbo from 93 d 75% G	v % to we na- 4' ray	
Note: 1 00:00 To 06:00 Com Continued cut mud returns. check bit. B: out 6" of fill	<b>ments</b> ting core w Rate of Pe it was worr	netration s out. Made	core bit 1 slowed dowr	from 100 n to .3	0.6 to <sup>-</sup> feet per	1006.9 v r hour.	with 90 POH to Cleaned		
Core # [ 21 1000 22 1006 Surveys	Depth .6'-1006.6' .6'-1006.9	Footage 6' .3'	% Recov 100 100	)% _	6	rks/Forma Braywacko Braywacko	Э		
Planned Azimuth MD Angle	Azm Tn	ip TVD	V.Sect	< Closi Distance	ure> Azm	Total (N/-S	Coordinate:		s
Mud									
Water L Wt Vis APIWL, ppg sec cc	Ck pH S 32nd	pH:FI CI- ppm	YP PV phsf cp	phs	10 Min. Sa af	nd Solid % %	lbm/bbl	ppm lbr	Jime n/bbl
8.40 32 25.00 Temperatures: Flowline		0.00 1000 m: 0.0 Ma		.0 0.00 F C	0.00 0	.00 1.00 : N	0.0	80	0.0
Mud Pumps			a - ann an						
Manufacturer	Model	Sik	Liner SPM	i Eu					
	<u></u>		<u>, en </u>		]				
				and the second	Wele for the grant the second second second	40	in the construction of the		





Well Name: Sul	oher Bank	15 Core			Report: 1	9 D	ate: 09/1	4/1994		Pa	ıge: 1
Sidetrack: AFE Number:	00000 342002					Size		Top ft	E	Sottom ft	
Supervisor: Rig Contractor:	Tomas/Bu Tonto Dri	ndy lling Co				20.000		0.0		28.0	
Rig Name:	U 500 020	1111g Co. )-500				10.750 8.625		0.0 -3.1		499.0 394.0	
Hours Drilled: Hours Tripped: Hours Repair: Hours Other:	17.00 0.00 0.00 7.00										
Rig Days: 19 Drlg Days: 15	Hours: Hours:	0 2	Depth @ 240 Footage:	00 Hours:	790.( -3345.(		TVD: ETD:	790.0 790.0			
Current Formatio	on:										
Accidents - LTA		Ν	Safety ]	Meetings:							
24 Hour Commer Drilled out o		E22	1 to 6011	reiteb En	11						
cleaning out and had 99% r to 790'. Had formation. 00:00 To 06:00 Co	and star ock cutt I full mu	ted se	eing forma oming over	ation cu shale	ttings a shaker s	at 710' startin	. Dril ng from	lled al n 759'			
Continued dri Bit torqued	lling 7- up. POF	-3/4" h 1. RIH	ole from 7 with 7-3/	790' to 8 4" dril:	303' wit ling ass	h full sembly.	. mud r	eturns	3.		
Surveys											
Planned Azimuth MD Angle	Azm	Tmp	TVD	ViSect	< Clo Distance	sure ——> Azm		Total Co (N/-S)		/- <b>W</b> }	DLS
Mud											
Water Wt Vis APIWI ppg sec cc	21 Ck pH	S pH F	I Cl- ppm	YP P' phsf cp	V 10 Sec	rength . 10 Min. .sf	Sand %		MBT lbm/bbl	Ca ppm	XLime lbm/bbl
8.69 48 30.00	3.0 0.	0.00	) 700 3	0.00 5	.0 18.00	19.00	1.00	0.00	19.0	360	0.0
Temperatures: Flowlin	e: 146.0	Suction:	0.0 Max:	0.0 deg_	F	Cooling To	wer: N				
Mud Pumps											
Manufacturer	Model		Stk Li	ner SPN	1 Eff						
Bits	<u></u>					]					
Last Bit: Flow Rate:	0.0 gpm	Pr	essure:	0.0 p	si						
No. Bitsize in	Serial #	МҒ-Тур	e I /	ADC ·	< Jet Si 32n			FFA in2			
4 7.750	E8208	SM DTJ		3	32 0 0	0 0	0 0	2.356			
No. Depth In De tt	eth Out	Drilled Distance ft	Hours	WOB Min/Max kip	RPM Min/Ma rpm	x I O	DL	B G	O R		
4 526.0	790.0	264.0	0.00	4.0 6.0	70 8	0					
Bottom Hole Assen	nblies										
BHA# 1 BIT-IBS	S-BS-XO-190.	7DC	1			- <b> </b>		Length: Weight:		.00 ft 9.9 kip	
BHA #								Length: Weight:			





Well Name: Sulpher Bank	15 Core	Report: 19 Date: 09/14/	1994	Page: 2
Torque/Drag		Drill Pipe		
Check Torque Depth On Off	< String Weight> RTY PU SO	0.D. G S	Joints @ Location	Joints to Repair
Fuel on Hand: Daily Cost	Fuel Used:			
Supv & Misc H2S/Noise Abatement Location Rig Rig Move Bits/Reamers Well Control Parts Mud & Chemicals Fuel Equipment Rentals	$\begin{array}{c} 0.00\\ 110.00\\ 0.00\\ 5967.00\\ 0.00\\ 0.00\\ 0.00\\ 830.00\\ 0.00\\ 4265.00\end{array}$	Cement & Services Air Compressors Directional Services Fishing Tools & Svcs Outside Labor & Svcs Transportation Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking		$\begin{array}{c} 0.00\\ 0.00\\ 0.00\\ 0.00\\ 2102.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 221.00\\ \end{array}$
		AILY TOTAL JMULATIVE AFE TOTAL		13495.00 398198.50 559000.00

**UNOCAL** 



Planned Azimuth <closure< th="">       Total Coordinates         MD       Angle       Azm       Tmp       TVD       V.Sect       Distance       Azm       Total Coordinates         Mud         Mud       Water Loss       Water Loss       (N/-S)       (If/-W)       DLS         Mud       Water Loss       Water Loss       Obstance       Azm       Solid       MBT       Ca       XLime         pgg       sso       o       320 dt       Solid       MBT       Ca       XLime         pgg       sso       o       320 dt       Solid       MBT       Ca       XLime         pgg       sso       o       320 dt       Solid       MBT       Ca       XLime         pgg       sso       o       320 dt       320 dt       320 dt       320 dt       320 dt         6.69       40       30.00       4.0       10.0       14.00       0.00       2.50       12.0       320 dt       0.0         femperatures:       Hower       Model       Sik       Liner       SPM       Eff         faust Bit:       Storal       Sik       Liner       SPM       Eff       12.2       TFA       12.2</closure<>	<u></u>						
AFE Number:       342002         Supervisor:       Tomas/Bundy         Rig Contractor:       Tomas/Bundy         Rig Name:       U 300 020-5000         Hours Fiplied:       0.00         Hours Fiplied:       0.00         Hours Spilled:       0.00         Current Formation:       Cement         Accidents - LTA:       N Safety Meelings:         24 Hour Comments       CPO - To Spilled: Coment at Spilled: Go - CPE - Wild Comments         POH.       RID and Spilled: Go - CPE - Wild Comments         Correst commont with Adv Spilled: Go - CPE - Wild Cold Nrs.       POH.         RID - Comment Spilled:       CPC - CPE - Midd Cold CPE - C	Well Name: Sul	pher Bank15 Core	2	Report: 1	8 Date: 09	/13/1994	Page: 1
AFE Number:       34/2002         Supervisor:       Tomas/Bundy         Rig Camirator:       Tomas/Bundy         Rig Camirator:       Tomas/Bundy         Rig Camirator:       Tomas/Bundy         Rig Camirator:       Tomas/Bundy         Hours Tripped:       0.00         Hours Tripped:       0.00         Hours Spilled:       0.00         Current Formation:       Cement         Actionst:       TSC Ottogs:         Allaur Comments       Value Comments         24 Hour Comments       Mile Coment Mile Dibls of Tresh water, Poll, Wile Coment Scient Scient Mile Proparing         70 class Coment Mile Adv Science Scient Core.       Had Comments         70 class Coment Mile Commits at 2400 hrs.       Obs Core.         70 class Coment Mile Commits at 2400 hrs.       Obs Core.         70 class Coment Mile Mile Mile Mile Mile Mile Mile Proparing       Coreement Scient Mile Mile Mile Mile Mile Mile		00000			Size	Тор	Bottom
Rig Gamme:       Tono Drilling Co.       20.793       0.00       4503         Hours Drilled:       0.00       0.00       3.623       3.1       394.0         Hours Drilled:       0.00       17.00       3.623       3.1       394.0         Hours Dringet:       7.00       17.00       1.500       3.623       3.1       394.0         Rig Days:       18       Hours: 0       Depth @ 2400 Hours:       4135.0 ft       TVD:       4135.0 ft         Big Days:       18       Hours: 2       Footage:       0.0 ft       ETD:       4135.0 ft         Current Formation:       Cement       Ascidents: 1.17.00       Science       0.0 ft       ETD:       4135.0 ft         Current Formation:       Cement       Science       0.0 ft       ETD:       4135.0 ft         Off Diass G       Generit with 40% Stills Floury, 4% Gel, and 0.6% CFP.3       Source and the papering for next cement is 26.1 (Ling Floury, 4% Gel, and 0.5% CFP.3       Hed cement for oscient is 26.2 (Source and papering for next cement is 26.2 (Source and papering for cement is 26.2 (Source and papering for next cement is 26		342002				ft	
Rig Manne:       U 500 020-500       If 1000 3000 300 300 300 300 300 300 300 3		Tonto Drilling Co					
Hours Triplet: 0.00 Hours Repair: 0.00 Hours Repair: 0.00 Hours Other: 17.00       Peth @ 2400 Hours: 4135.0 ft       TVD: 4135.0 ft         Rig Days: 18 Hours: 0 Footage: 0.0 ft       ETD: 4135.0 ft         Out entformation: Comment Acadedms: 1.71.N 03HA: N Safety Meetings: 24 Hour Comments       Safety Meetings: 24 Hour Comments         POH, All with 5' CHD 134 rod to 772'. Circulated. Rigged up Haliburton. Primed 20 barnels: Gater Mixed and pumped 400 CF of centent slurry consisting off Class 6 Genert with 40% Silica Flour, 4% Gol, and 0.5% CFR-3. Displaced cement with 40% Silica Flour, 4% Gol, and 0.5% CFR-3. Displaced cement with 40% Silica Flour, 4% Gol, and 0.5% CFR-3. Displaced cement with 40% Silica Flour, 4% Gol, and 0.5% CFR-3. Hill cementing and iocated TOC at 660'. Circulated while preparing for next cement job. Howco mixed and pumped 201 GF Cement slurry consisting off class 6 Cement with 40% Silica Flour, 4% Gol, and 0.5% CFR-3. Hill cement with 40% Silica Flour, 4% Gol 5 hours. Rith. Located top of soft cement at 526'. WOC for 2 hours. Cleaned out cement from 526' to 533' with full mud returns at 2400 hrs.         Wind Visative Zoak and the function of the form form 533' to 691' with full mud returns. Surveys         Primed Armutis WD Angle Arm Trap TVD Vset Distance Arm (VrS) (D/W) DIS         Mud Wind Visative Zoak int Trap TVD Vset Distance Arm (VrS) (D/W) DIS         No Angle Arm Trap TVD Vset Distance Arm (VrS) (D/W) DIS         No Angle Arm Trap TVD Vset Distance Arm (VrS) (D/W) DIS         Nud Wind Mud Visative Took inf Mixer Distance Arm (VrS) (D/W) DIS         No Angle Arm Trap TVD Vset Distance Arm (VrS) (D/W) DIS         No Angle Arm Tra							
Hours Right       7.00         Hours Right       7.00         Hours Right       7.00         Hours Right       0.0 ft         Hung Days:       18 Hours: 0       Depth @ 2400 Hours: 4135.0 ft         Ung Days:       14 Hours: 2       Footage:       0.0 ft         Current Formation:       Cement         Accidents - LTA: N OSHA: N       Safety Meetings:         24 Hour Comments       POH. RIH with 5° CHD 134 rod to 772'. Circulated.       Rigged up Haliburton.         Pumped 20 Dearrels water.       Mixed and pumped 400 CF or cement slurry consisting of class 6 Gement with 40% Silica Flour, 4% 661, and 0.5% CFR-3.       Displaced cement with 40% Silica Flour, 4% 661, and 0.5% CFR-3.         R1H with cementing and displacing. CIP at 0400 hrs.       POH. W0C 3 hours.       Had comments         07 class 6 Gement with 40% Silica Flour, 4% 661, and 0.5% CFR-3.       Had comments         18 with cementing and displacing. CiP at 0400 hrs.       POH. W0C 3 hours.       Had code while preparing for next cement is 252'. W0C for 2 hours.         10 class 6 Gement with 40% Silica Flour, 4% 661, and 0.5% CFR-3.       Had comment for 533' with full mud returns at 2400 hrs.         00 continued drilling out cement from 533' to 691' with full mud returns.         Surveys       Phone Ana Tmp TYD       Y Set I Datance Ana Sulf MBT Ca XLine KiMBD ppm         Mud       Ana Tmp TYD <td>Hours Drilled:</td> <td>0.00</td> <td></td> <td></td> <td></td> <td></td> <td></td>	Hours Drilled:	0.00					
Hours Other:       17.00         Rlg Days:       18       Hours:       0       Depth @ 2400 Hours:       4135.0 ft         Ding Days:       18       Hours:       0.0 ft       TVD:       4135.0 ft         Ding Days:       18       Hours:       0.0 ft       TVD:       4135.0 ft         Current Formation:       Cement       Accidents-LTA:       N       Safety Meetings:         24 Hour Comments       PUMped       20 barrels water       Mixed and pumped 400 CF of cement slurry consisting of class G Cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Displaced cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Had good mud returns to surface while cementing and located TOC at 660'.       Chronitated while presting         7 Class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Had cement of class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Had cement of class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Had cement of class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Had cement of class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Had cement of class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Had cement from 526'         0 Closs Surface.       Pulled back to 480' and clarculated out cement from 526'       Solid Mixe Silica Flour, 4% Gel, and 0.5% CFR-3.       Had cement from 526'         0 Clos To Ge:00 Comments       Continued offiling cont cement	Hours Tripped:	7.00					
Rig Days:       18       Hours:       0       Depth @ 2400 Hours:       4135.0 ft       TVD:       4135.0 ft         Dirg Days:       14       Hours:       2       Depth @ 2400 Hours:       4135.0 ft       VD:       4135.0 ft         Current Formation:       Cemment       Accidents:LTA:       N OSHA:       N       Safety Meetings:         24 Hour Comments       POH.       Rift with 5°       CHD 134 rod to 772'.       Circulated.       Rigged up Haliburton.         Pumped 20 Genent with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Displaced cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.       Had cement rod runns to surface.         While cementing and displacing.       CIP at O400 hrs.       POH. WOC 3 hours.       Sinie cement rod runns to surface.         of rest.       Hours:       Just 2000 fm.       Hours.       Color 3 hours.       Sinie cement rod runns to surface.         of rest.       Hours:       Hours:       Clours.       Color 3 hours.       Had cement rod runns to surface.         00 of 06:00 Comments       Fourse of rest.       Hours.       Cleaned out cement rom 526'.       UO:00 for 6:00 Comments.         Continued drilling out cement from 533' to 691' with full mud returns.       Surveys       Total Coordinates.       US         Mud       Water Lass.       Dat D       <	Hours Repair: Hours Other:						
Drig Days: 14 Hours: 2 Footage: 0.0 ft ETD: 4135.0 ft Current Formation: Cement Accidents-LTA: N OSHA: N Safety Meetings: 24 Hour Comments POH. RTH with 5° CHD 134 rod to 772'. Circulated. Rigged up Haliburton. Pumped 20 Darrels water. Mixed and pumped 400 CF of cement slurry consisting of Class G Cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Displaced cement with 5 bls of fresh water. Had good mud returns to surface while cementing and displacing. CIP at 0400 hrs. POH. WOC 3 hours. RTH with cementing string and located TOC at 660'. Circulated while preparing for next cement job. How omixed and pumped 291 CF cement slurry consisting of Class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. RTH with cementing the bls ack to 480 and circulated out cement inside casing. POH. Made up 7-3/4' offiling assembly. WOE 3 hours. RTH. Located of pof soft cement at 526'. WOC for 2 hours. Cleaned out cement from 526' to 533' with full mud returns at 2400 hrs. US00 for 06:00 Comments Out of the state of the state of the state offic o							
Gurrent Formation: Coment         Accidents - LTA: N 0SHA: N       Safety Meetings:         24 Hour Comments         POH., RIH, with 5° CHD 134 rod to 772'. Circulated. Rigged up Haliburton.         Pumped 20 barrels water.       Mixed and pumped 400 CF of oement tillary consisting of splass deement with 6 bbls. If Fresh witer 6 H, dn 000 Stoc FR.3.         Numbed 20 barrels water.       Mixed and pumped 400 CF of oement tillary consisting of splass deement with 6 bbls. If Fresh witer 6 H, dn 00 Stoc FR.3.         Numbed 20 barrels water.       Mixed and pumped 201 CF coment 5.         POH. with cementing and located TOC at 660'. Circulated wille preparing for next cement indix and located TOC at 660'. Circulated wille preparing of Class 6 cement with 40% Silica Flour. 4% Gel, and 0.5% CFR.3. Had cement returns to surface.         POH. Made up 7.3/4° drilling assembly. WOC 5 hours. RIH. Located casing. POH. Made up 7.3/4° drilling assembly. WOC 5 hours. RIH. Located to 526'.         00:00 To 06:00 Comments       Continued drilling out cement from 533' to 691' with full mud returns.         Surveys       Phone Admute       Continued Admute         MD       Angle Arm Trup       TYD       Viset Distance Arm       (N/S)       (G/W)       DLS         Mud       Mud       Must Cement from 533' to 691' with full mud returns.       Surveys       Numer Soute Arm Trup       Numer Soute Arm Trup       Numer Soute Arm Trup       Numer Soute Arm Trup <td< td=""><td>Rig Days: 18 Drig Days: 14</td><td></td><td>Depth @ 2400 Hours: Footage:</td><td></td><td></td><td></td><td></td></td<>	Rig Days: 18 Drig Days: 14		Depth @ 2400 Hours: Footage:				
Accidents-LTA: N OSHA: N       Safety Meetings:         24 Hour Comments         POH., RTH with 5° CHD 134 rod to 772'. Circulated. Rigged up Haliburton.         Pumped 20 barrels water. Mixed and pumped 400 CF of cement slurry consisting of Class G Cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.         Displaced cement with 60% Silica Flour, 4% Gel, and 0.5% CFR-3.         RIH with cementing and located TOC at 660'. Circulated while preparing for next cement job. Howco mixed and pumped 291 CF cement slurry consisting of Class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3.         RIH with cementing and located TOC at 660'. Circulated while preparing for next cement at 526'. WOC for Jours. Pulled back to 480 and circulated out cement inside casing. POH. Made up 7.3/4' drilling assembly. WOC 5 hours. RIH. Located to 50 of sort cement at 526'. WOC for Jours. Class Comments         Continued drilling out cement from 533' to 691' with full mud returns.         Surveys         Phumed Atmuth         Wud         Wud         Wud         Wud         Wud         Wu Vik APDVL/CK       PIT S PHT Cit. YP       YV       CelStrugh       Said MRT cas MLmee JDm/SDD on 2.50 12.0 320 0.0         Reserves: Flowline: 10.0.0 Suction: 0.0 Max: 0.0 deg F       CeelIng Tower: N       MLMP         Mud Pumps       Said Vike Kiker SPM Eff       P2       P2       P2       P2         Advada       Sub Kiker SPM Eff	ung bays. 14		i oolugo.	0.0		4155.0 II	
24 Hour Comments         POH. RIH with 5" CHD 134 rod to 772'. Circulated. Rigged up Haliburton. Pumped 20 barrels water. Mixed and pumped 400 CF of cement slurry consisting of Class G Cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Hours. The second stream of the bals of fresh water. Had good mud returns to surface while cementing and displacing. CIP at 0400 hrs. POH. WOC 3 hours. The displaced while preparing for next cement job. How omixed and pumped 291 CF cement slurry consisting of Class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement returns to surface. Pulled back to 480' and circulated out cement inside casing. POH. Made up 7.3/4' drilling assembly. WOC 5 hours. RIH. Located top 533' with full mud returns. Surveys         00:00 To 06:00 Comments       Continued drilling out cement from 533' to 691' with full mud returns. Surveys         Planned Admuth       Vise 4200 hrs.       Total Coordinates. (N/S) (P/W) DLS         Mud       Vise 4200 hrs.       Pol Note: Aum Tmp       TYD       Vise Closure and Solid MBT Ca Stlime provide the burded primbolic for the provide the burded primbolic for the burded primbolic for the provide the burded primbolic for the provide the prime of the burded primbolic for the burded prime for the prime prime of the prime for the prime prime of the prime set of the burded prime formbolic prime formbolic prime formbolic for the prime prime of the prime precement prime pressure prime precement prim pr	<b>Current Formation:</b>	Cement					
POH. RIH with 5" CHD 134 rod to 772'. Circulated. Rigged up Haliburton. Pumped 20 Darrels water. Mixed and pumped 400 CF of cement slurry consisting of Class G Cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Displaced cement with 60 bls of fresh water. Had good mud returns to surface while cementing and isplacing. CIP at 0400 hrs, POH. WoC 3 hours. RIH with cementing string and located TOC at 660 . Circulated while preparing for next cement 100. How omixed and pumped 20 for cement slurry consisting of class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement from 528 cement from 533 to 691' with full mud returns. Surveys Planed Admuth Vis APINL/CK pHS pHFI Ch YP PV 136% IDMin Sand Sold MBT Cs XLine Mud Mud Hud Kud Kud Kud Kud Kud Kud Kud Kud Kud K	Accidents - LTA: 1	N <b>OSHA:</b> N	Safety Meetings:				
Pumped 20 barrels water. Mixed and pumped 400 CF of coment slurry consisting of Class G Cement with 60% Silica Flour, 4% Gel, and 0.5% CFR-3. Bisplaced cement joind displacing. CIP at 0400 hrs. POH. WOC 3 hours. RIH with cementing and located TOC at 660'. Circulated while preparing for next cement job. How comixed and pumped 291 CF cement slurry consisting of class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement returns to surface. Pulled back to 480' and circulated out cement inside casing. POH. Made up 7-3/4' drilling assembly. WOC 5 hours. RIH. Located top of soft cement at 526'. WOC for 2 hours. Cleaned out cement from 526' to 533' with full mud returns at 2400 hrs. 00:00 To 06:00 Comments Continued drilling out cement from 533' to 691' with full mud returns. Surveys Planed Aximuts MD Angle Arm Tmp TVD V.Sect Distance Arm (N/S) (D/W) DLS Mud Mud Mud Mud Mud Mud Mud Mud Mud Mud	24 Hour Comments						
Pumped 20 barrels water. Mixed and pumped 400 CF of coment slurry consisting of Class G Cement with 60% Silica Flour, 4% Gel, and 0.5% CFR-3. Bisplaced cement joind displacing. CIP at 0400 hrs. POH. WOC 3 hours. RIH with cementing and located TOC at 660'. Circulated while preparing for next cement job. How comixed and pumped 291 CF cement slurry consisting of class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFR-3. Had cement returns to surface. Pulled back to 480' and circulated out cement inside casing. POH. Made up 7-3/4' drilling assembly. WOC 5 hours. RIH. Located top of soft cement at 526'. WOC for 2 hours. Cleaned out cement from 526' to 533' with full mud returns at 2400 hrs. 00:00 To 06:00 Comments Continued drilling out cement from 533' to 691' with full mud returns. Surveys Planed Aximuts MD Angle Arm Tmp TVD V.Sect Distance Arm (N/S) (D/W) DLS Mud Mud Mud Mud Mud Mud Mud Mud Mud Mud	POH. RIH wit	th 5" CHD 134 r	od to 772'. Circ	ulated.	Rigged up	Haliburto	n.
<pre>while cementing and displacing. CIP at 0400 hrs. POH. WOC 3 hours. RIH with cementing string and located TOC at 660'. Circulated while preparing for next cement job. Howco mixed and pumped 291 CF cement slurry consisting of Class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFH.3. Had cement returns to surface. Pulled back to 480' and circulated out cement inside casing. POH. Made up 7.3/4" drilling assembly. WOC 5 hours. TH. Located top of soft cement at 526'. WOC for 2 hours. Cleaned out cement from 526' to 533' with full mud returns at 2400 hrs. 00:00 To 06:00 Comments Continued drilling out cement from 533' to 691' with full mud returns. Surveys Planed Azimuth MD Angle Arm Tmp TVD V.Sect Distance Arm (N/S) (E/W) DLS Mud Mud Mud Mud Water Loss MU Vus APIWL/Ck pIIS pHFH CL. YP PV CetStrength Sec 10 Min. Sund Solid MET Ca KLime iBm/bb ppm phst op phst % % iBm/bb ppm iBm/bb/ Seg 40 30.00 4.0 12.40 0.00 800 8.00 4.0 11.00 14.00 0.00 2.50 12.0 320 0.0 Temperatures: FlowIne: 100.0 Suction: 0.0 Max: 0.0 deg_F Cooling Tower: N Mud Pumps Aud Pumps Aud Pumps Aud Pumps Aud Pumps Aud Pumps Aminiature Model Sik Liner SPM Eff in Aud Pumps Aud Pumps Aud Pumps Aud Pumps Aud Pumps Aud Pumps Aud Pumps Aud Pumps Aud Distance Heurs Min/Max Min/Max L O D L B G O R N Np rpm Pime A RDM Aud Pumps Min/Max Min/Max L O D L B G O R N Np rpm Pime A RDM Aud Pumps Min/Max Min/Max L O D L B G O R N Np rpm Pime A RDM No Do D D D D D D D D D D D D D D D D D</pre>	Pumped 20 bar	rels water. 🛽	lixed and pumped 4	00 CF o	f cement sl	urrv consi	stina.
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or Class G cement with 40% Silica Flour, 4% Gel, and 0.5% CFH-3. Had cement returns to surface. Pulled back to 480° and circulated out cement inside casing. POH. Made up 7-3/4" drilling assembly. WOC 5 hours. RIH. Located top of soft cement at 526'. WOC for 2 hours. Cleaned out cement from 526' to 533' with full mud returns at 2400 hrs. 00:00 To 06:00 Comments Continued drilling out cement from 533' to 691' with full mud returns. Surveys Planed Azimuth MD Angle Azm Trop TVD V.Sect Distance Azm (N/S) (E/W) DLS Mud Mud Mud Mud Mud Mud Vis APIWL/CK pHS pHFN Ct. VP PV GelStrength ppm phst % % bom/bbl ppm Kim/bbl ppm phst % % bom/bbl ppm Kim/bbl ppm phst % % bom/bbl ppm Kim/bbl 169 40 30.00 4.0 12.40 0.00 800 8.00 4.0 11.00 14.00 0.00 2.50 12.0 320 0.0 Temperatures: Flowline: 100.0 Suction: 0.0 Max: 0.0 deg_F Cooling Tower: N Mud Pumps familaturer Model Sik Liner SPM Eff n ABIBIZE Serial # MF-Type 1 A D C <> TFA n 7.750 SE 3 32 0 0 0 0 0 0 2.356 Drilled WOB RPM And Min Min Min Min Min Min Min Min Max Min/Max 1 0 D L B G O R	while cementi	ing and displac	ing. CIP at 0400	hrs.	POH. WOC 3	hours.	
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casing. POH. Made up 7-3/4" drilling assembly. WOC 5 hours. RIH. Located top of soft comment at 526'. WOC for 2 hours. Cleaned out cement from 526' to 533' with full mud returns at 2400 hrs. OD:00 TO 06:00 Comments Continued drilling out cement from 533' to 691' with full mud returns. Surveys Planed Azmu Tmp TVD V.Sect Distance Azm (N/S) (E/W) DLS MUD Angle Azm Tmp TVD V.Sect Distance Azm (N/S) (E/W) DLS Mud Water Loss VI Vis APIWL/CK pHS pHFI Ct. YP PV GetStrength 10.9 do 30.00 4.0 12.40 0.00 800 8.00 4.0 11.00 14.00 0.00 2.50 12.0 320 0.0 Pemperatures: Flowline: 100.0 Suction: 0.0 Max: 0.0 deg_F Cooling Tower: N Mud Augumps finufacturer Model Sik Liner SPM Eff ast Bit Flow Rate: 0.0 gpm Pressure: 0.0 psi ast Bit Flow Rate: 0.0 gpm Pressure: 0.0 psi ast Bit Flow Rate: 0.0 gpm Pressure: 0.0 psi a. Bitsize Serial # MF-Type 1 A D C <> TFA in	of Class G ce	ement with 40%	Silica Flour, 4%	Gēl, and	d 0.5% CFR-	3. Had ce	ment
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to 533' with full mud returns at 2400 hrs. 00:00 To 06:00 Comments Continued drilling out cement from 533' to 691' with full mud returns. Surveys Planned Azimuth MD Angle Azm Tmp TVD V.Sect Distance Azm (N/S) (E/W) DLS Mud Mud Mud Mud Mud Mud Mud Mud	top of soft o	ement at 526'.	WOC for 2 hours	. Clea	ned out cem	ent from 5	26'
Continued drilling out cement from 533' to 691' with full mud returns.         Surveys         Planned Aximult         MD       Angle       Arm       Tmp       TVD       V.Sect       Distance       Arm       Total Coordinates         MU       Angle       Arm       Tmp       TVD       V.Sect       Distance       Arm       Total Coordinates         Mud       Mud       Mud       Sand       Solid       MBT       Case       XLime       Sand       Solid       MBT       Case       XLime         059       40       30.00       4.0       12.40       0.00       800       4.0       11.00       14.00       0.00       2.50       12.0       320       0.0         Cemperatures: Flowline:       100.0       Suction:       0.0       Max:       0.0       deg F       Cooling Tower: N         Mud Pumps       Angle       Sik       Liner       SPM       Eff       In2       Treasure:       0.0       gat 3       32       0       0       0       2.356       TFA         Int       Mid       MeTrype       1       A       D       C       Cooling Tower: N       TFA       In2	to 533' with	full mud retur	ns at 2400 hrs.				
Surveys           Planned Aximuth         Closure>         Total Coordinates           MD         Angle         Arm         Tmp         TVD         V.Sect         Distance         Arm         Total Coordinates           MUd         Angle         Arm         Tmp         TVD         V.Sect         Distance         Arm         Total Coordinates         DLS           Mud         Water Loss         Vis APIWL/Ck         pH S         pH S         Cl-         YP         PV         Gel Strength 10 Sec 10 Min. Sand Solid         Solid         MBT         Ca         XLime           ppg         sec         co         32.04         12.40         0.00         800         8.00         4.0         11.00         14.00         0.00         2.50         12.0         320         0.0           Premeratures: Flowline:         100.0         Suction:         0.0         Max:         0.0         deg F         Cooling Tower:         N           Mud Pumps         Taufacturer         Model         Site         Liner         SPM         Eff           in         n         Site         Liner         SPM         Eff         TA         D         C							
Planned Azimuth       < Closure       Total Coordinates         MD       Angle       Azm       Tmp       TVD       V.Sect       Distance       Azm       Total Coordinates         Mud       Water Loss       Water Loss       Water Loss       (N/-S)       (E/-W)       DLS         Mud       Water Loss       Water Loss       Water Loss       Obstance       Azm       Solid       MBT       Ca       XLime         pgg       860       00       30.00       4.0       12.80       Solid       MBT       Ca       XLime         Solid       MBT       Class       Obstance       PP       Vis       Gel Strength       Solid       MBT       Ca       XLime         Solid       MBT       Cas       Solid       MBT       Cas       XLime       Solid       MBT       Cas       XLime         Solid       MO.0       Solid       Max       0.0       deg_F       Cooling Tower: N       N       N       N         Mud Pumps       Inter       Site       Liner       SPM       Eff       Cooling Tower: N       TFA       N         Mud Pumps       MF-Type       1       A       D       C       Imm       S	Continued dri	lling out ceme	nt from 533' to 69	91' with	n full mud i	returns.	
MD       Angle       Azm       Tmp       TVD       V. Sect       Constraint end of the Azm       Total Coordinates         MUd         Mud         MU       Water Loss       pH S       pH FI       CL       YP       PV       US ec: 10 Min. Sand       Solid       MBT       Ca       XLime         ppg       sec       co. 32ndt       ppm       phef       cp       10 Sec: 10 Min. Sand       Solid       MBT       Ca       XLime         6.69       40       30.00       4.0       12.40       0.00       800       8.00       4.0       11.00       14.00       0.00       2.50       12.0       320       0.0         remperatures: Flowline:       100.0       Suction:       0.0       Max:       0.0 deg_F       Cooling Tower: N       N       N         Mud Pumps	Surveys						
MD         Angle         Ann         Tmp         TVD         V. Sect         Distance         Azm         (N/-S)         (E/-W)         DLS           Mud           Mud           Mud           Vis         APIWE/Ck         pH S         pH FI         Cl.         YP         pV         Get Strength phaf         Solid         MBT         Ca         XLme           http://pg         sec         0         30.00         4.0         12.40         0.00         800         8.00         4.0         11.00         14.00         0.00         2.50         12.0         320         0.0           Remperatures: Flowline:         100.0         Suction:         0.0         Max:         0.0         deg_F         Cooling Tower:         N           Aud Pumps	Planned Azimuth					<b>T</b> .(1)( <b>C</b> ) - <b>H</b>	
Mud         Water Loss oc 32ndt         pH S         pH FI         Cl. ppm         YP         PV         Gel Strength 10 Sec 10 Min.         Sand %         Solid (lbm/bbl ppm         MBT         Case (lbm/bbl ppm         XLime (lbm/bbl ibm/bbl           16.9         40         30.00         4.0         12.40         0.00         800         8.00         4.0         11.00         14.00         0.00         2.50         12.0         320         0.0           Temperatures: Flowline:         100.0         Suction:         0.0         Max:         0.0 deg_F         Cooling Tower: N         Mud           Mud Pumps	MD Angle	Azm Tmp	TVD V.Sect		******		
Water Loss APIWL/Ck         pH S         pH FI         Cl. ppm         YP         PV         Gel Strength 10 Sec. 10 Min.         Sand Sec         Solid         MHT         Ca         XLime (bm/bb)           0.90         sec         32/id*         0.00         800         8.00         4.0         11.00         14.00         0.00         2.50         12.0         320         0.0           169         40         30.00         4.0         12.40         0.00         800         8.00         4.0         11.00         14.00         0.00         2.50         12.0         320         0.0           remperatures: Flowline:         100.0         Suction:         0.0         Max:         0.0         deg_F         Cooling Tower:         N           Mud Pumps	a l						
Water Loss APIWL/Ck         pH S         pH FI         Cl. ppm         YP         PV         Gel Strength 10 Sec. 10 Min.         Sand Sec         Solid         MHT         Ca         XLime (bm/bb)           0.90         sec         32/id*         0.00         800         8.00         4.0         11.00         14.00         0.00         2.50         12.0         320         0.0           169         40         30.00         4.0         12.40         0.00         800         8.00         4.0         11.00         14.00         0.00         2.50         12.0         320         0.0           remperatures: Flowline:         100.0         Suction:         0.0         Max:         0.0         deg_F         Cooling Tower:         N           Mud Pumps							
Wit       Vis       APIWL/Ck       pH S       pH FI       Cl:       YP       PV       10 Sec. 10 Min       Sand phsf       Solid       MBT       Ca       XLime (bm/bb)         0.69       40       30.00       4.0       12.40       0.00       800       8.00       4.0       11.00       14.00       0.00       2.50       12.0       320       0.0         Temperatures:       Flowline:       100.0       Suction:       0.0       Max:       0.0       deg_F       Cooling Tower:       N         Mud Pumps       Mud Pumps       Sik       Liner       SPM       Eff       Eff       Size	Mud						
ppg       sec       cc       32nd       ppm       phsf       cp       phsf       %       %       Ibm/bbl ppm       Ibm/bbl         1.69       40       30.00       4.0       12.40       0.00       800       8.00       4.0       11.00       14.00       0.00       2.50       12.0       320       0.0         Temperatures: Flowline:       100.0       Suction:       0.0       Max:       0.0       deg_F       Cooling Tower:       N         Mud Pumps       Model       Sik       Liner       SPM       Eff       Eff       Sik       Liner       SPM       Eff         in       0.0       gpm       Pressure:       0.0       psi							<b>.</b>
.69       40       30.00       4.0       11.00       14.00       0.00       2.50       12.0       320       0.0         Iemperatures: Flowline:       100.0       Suction:       0.0       Max:       0.0       deg_F       Cooling Tower:       N         Mud Pumps	***************************************						
Temperatures: Flowline:       100.0       Suction:       0.0       Max:       0.0       deg_F       Cooling Tower: N         Mud Pumps       Model       Sile       Liner       SPM       Eff         dinufacturer       Model       Sile       Liner       SPM       Eff         distantiacturer       Model       Sile       Liner       SPM       Eff         distance       0.0       gpl       Eff       Image: Second and and and and and and and and and a						******	
Mud Pumps         Manufacturer       Model       Sik       Liner       SPM       Eff         Jilts							
Manufacturer       Model       Sik       Liner       SPM       Eff         in	Temperatures: Flowlin	e: 100.0 Suction:	0.0 Max: 0.0 deg	_F(	Cooling Tower: N		
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ast Bit: Flow Rate:       0.0 gpm       Pressure:       0.0 psi         o.       Bitsize Serial #       MF-Type       I A D C       <> Jet Sizes> TFA in2         7.750       SE       3 32 0 0 0 0 0 0 0 0 0 2.356         Drilled       WOB       RPM Min/Max         0.       Depth In Depth Out       Distance       Hours       Min/Max       Min/Max       I O D       L B G O R							
ast Bit: Flow Rate:       0.0 gpm       Pressure:       0.0 psi         o.       Bitsize Serial #       MF-Type       I A D C       <> Jet Sizes> TFA in2         7.750       SE       3 32 0 0 0 0 0 0 0 0 0 2.356         Drilled       WOB       RPM Min/Max         0.       Depth In Depth Out       Distance       Hours       Min/Max       Min/Max       I O D       L B G O R							
o.       Bitsize in       Serial #       MF-Type       I       A       D       C       <>       Jet Sizes 32nd*      >       TFA in2         7.750       SE       3       32       0       0       0       0       2.356         o.       Depth In       Depth Out ft       Distance       Hours       Min/Max kip       RPM Min/Max I       I       O       D       L       B       G       O       R	Bits						
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### UNOCAL®



BHA # 1       BIT-IBS-BS-XO-190.7DC       Length: 199.00 ft         BHA #       Length: Weight:       9.9 kip         BHA #       Length: Weight:       9.9 kip         Torque/Drag       Drill Pipe       Joints       Joints         Check       Torque        Joints       Joints       Joints         Depth       On       Off       RTY       PU       SO       O.D.       G       S       @ Location       to Repair         Fuel on Hand:       Fuel Used:       Daily Cost       0.00       Cement & Services       21866         Misc       0.00       Air Compressors       0.00       Directional Services       0.00	
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DAILY TOTAL 31193 CUMULATIVE 384703 AFE TOTAL 559000	.50

Report #17 9/12/94

Continued cleaning out bridge from 1120 to 1148 with 80% returns. Hole slonghing . Had tight hole and 10' of fill. Large amounts of cuttings were Coming over the shoker. POH to shoe. Changed slush pump liners and volve seat. Changed worn out stripper rubber on votating head. Cleaned ant mul tanks and mixed new mud. RIH with 7-3/4" cleanout assembly. Encounter bridge at 665's Cleaned out bridge to 775. POH. Made wiper trip to 103/4" shoe. RIH to 775'. No tight hole and no fill.

Report #15. 9/10/94

Continued POH to 10-3/4" shoe. Hole pulling tight all the way to 573. Built up much volume with cotton seed LCM in much pits. RIH with same 7-3/4" clean out assembly. Encountered bridge at 730'. Cleaned out bridge to 770'. RIH to 1165'. Cleaned out bridge to 125' with PLC of 50 BPH. RIH to 1465'. Cleaned out bridge to 1475'. RIH to 1694'. Cleaned out bridge blind with much 1734'. RIH to 1871. Reamed and washed 8-3/4" hole blindwith hund to 2344.

Report #16 9/11/94

Continued reaming 8-3/4" hole blind with mud from 2344' to 2580'. Centrifugal pump used for mixing mud broke lown. Running low on mud. POH. Hole tight at 2520'. Circulated and worked pipe. POH. Hole tight from 858' to 720'. Continued POH. Checked bit. Bit still ok. RIH to 394'. Built up mud volume. Continued RIH with 7-3/4" cleanout assembly, Encountered bridge at 716'. Cleaned aut bridge to 848' with partial circulation loss of 70 BPH. POH to 690' to checks if hole will stay open. Ran back to 850's RIH to 1120'. Added extra pump to gun system.

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9/9/ Cont. cleaning out hale fr. 1225 to 1670' w PLC of 25 BPH. Enc. TLC @ 1670'. Reamed and washed 970 hole blind to top of 934 hole at 1790 St. Cont. cleaning out 934" hole blind w/mud to 2200: Hole shughed - hole toglit - worked pipe.

Rpt. 13

RIH to 1034" she cleaned mud tanks & mixed new mild of cettonseed that LCU. Alt w/720 cleaneut assembly. Enc. bridge at 671. Cleaned out bridge to 710 w/ partial loss core, of 20 BPth. Note sloughing. Spent 6 hr. reaming and circ. hole clean at this spot. Cleaned out bridge to 720'. TLC. Con and worked pipe RIH by stands to 1143'. Cleaned out bridge fr. 1143 to 1221 W. partvol LC of 26 Blth Spent 2 hr. cleaning wet hole fir. 1200 to 1220° due to sloughing problem. Cleaned out bridge to 1225°. Enc. TLC, Corc. and worked pipe, regaining partial returns as of 2400 hrs.

(v) 09/06/94

cout cling out bridge to 66%. Reg. full veturns. Built up mid vol. & cleand out pridge w/ polymer mud to 680'. Cleand out bridge for 685' to 710' w/ intermittent returns. Having 5' & full. Had to ve-vean hole and shapped hivis pill as mecessary. Built up gel/lime mid in mud pits. Cleand out bridge from 710 to 747. Enc. TIC @ 748 best vegained. circulation back after 5 minutes, Cont. cleaning out the bridge w/ mud from 748 to 1499 Fire TIC or 1420 Mile alting 748 to 1439. Euc. TLC. at 1439 the getting tight. Worked pipe free. 12 09/07/94 POH to 1034" shoe, Wad tight spot fir. 1310 to 1231. RIH. Enc. bridge at Th! Cleaned out bridge to 1284 - w/ 50% veturns. Circ. Pipe got stuck while making connection. Worked pipe fixe. Cove. to condition mild & clan hol. Cleaned out bridge to 1295. Enc. The Pott. Had stight hole from 1100 to 700°, Charged bit. Making up 734" cleanous ascembly as of 2400 hr

REPORT 10 - SEPTEMBER 5, 1994 - MONDAY, LABOR DAY

CLOSED BLIND RAM, MADE LIP 74" O.D. SOCKET DRESSED TO 3" SLIP SHORT CATCH. CHECKED PRESSLIRE GALIGE ON CHOKELINE BEFORE OPENING WELL. WELL HAD 30 P.S.I. EVEN WHILE CONTINUOUSLY PLIMPING WATER DOWN ANNULLISAT 2 BPM. WELL WAS ON VACULUM AFTER PLIMPING CONDENSATE WATER FOR 3 HR. RIH W/FISHING ASSEMBLY LOC. TOP OF PACKER AT 623: CIRC. TRIED TO GET HOLD OF PACKER WO/SLICCESS. P.O.H. RIH W/PACKER-RETRIEVING TOOL POWN TO (828) HAD SUDDEN IN CREASE IN PUMP PRESSLIRE AND HAD GAINED ADDITIONAL STRING WT. P. O.H. REDOVERED & LAID DOWN PACKER. MADE UP 734" CLEAN-OLIT ASSEMBLY. RIH & ENCOLINTERED BRIDGE AT (28), CLEANED OUT BRIDGE WATER TO 651. UNABLE TO MAKE ROP CONNECT. HAP 8-10 FT OF FILL. RE-REAMED HOLE & PLIMPED 20 & BARREL MUD SWEEP.

REPORT 9 - SEPTEMBER 4, 1994 - SUNPAY

CIRCULATED OUT SAND FILL TO TOP OF BAKER INFLATABLE PACKER RETRIEVING TOOL TO 4777 FT: CIRC. TRIED TO GET AHOLD OF PACKER WO/SLICCESS. PACKER SLIPPING POWNHOLE. CHASED PACKER TO 517 FT! TRIED AGAIN TO GET AHOLD OF PACKER WO/SLICCESS. POH. FABRICATED 7" LIP GUIDE FOR BAKER RETRIEVING TOOL. RIH TO 620 FT. CIRC. WORKED RETRIEVING TOOL WO/SLICCESS. RAN BACK W/SAME FISHINGS TOOL TO 620 FT! PUMPED 168 CF HI-VIS PILL. WORKED TOOL POWN TO 623 FT. TRIED TO GET HOLD OF FISH SEVERAL TIMES WO/SLICCESS. P.O.H. CHECKED FISHING TOOL & FOLND TIP OF LIP GUIDE A LITTLE BENT N.

### **Calculation Record**

## **UNOCAL**

	PREPARED BY	CHECKED BY	DATE	PAGE OF
UBJECT 5B-15-D (RPT. 8)			W.0/A.F.E. NO.	
SAT! SEPT! 3 DAILY	REPORT (	TRANSCRIB FROM CRT	ED)	
WELDED 858" CSNG. HEAD. TO 500 PSI (OK), INSTALLED SPOOL & A 10" WKM MASTER ROTATING HEAD & FLOWLINE. PRESSLIRE-TESTED BLIND RAM W/734" BIT, LOC. T.O.C. INSI CLEANED OUT TO 370', CIRCL RAM & ANNULLAR RAM TO 500 TO 372 FT. P.O.H. PICKED FT. AS OF 2400 HRS.	P A- 10" DC VALVE. HOOKED UI \$ CHOKELI PE 85%" C1 ILATED. PI P.S.1 (OK).	NUT-400 NIPPLE UP CHOKELIN NE TO 500 SING AT 3 RESSURE CLEANEI	PONUT H BOP. IN IE & KIL PSI (OK) 341 FT. TESTED P 2 OUT CE	HANGER 15TALLI 1. LINE 1. RIH

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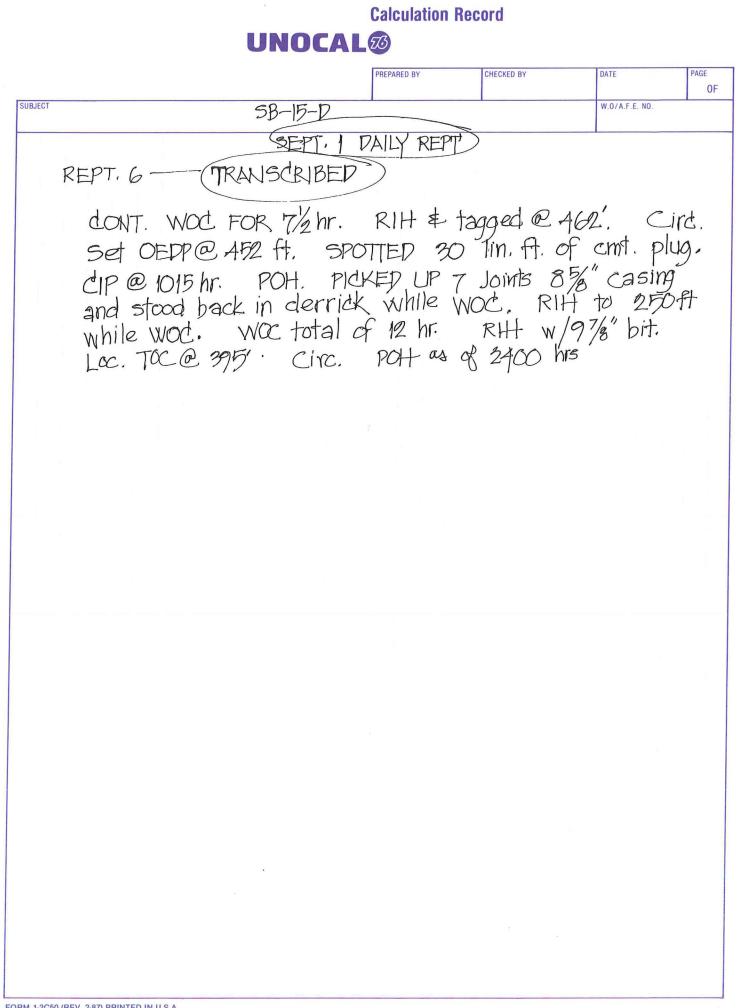


Mall Nama O 1				Densub 7		00/03/4004	Danci d
Well Name: Sulj Sidetrack:	$\frac{1}{00000}$	15 Core		Report: 7	Date: Size	09/02/1994 <b>Top</b>	Page: 1 Bottom
AFE Number:	342002				in	ft	ft
Supervisor: Rig Contractor:		rilling Co.			20.000 10.750	$\begin{array}{c} 0.0 \\ 0.0 \end{array}$	28.0 499.0
Riğ Name:	U 5000	-			8.625	-3.1	394.0
Hours Drilled: Hours Tripped:	$0.00 \\ 1.00$						
Hours Repair:	0.00						
Hours Other:	23.00				L		
Rig Days: 7 Drlg Days: 3	Hours: Hours:	2	Depth @ 2400 Hours: Footage:	4135.0 0.0	Oft <b>TV</b> Oft <b>ET</b>	<b>D:</b> 4135.0 <b>D:</b> 4135.0	ft ft
<b>Current Formation:</b>							
Accidents - LTA: 1	V OSHA:	Ν	Safety Meetings:				
24 Hour Comments							
Continued POH	I. Pres	ssure te	sted casing to 2 nt. Ran 10 join ce couplings. N 5/8" flapper flo	00 psi f	or 10 min 5/8" 36#	utes,(Ok).	Rigged
casing with s	pecial	clearan	ce couplings. N	et Lengt	h = 397.1	1'. Lande	d ted to
cool well pri	or to d	cement ca	asina. Cemented	8-5/8"	casina wi	th 124 CF	cement
slurry consi	.stina a	of Class	G Cement with 4 th 118 CF water.	0% Silic:	a Flour. :	3% Gel and	1%
cement return	is to su	irface wi	ile displacing down BOP and 1	cement.	WOC 12 h	rs. Slack	ed off
casing and la	id dowr	ig. Laid 1 10-3/4	' casing head.	U" maste Made fina	r valve. al cut on	8-5/8" ca	sing at
2400 hrs.			-				-
00:00 To 06:00 Con		ing boog	I. Pressure tes	tod casi	na haad w	ald to 500	nei
(OK). Instal	1ed 10"	-400 dor	nut hanger spool	and 10"	WKM maste	er valve.	her,
Nippled up BO connections.	PE. At	: 0600 hr	rs, tightening b	olts on w	wellhead a	and BOPE fi	Lange
Surveys							
Planned Azimuth						<i></i>	
MD Angle	Azm	Tmp	TVD V.Sect	< Clo Distance	sure> Azm	Total Coor (N/-S)	dinates (E/-W) DLS
Mud							
Water	loss			Gel St	rength		
Wt Vis APIWL		H S pH FI	CI- YP		: 10 Min. San	d Solid N	ABT Ca XLime
Temperatures: Flowlin	e:	Suction:	Max:		Cooling Tower:		
Mud Pumps							
Manufacturer	Model		Stk Liner S	9M EU			
	<u>.</u>						
Bits	ananananin'n 700000000000000000000000000000000000				<u>_</u>		
Last Bit: Flow Rate:		Pro	essure:				
	Serial #	МЕ-Тура	· IADC	< Jet S	izes>	TFA	
No. Bitsize	10000000000000000000000000000000000000	, P		•			
No. Bitsize							
No. Bilsize							
		Drilled	WOB	RPM			
No. Bilsize		Drilled Distance	WOB Hours Min/Max	RPM Min/Ma		L B G (	) R
	pth Out					LBG (	D R
						LBG(	D R





Well Name: Sulpher Bank	15 Core	Report: 7 Date: 09/02	2/1994 <b>Page: 2</b>
Bottom Hole Assemblies			······
BHA #			Length: Weight:
BHA #		J.	
			Length: Weight:
Torque/Drag		Drill Pipe	
Check Torque	<> String Weight>	<u> </u>	Joints Joints
Depth On Off	RTY PU SO	O.D. G S	@ Location to Repair
Fuel on Hand:	Fuel Used:		
Daily Cost			
Supv & Misc	0.00	Cement & Services	10783.00
H2S/Noise Abatement Location	$\begin{array}{c} 110.00\\ 0.00\end{array}$	Air Compressors Directional Services Fishing Tools & Svcs	0.00 0.00
Rig	5967.00	Fishing Tools & Svcs	0.00
Rig Move Bits/Reamers	0.00 0.00	Outside Labor & Svcs Transportation	828.00 300.00
Well Control Parts	0.00	Casing & Accessories	6329.00
Mud & Chemicals Fuel	0.00 0.00	Production Equipment Tool/Equipment Maint	0.00 0.00
Equipment Rentals	1312.00	Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking	0.00
	D		05(00.00
	CU	AILY TOTAL MULATIVE	25629.00 206677.00
		AFE TOTAL	559000.00







Well Name: Sulpi	her Bank15 Core		Report: 5	Date	: 08/31/1994	Page: 1
AFE Number: Supervisor: Rig Contractor:	0 0 0 0 0 342002 Walters/Bundy/Tom Tonto Drilling Co. U 5000	as		Size in 20.000 10.750	<b>Top</b> It 0.0	
Hours Tripped: Hours Repair:	0.00 19.50 0.00 4.50					
Rig Days: 5 Drlg Days: 1		Depth @ 2400 Hours: Footage:	4135.0 0.0		<b>VD:</b> 4135. <b>TD:</b> 4135.	
Current Formation: Accidents - LTA: N	OSHA: N	Safety Meetings	Held BOF	and H2S	meeting	
no obstruction out of hole. with top of pl sand down hole located top of down 10-3/4" of 458'. Cleaned sand fill. Cl	n. Continuous RIH with 7" Ba Lug at 477'. S sthrough OEDP. sand at 473'. casing. RIH wi lout sand to 4 P at 1900 hrs. WOC at 2400 h	le up 9-7/8" dr y pumped water ker inflatable Set OEDP at 451 Waited on sa POH. Droppe th CHD coring 68'. Placed 1 POH. Ran in urs.	in annulu packer (F '. Droppec nd to sett d additior rods. Loc 5 linear f	IS at 2 P.I.P) a 1 10 sac 1e. Ra 1al 6 sa 2ated to 2et of	BPM while nd set at ks of scr n back OE cks of sa p of sand cement on	tripping 491 eened DP nd fill at top of
Continue WOC f	or a total of continue POH to	7-1/2 hrs. Rai run 8-5/8" ca:	n in hole sing.	and tag	ged at 460	6'. POH.
Surveys		,				
Planned Azimuth MD Angle Mud	Azm Tmp	TVD V.Sect	< Clos Distance	aure> Azm	Total C (N/-S)	oordinates (E4-W) DLS
Water L Wi Vis APIWL/		CI- YP	Gel Sti PV 10 Sec.		and Solid	MBT Ca XLime
Temperatures: Flowline	Suction:	Max:	0	Cooling Tower	ſ:	
Mud Pumps						
Manufacturer	Model	Sik Liner	SPM Eff			
Bits Last Bit: Flow Rate: No. Bitsize S in	0.0 gpm Pre erial # MF-Type		0 psi < Jet Sl 32n		> TFA in2	
1 9.880 5	70682 SE M44N	1 2 1 4	0000	000	0 0.000	
No. Depth In Dep ft	Drilled Ih Out Distance 1 ft	WOB Hours Min/Max kip	RPM Min/Ma rpm	x 1 0	DLBG	O R
1 515.0	515.0 0.0	0.00 0.0 0.0	0 0	1 1	NOA1I	NO TD





Bottom Hole Assemblies BHA #	w		
BHA #			
			Length: Weight:
BHA #			Length: Weight:
Torque/Drag	<u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>	Drill Pipe	
	String Weight>		Joints Joints
Depth On Off RTY	PU SO	0.D. G S	@ Location to Repair
	iel Used:		
	570.00	Ormanit & Ormitan	4524.00
H2S/Noise Abatement	860.00	Air Compressors	0.00
Location	6016.00	Directional Services	0.00
Rig Move	0.00	Outside Labor & Svcs	374.00
Bits/Reamers	0.00	Transportation Casing & Accessories	304.00
Mud & Chemicals	0.00	Production Equipment	0.00
Fuel   Equipment Rentals	0.00 2026.00	Tool/Equipment Maint Vacuum Trucking	0.00
	D	AILY TOTAL	33595.00
	CU	JMULATIVE AFE TOTAL	158654.00
Daily Cost Supv & Misc H2S/Noise Abatement Location Rig Rig Move Bits/Reamers Well Control Parts	0.00 0.00 0.00 2026.00 D	Cement & Services Air Compressors Directional Services Fishing Tools & Svcs Outside Labor & Svcs Transportation Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking	$\begin{array}{c} 0.00\\ 0.00\\ 374.00\\ 304.00\\ 9035.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\end{array}$

# UNOCAL® Unocal Energy Resources and Power Generation



Sidetrack: 00000	-15 Core	Report	t: 4 Date: 08/3	0/1994	Page: 1
AFE Number: 342002 Supervisor: Walters/E			Size m 20.000 10.750		Bottom ft 28.0 499.0
Hours Drilled: 0.00 Hours Tripped: 0.00 Hours Repair: 0.00 Hours Other: 24.00					
Rig Days: 4 Hours: Drig Days: 0 Hours:	0 Depth @ 0 Footage	<b>2400 Hours:</b> 41 :	35.0 ft         TVD:           0.0 ft         ETD:		
Current Formation:					
Accidents - LTAN OSHA:	N Sai	fety Meetings:			
24 Hour Comments					
Rig up 100% complete rotating head, hooke tested BOPE,(OK). Op condensate water. St BPM at 2400 hrs.	d up flowline ened 3" wing	, choke line and valve. WHP = 130	d manifold. Fu ) PSI. Killed v	nctioned well using	
00:00 To 06:00 Comments	-				
Killed well at 1.6 B 0600 hrs with no obs annulus at 2 BPM to 1	truction encou	intered. Contin	nuously pumped w	water in the	of
Surveys Planned Azimuth					
MD Angle Azm	Тшр ТVD		– Closure — > nce Azın	Total Coordinates (N/-S) (E	/-W) DLS
Mud					
· · · · · · · · · · · · · · · · · · ·					
Water Loss	IS pH FI Cl-		iel Strength 0 Sec, 10 Min, Sand	Solid MBT	Ca XLime
Water: Loss Wt Vis APIWL / Ck pl				Solid MBT	Ca XLime
Water: Loss Wt Vis APIWL / Ck pl		YP PV 1	0 Sec: 10 Min, Sand	Solid MBT	Ca XLime
Water: Loss         Wt       Vis         APIWL / Ck       pf         Temperatures:       Flowline:         Mud       Pumps         Manufacturer       Model		YP PV 1	0 Sec: 10 Min, Sand	Solid MBT	Ca XLime
Water: Loss         Wt       Vis         APIWL / Ck       pf         Temperatures:       Flowline:         Mud       Pumps         Manufacturer       Model         Bits       Bits	Suction: N Stk	YP PV 10 fax:	0 Sec. 10 Min. Sand	Solid MBT	Ca XLiine
Water: Loss         Wt       Vis         APIWL / Ck       pf         Temperatures:       Flowline:         Mud       Pumps         Manufacturer       Model	Suction: M	YP PV 10 fax:	0 Sec: 10 Min. Sand Cooling Tower: Eff	Solid MBT	Ca XLime
Water Loss         Wt       Vis         APIWL / Ck       pf         Temperatures:       Flowline:         Mud       Pumps         Manufacturer       Model         Bits       Last Bit:         Flow Rate:       Manufacture	Suction: M Stk Pressure: MF-Type	YP         PV         1           fax:	0 Sec: 10 Min. Sand Cooling Tower: Eff Jet Sizes>		Ca XLime
Water Loss         Wt       Vis         APIWL / Ck       pf         Temperatures:       Flowline:         Mud       Pumps         Manufacturer       Model         Bits       Last Bit:         Flow Rate:       Manufacture	Suction: N Stk Pressure;	YP         PV         10           fax:	0 Sec: 10 Min. Sand Cooling Tower: Eff Jet: Sizes>		Ca XLime
Wt       Vis       APIWL / Ck       pf         Temperatures:       Flowline:       Mud         Mud       Pumps       Model         Manufacturer       Model         Bits       Last Bit:       Flow Rate:         No.       Bitsize       Serial #         No.       Depth In       Depth Out         Bottom Hole       Assemblies	Suction: M Stk Pressure: MF-Type Drilled	YP         PV         10           fax:	0 Sec: 10 Min. Sand Cooling Tower: Eff Jet: Sizes>	FFA B G O R	Ca XLime
Wt       Vis       APIWL / Ck       pf         Temperatures:       Flowline:       Manufactures:       Model         Manufacturer       Model       Model         Bits       Last Bit:       Flow Rate:         No.       Bitsize       Serial #	Suction: M Stk Pressure: MF-Type Drilled	YP         PV         10           fax:	0 Sec: 10 Min. Sand Cooling Tower: Eff Jet: Sizes>	FFA B G O R Length:	Ca XLime
Wt       Vis       APIWL / Ck       pf         Temperatures:       Flowline:       Mud         Mud       Pumps       Model         Manufacturer       Model         Bits       Last Bit:       Flow Rate:         No.       Bitsize       Serial #         No.       Depth In       Depth Out         Bottom Hole       Assemblies	Suction: M Stk Pressure: MF-Type Drilled	YP         PV         10           fax:	0 Sec: 10 Min. Sand Cooling Tower: Eff Jet: Sizes>	FFA B G O R	Ca XLinne



## Unocal Energy Resour



Well Name: Sulpher Bank	-15 Core	Report: 4 Date: 08/30/1	.994 Page: 2
Torque/Drag		Drill Pipe	
Check Torque Depth Ou Off	< String Weight-> RTY PU SO	O,D. G S	Joints Joints @ Location to Repair
Fuel on Hand: Daily Cost	Fuel Used:		
Supv & Misc H2S/Noise Abatement Location Rig Rig Move Bits/Reamers Well Control Parts Mud & Chemicals Fuel Equipment Rentals	$\begin{array}{r} 1824.00\\ 0.00\\ 0.00\\ 840.00\\ 66418.00\\ 3480.00\\ 650.00\\ 0.00\\ 0.00\\ 2486.00\end{array}$	Cement & Services Air Compressors Directional Services Fishing Tools & Svcs Outside Labor & Svcs Transportation Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking	$\begin{array}{c} 0.00\\ 0.00\\ 0.00\\ 0.00\\ 2939.00\\ 4472.00\\ 0.00\\ 200.00\\ 0.00\\ 0.00\\ 0.00\end{array}$
		DAILY TOTAL UMULATIVE AFE TOTAL	83309.00 125059.00 559000.00

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Well Name: S	ulpher Bank-	15 Core		Report: 3	Date: 08/2	29/1994	Page: 1
Sidetrack: AFE Number: Supervisor: Rig Contractor: Rig Name:	0 0 0 0 0 0 342002 Walters/I Tonto Di U 5000			2	Size in 0.000 0.750	Top ft 0.0 0.0	Bottom ft 28.0 499.0
Hours Drilled: Hours Tripped: Hours Repair: Hours Other:	0.00 0.00 0.00 24.00						
Rig Days: 3 Drig Days: 0		0 0	Depth @ 2400 Hours: Footage:	4135.0 ft 0.0 ft		4135.0 ft 4135.0 ft	
Current Formation Accidents - LTA:	N OSHA:	N	Safety Meetings:				
8-5/8" casi 00:00 To 06:00 (	onto U 50 g. Insta ng to loc Comments	ation.	rig. Rig up is E. Working on ch Six living trail	95% comple noke and ki ers set.	ete. Fini 11 lines.	shed water Hauled	
No activity <b>Surveys</b>	. Daylig	ht rig ι	, dr				
Planned Azimuth MD Angl	• Azm	Ттр	TVD V.Sect	< Closure Distance	> Azm	Total Coordina (N/-S)	les (E/-W): DES
Mud							
	Second Street and Antonio Street Street						
	er Loss WL/Ck p	HS pHF	CI-YP F	Gel Strenn V 10 Sec. 10		Solid MBT	Ca XLime
	WL/Ck p	H S pH Fl Suction:	EL YP F	W 10 Sec. 10		Solid MBT	Ca XLime
Wt Vis API Temperatures: Flow Mud Pumps	WL/Ck p. /line:		Max:	2V 10 Sec 10 Cool	Min. Sand	Solid MBT	Ca XLime
Wt Vis API Temperatures: Flow	WL/Ck p		Max:	W 10 Sec. 10	Min. Sand	Solid MBT	Ca XLime
Wt Vis API Temperatures: Flow Mud Pumps Manufacturer Bits	WL/Ck p /line:  Modei	Suction:	Max: Sik Liner SP	2V 10 Sec 10 Cool	Min. Sand	Solid MBT	Ca XLime
Wt Vis API Temperatures: Flow Mud Pumps Manufacturer	WL/Ck p /line:  Modei	Suction:	Max: Sik: Liner SP	2V 10 Sec 10 Cool	Min: Sand	Solid MBT	Ca XLime
Wt Vis API Temperatures: Flov Mud Pumps Manufacturer Bits Last Bit: Flow Rate: No: Bitsize	WL/Ck p (line: 	Suction:	Max: Sik: Liner SP	2V 10 Sec 10 Cool M EIT	Min: Sand		
Wt Vis API Temperatures: Flow Mud Pumps Manufacturer Bits Last Bit: Flow Rate: No. Bitsize No. Depth In	WL/Ck p. /line: 	Suction: Pri MF-Type Drilled	Max: Sik Liner SP essure: e I A D C WOB	•V 10 Sec 10 Cool M EIT < Jet Sizes 	Min: Sand	TFA	
Wt Vis API Temperatures: Flov Mud Pumps Manufacturer Bits Last Bit: Flow Rate: No: Bitsize	WL/Ck p. /line: 	Suction: Pri MF-Type Drilled	Max: Sik Liner SP essure: e I A D C WOB	•V 10 Sec 10 Cool M EIT < Jet Sizes RPM	Min: Sand	TFA	
Wt Vis API Temperatures: Flow Mud Pumps Manufacturer Bits Last Bit: Flow Rate: No. Bitsize No. Depth In Bottom Hole Asse	WL/Ck p. /line: 	Suction: Pri MF-Type Drilled	Max: Sik Liner SP essure: e I A D C WOB	•V 10 Sec 10 Cool M EIT < Jet Sizes RPM	Min: Sand	TFA B G O I Length:	
Wt     Vis     API       Temperatures: Flow       Mud Pumps       Manufacturer       Bits       Last Bit: Flow Rate:       No.       Bitsize       No.       Depth In       Bottom Hole Asse       BHA #	WL/Ck p. /line: 	Suction: Pri MF-Type Drilled	Max: Sik Liner SP essure: e I A D C WOB	•V 10 Sec 10 Cool M EIT < Jet Sizes RPM	Min: Sand	TFA B G O I Length: Weight: Length:	
Wt     Vis     API       Temperatures: Flow       Mud Pumps       Manufacturer       Bits       Last Bit: Flow Rate:       No.       Bitsize       No.       Depth In       Bottom Hole Asse       BHA #	WL/Ck p. /line: 	Suction: Pri MF-Type Drilled	Max: Sik Liner SP essure: e I A D C WOB	•V 10 Sec 10 Cool M EIT < Jet Sizes RPM	Min: Sand	TFA B G O I Length: Weight: Length:	





Well Name: Sulpher Bank-	15 Core	Report: 3 Date: 08/29/1994	Page: 2
Torque/Drag		Drill Pipe	
Check Torque Depth On Off	< String Weight> RTY PU SO		oints Joints Location to Repair
Fuel on Hand: Daily Cost	Fuel Used:		
Supv & Misc HZS/Noise Abatement Location Rig Rig Move Bits/Reamers Well Control Parts Mud & Chemicals Fuel Equipment Rentals	$\begin{array}{c} 500.00\\ 0.00\\ 0.00\\ 750.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\end{array}$	Cement & Services Air Compressors Directional Services Fishing Tools & Svcs Outside Labor & Svcs Transportation Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking	$\begin{array}{c} 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 500.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\end{array}$
	L I C	DAILY TOTAL CUMULATIVE AFE TOTAL	1750.00 41750.00 559000.00

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	Report: 2 Date: 08/28/1994 Page: 1
Sidetrack: 0 0 0 0 0 AFE Number: 342002 Supervisor: Walters/Bundy Rig Contractor: Tonto Drilling Co. Rig Name: U 5000	Size in         Top ft         Bottom ft           20.000         0.0         28.0           10.750         0.0         499.0
Hours Drilled:0.00Hours Tripped:0.00Hours Repair:0.00Hours Other:24.00	
Rig Days: 2 Hours: 0 Depth @ 2400 Hours: Drig Days: 0 Hours: 0 Footage:	4135.0 ft <b>TVD:</b> 4135.0 ft 0.0 ft <b>ETD:</b> 4135.0 ft
Current Formation: Accidents - LTA: N OSHA: N Safety Meetings: 24 Hour Comments	
Rigging up core rig. 70% rigged up. Comple 1245 hrs. Set in sub-bases. Mounted and ra <b>00:00 To 06:00 Comments</b> No activity. Rigging up, daylights only.	aised mast. Set in mud pits.
Surveys Planned Azimuth MD Angle Azm Tmp TVD V.Sect	< Closure> Total Coordinates Distance Azm (N/-S) (E/-W) DLS
Mud	
Water Loss Wt Vis APIWL / Ck pH S pH Fi Cl- YP	Gel Strength PV 10 Sec. 10 Min. Sand Solid MBT Ca XLime
Temperatures: Flowline: Suction: Max:	Cooling Tower:
Mud Pumps	M Eff
Manufacturer Model Sik Liner SF	
Bits Last Bit: Flow Rate: Pressure:	< Jet Sizes> TFA
Bits Last Bit: Flow Rate: Pressure:	
Bits Last Bit: Flow Rate: Pressure: No. Bitsize Serial # MF-Type I A D C Drilled WOB	< Jet Sizes> TFA
Bits Last Bit: Flow Rate: Pressure: No. Bitsize Serial # MF-Type I A D C Drilled WOB No. Depth In Depth Out Distance Hours Min/Max	< Jet Sizes> TFA
Bits Last Bit: Flow Rate: Pressure: No. Bitsize Serial # MF-Type I A D C No. Depth In Depth Out Distance Hours Min/Max Bottom Hole Assemblies	< Jet Sizes> TFA RPM Min/Max I O D L B G O R Length:
Bits         Last Bit: Flow Rate:       Pressure:         No.       Bitsize       Serial #       MF-Type       I       A       D       C         No.       Bitsize       Serial #       MF-Type       I       A       D       C         No.       Depth In       Depth Out       Drilled       WOB       WOB         No.       Depth In       Depth Out       Distance       Hours       Min/Max         Bottom Hole Assemblies       BHA #       Torque/Drag       Image: Constant Series       Image: Constant Series	<pre>     Sizes&gt; TFA      RPM Min/Max 1 O D L B G O R      Length:     Weight:     Length:     Weight:     Drill Pipe </pre>
Bits Last Bit: Flow Rate: Pressure: No. Bitsize Serial # MF-Type I A D C No. Depth In Depth Out Distance Hours Min/Max Bottom Hole Assemblies BHA # BHA #	<pre> </pre> Set Sizes> TFA   RPM Min/Max I O D L B G O R   Length: Weight: Length: Weight:





Well Name: Sulpher Bank	-15 Core	Report: 2 Date: 08/28/1994	Page: 2
Fuel on Hand:	Fuel Used:		
Daily Cost	······································		
Supv & Misc H2S/Noise Abatement Location Rig Rig Move Bits/Reamers Well Control Parts Mud & Chemicals Fuel Equipment Rentals	$\begin{array}{c} 0.00\\ 0.00\\ 5000.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\end{array}$	Cement & Services Air Compressors Directional Services Fishing Tools & Svcs Outside Labor & Svcs Transportation Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking	$\begin{array}{c} 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 0.00\\ 35000.00\\ 0$
	(	DAILY TOTAL CUMULATIVE AFE TOTAL	40000.00 40000.00 559000.00
	-		

e di di terre



Well Name: Sulpher	Bank15 Core		Report: 1	Date: 08/27/1994	Page: 1
AFE Number: 342 Supervisor: Wa Rig Contractor: Tor	0 0 0 2002 llters/Bundy nto Drilling Co. 5000		Size in 20.00 10.75	ft 0 0.0	Bottom ft 28.0 499.0
Hours Drilled: 0.00 Hours Tripped: 0.00 Hours Repair: 0.00 Hours Other: 24.0	0 0				
	ours: 0 Durs: 0	Depth @ 2400 Hours: Footage:	4135.0 ft 0.0 ft	TVD:4135.0ETD:4135.0	ft ft
Current Formation: Accidents - LTA: N OS 24 Hour Comments	SHA: N	Safety Meetings:	Contractor orien	tation 8-26-94	
Moved in Tonto U Held general saf interested parti 00:00 To 06:00 Commen		rig. Rigging up. tion for all cont /94 at 0900 hrs a	tractors, scie at Unocal lunc	entists and o chroom.	ther
No activity. On <b>Surveys</b>	daylights	rigging up core r	`ig.		
Planned Azimuth	zm Tinp	TVD V.Sect	< Closure Distance Azm		ordinates (E/-W) DLS
Mud					
Water Loss					
Wi Vis APIWL/Ck	pHS pHF	I CI- YP I	Gel Strength V 10 Sec. 10 Min.	Sand Solid	MBT Ca XLime
	pH.S pH F Suction:	I CI- YP I Max:			MBT Ca XLime
WL VIS APIWL/CK Temperatures: Flowline: Mud Pumps	Suction:	Max:	V 10 Sec. 10 Min. Cooling 1		MBT Ca XLime
WL VIS APIWL/CK Temperatures: Flowline: Mud Pumps			V 10 Sec. 10 Min. Cooling 1		MBT Ca XLime
WL VIS APIWL/CK Temperatures: Flowline: Mud Pumps	Suction:	Max:	V 10 Sec. 10 Min. Cooling 1		MBT Ca XLime
Wi Vis APIWL/Ck Temperatures: Flowline: Mud Pumps Manufacturer M	Suction: Iodei	Max: Sile Liner SP	V 10 Sec. 10 Min. Cooling 1		MBT Ca XLime
Wt Vis APIWL/Ck Temperatures: Flowline: Mud Pumps Manufacturer M Bits Last Bit: Flow Rate:	Suction: Iodel Pr J # MF:Typ Drilled	Max: Sile Liner SP	I 0 Sec. 10 Min.           Cooling 1           M           Eff	ower:	
Wi Vis APIWL/Ck Temperatures: Flowline: Mud Pumps Manufacturer M Bits Last Bit: Flow Rate: No. Bitsize Seria	Suction: Iodel Pr J # MF:Typ Drilled	Max: Sik Liner SP essure: e E A D C WOB	I 0 Sec. 10 Min.           Cooling 1           M           Eff	ower: > TFA	
Wi       Vis       APIWL / Ck         Temperatures: Flowline:       Image: Comparison of the second	Suction: Iodel Pr J # MF:Typ Drilled	Max: Sik Liner SP essure: e E A D C WOB	I 0 Sec. 10 Min.           Cooling 1           M           Eff	ower: > TFA	0 R
Wi       Vis       APIWL/Ck         Temperatures: Flowline:	Suction: Iodel Pr J # MF:Typ Drilled	Max: Sik Liner SP essure: e E A D C WOB	I 0 Sec. 10 Min.           Cooling 1           M           Eff	ower: > TFA O D L B G Length:	0 R





Well Name: Sulpher Bank-	15 Core	Report: 1 Date: 08/27/19	94 Page: 2
Torque/Drag		Drill Pipe	
Check Torque Depth On Off	< String Weighi> RTY PU SO	0.D. G S	Joints Joints @Location to Repair
Fuel on Hand: Daily Cost	Fuel Used:		
Supv & Misc H2S/Noise Abatement Location Rig Rig Move Bits/Reamers Well Control Parts Mud & Chemicals Fuel Equipment Rentals	$\begin{array}{c} 0.00\\$	Cement & Services Air Compressors Directional Services Fishing Tools & Svcs Outside Labor & Svcs Transportation Casing & Accessories Production Equipment Tool/Equipment Maint Vacuum Trucking	$\begin{array}{c} 0.00\\$
	D CT	AILY TOTAL JMULATIVE AFE TOTAL	0.00 0.00 559000.00

### Sandia National Laboratories

Purchasing Organization 10232 P. O. Box 5800 Albuquerque, NM 87185-5800 DOCUMENT NUMBER AI-8115

Document Date ALIG | 2 1994

Financial Rating:

This is a Contract on a Cost Sharing basis between Sandia and the Contractor noted below.

CONTRACTOR: UNOCAL CORPORATION ATTENTION: BRIAN KOENIG 3576 UNOCAL PLACE SANTA ROSA, CA 95403

This Contract includes the terms on this Signature Page and: 1. Section I bearing the above document date 2. Section II SF 6432-CR (06-91) and no other terms except as expressly agreed to in writing.

Prop: V Class: U Priority: Nonrated Insp: X Case Sub Cls: 1651010 346 Buyer: Green Org: 10232 Ph: 4-0765 Analyst: Requester: A. R. Sattler Org: 06111 Ph: 4-1019 Deliver To: Org: Bldg: Room: Recvng Rpt: 10232 103 #1 - AI-8115 \* \* U\* U\* \* 400000 \* U02362 N 103 #2 - \* \* NA NA \* \* PO CS \* \* \* \* \* \* 103 #3 -\* \* \* 1 \* 0 1 0 \* \* NS \* 0 N 3204 103 #4 083195 - \* \* \* \* 103 #5 - \* \* 103 #6 -\* \* Purchasing Approvals: SCR TL Dept PPO Dir

DOCUMENT DATE

AUG | 2 1994

### SECTION I

CLAUSE 0 - MODIFICATIONS TO SECTION II.

1. Clause A10 - Definitions are modified by:

Delete: Contract No. DE-AC04-76DP00789 Add: Contract No. DE-AC04-94AL85000

- 2. Clause R11 Patent Royalties Due AT&T is deleted in its entirety.
- 3. Clause A52 or D42 Titled Patent Indemnity is replaced in its entirety as follows:

#### PATENT INDEMNITY

- The Contractor shall indemnify Sandia and the Government and (a) their officers, agents, and employees against liability, including costs, for infringement of any United States patent (except a patent issued upon an application that is now or may hereafter be withheld from issue pursuant to a Secrecy Order under 35 U.S.C. 181) arising out of the manufacture or delivery of supplies, the performance of services, or the construction, alteration, modification or repair of real property (hereinafter referred to as "construction work") under this contract, or out of the use or disposal by or for the account of Sandia or the Government of such supplies or construction work, but only to the extent that the manufacture or delivery of supplies, the performance of services, or construction work are those that normally are or have been sold or offered for sale by any supplier to the public in the commercial open market or that are the same as such supplies or services with relatively minor modifications.
- (b) This indemnity shall not apply unless the Contractor shall have been informed as soon as practicable by Sandia or the Government of the suit or action alleging such infringement and shall have been given the opportunity as is afforded by applicable laws, rules, or regulations to participate in its defense. Further, this indemnity shall not apply to (1) an infringement resulting from compliance with specific written instructions of the SCR directing a change in the supplies to be delivered or in the materials or equipment to be used, or directing a manner of performance of the contract not normally used by the Contractor, (2) an infringement resulting from addition to or change in supplies or components furnished or construction work performed that was made subsequent to delivery or performance, or (3) a claimed infringement that is unreasonably settled without the consent of the Contractor, unless required by a final decree of a court of competent jurisdiction.

### CLAUSE 1 - STATEMENT OF WORK

#### CORING IN THE GEYSERS GEOTHERMAL FIELD

The Geothermal Research Department, Organization 6111, is supporting the Department of Energy/Geothermal Division in a diamond-coring operation to be conducted in the Geysers Geothermal Field located about 100 miles north of San Francisco. The Geysers field pressure is declining at about 10% per year. This decline is due to a loss of working fluids (primarily water), and it is an issue of concern to the geothermal industry because The Geysers Field is one of the prime examples of geothermal development in the United States.

The DOE/GD has supported work in the Geysers for several decades, and recently Joint Industry/DOE Teams (Geysers Working Group) have been formulated to address the pressure-decline problem. These teams recognized that the pore structure of Geysers rocks may provide important clues to reservoir behavior. To study this possibility, carefully collected and preserved specimens of reservoir material are needed for laboratory analysis, and this material may be obtained by deepening an existing well using diamond coring techniques.

Day-to-day management of the coring will be under the directions of UNOCAL. Scientific direction for the project will come from the Joint Teams, and it will be transmitted to UNOCAL. Sandia will assist the Joint Teams in transmitting the scientific direction to UNOCAL as necessary.

The specific tasks to be undertaken by UNOCAL are:

- 1. Initiate diamond coring operations from the bottom of an existing hole, and continue until the funds allowed by Sandia are depleted. The coring operations should start at as large a diameter as possible commensurate with hole conditions and with the scientific goals determined by the Joint Teams that oversee the project. If hole conditions become difficult, or if scientific priorities indicate, the hole diameter may be decreased. In the eventuality that hole conditions become very difficult, operations may be ceased at any time by UNOCAL, Sandia and the Joint Teams in mutual consultation, before all allowed funds are spent. In any case, UNOCAL will have the final say regarding issues of safety and concerns by regulatory bodies.
- 2. Sandia requests that the recovered core be delivered to:

UURI Research Park Earth Science Department Attn: Jeffrey Hulen 391 Chipeta Way, Ste C Salt Lake City, Utah 84108

UNOCOL may retain any portion of the core agreed to by the Sandia Delegated Representative (SDR).

or

- 3. Provide information on operation costs, rate of hole advancement and percent of core recovery to Sandia on a daily basis. These data will be used to allow a cost forecasting of the operation.
- 4. Provide a summary report on drilling conditions, problems encountered, solutions employed, and engineering practices and innovations used to complete the project.
- 5. Provide information on the drilling muds and other engineering data as requested that may cause perturbations to the Science Plan developed by the Joint Teams.
- 6. Arrange for subcontracts pertinent to the coring operations. The main coring subcontractor is to be decided upon jointly with Sandia, but details of the subcontract remain the purview of UNOCAL.
- 7. UNOCAL will make any necessary arrangements for processing and preservation of the core. These arrangements will be made in consultation with the Joint Teams who will provide a site specific Core Protocol.

### CLAUSE 2 - SUBCONTRACTS

Subcontracting effort, identified below, is authorized under this contract.

Subcontractor name:	Description of <u>effort to be furnished</u> :		
Tonto Drilling Services, Inc. Salt Lake City, UT	Wireline coring		
M-I Drilling Fluids Company Healdsburg, CA	Drilling fluids		
Epoch Well Logging, Inc. Bakersfield, CA	Core logging/handling		
See Section II Standard Terms and Labor Hours Contracts, Clause A35			

#### CLAUSE 3 - PERIOD OF PERFORMANCE

The term of this contract shall be from May 1, 1994 through a period of one year.

### CLAUSE 4 - PRECONTRACT COSTS - 212-KPC (12-92)

Costs and/or commitments incurred subsequent to May 1, 1994 in the performance of the scope of work of this contract and charged to the Contractor's job number 342002 will be allowable to the extent that these costs would have been allowable if incurred after the date of this contract; and provided that these costs and/or commitments do not exceed \$200,000.00 prior to the date of this definitive contract.

### CLAUSE 5 - CEILING PRICE

The ceiling price for this contract is \$400,000.00

Sandia shall not be obligated to make any additional payments and the Contractor shall not be obligated to furnish further services, when cumulative billings under this contract total the above amount, or a lesser amount as indicated in the "Limitation of Obligation" Clause, if such an clause appears in this contract.

Contractor shall give written notification to Sandia's Contracting Representative, when billings total 75% of the ceiling price.

### CLAUSE 6 - LIMITATION OF OBLIGATION - NON-FIXED PRICE CONTRACTS - 220-KLM (05-92)

Funding for the performance of this contract is authorized in accordance with the schedule given herein, until this contract clause is amended. Contractor shall not incur costs and/or make commitments for expenditures allowable under this contract in excess of the amount shown for the period ending at the date listed. When no date is stated, the funding limitation remains in full force and effect until this contract clause is amended, or until expiration of the contract. The limitation of obligation amount shown on each line is cumulative through the indicated time period(s).

#### CLAUSE 7 - ESTIMATE OF COST STATUS - 249-CH (05-92)

Contractor shall furnish to the SCR:

- (a) With the quotation, an estimate of the percentage of cost which will be incurred each month from start to finish of the proposed contract.
- (b) After award of contract, a Contractor's Monthly Cost Status Report in a form prescribed or agreed to by the SCR to reach the SCR not later than the 15th of each month following the report period or at such other time as requested by the SCR during contract.

\$333.33

0.00

#### CLAUSE 8 - ALLOWABLE CHARGES

Labor

Cost of drilling for core per linear foot (Include all costs - equipment, manpower, G&A, etc. Provide a cost breakout for each cost element included in this proposal.)

Fixed Fee

1) \$9,000 total cost per day for drilling operations

2) Penetration rate equals 75 ft./day

3) \$145,000 (of the \$400,000) available for wireline coring

4) Total penetration is 12000 ft.

The calculations are:

\$145,000/\$9,000/day - approximately 16 days

16 days x 75 ft./day = 1,200 ft.

\$400,000/1200 ft. = <u>\$333.33/linear foot</u>

Sandia will Cost Share this contract. The Sandia share will be \$400,000.00. In the event all funds are not used, a portion of the funding will be returned to Sandia. In the event that the project exceeds the \$400,000.00, Sandia will not be liable for any additional costs. The Cost Share breakout is shown on Attachment 1 - Summary of Shared Costs.

#### CLAUSE 9 - SANDIA NORMAL WORK HOURS AND HOLIDAYS

Sandia, Albuquerque normal work hours are:

8:00 AM to 4:30 PM, Monday through Friday.

Due to Sandia's observance of the below listed holidays, no work will be available at Sandia for the Contractor's employees under this contract on those days (except on an emergency basis as discussed in Clause I, Statement of Work:

- 1. Memorial Day
- 2. Independence Day
- 3. Labor Day
- 4. Thanksgiving Day
- 5. The six working days comprising the Christmas/New Year holiday season
- 6. Energy Conservation Day; date varies

Normally, when a holiday falls on Saturday, the preceding Friday is observed as the holiday; if the holiday falls on Sunday, the following Monday is observed as the holiday.

### CLAUSE 10 - BILLING

Contractor's billing shall be submitted only once each month and shall include:

- · Contract number
- Hours worked by labor category and by person(s) populating that category(ies)
- Listing of all purchased supplies/materials with quantities and prices of same
- Travel expenses with a detailed cost breakdown by trip by person showing dates and times of day that travel occurred, air fare, car rental, lodging, meals, etc.

CLAUSE 11 - DELEGATION OF AUTHORITY - 404-KDA (06-91)

The following Sandia personnel are hereby authorized to act as official representatives of Sandia for the specific purpose(s) shown.

Delegated representatives shall exercise no supervision over the Contractor's employees.

DELEGATE(S) PHONE (	ORG.	NO.	PURPOSE(S)
---------------------	------	-----	------------

Allan	Sattler	505	6111
		844-1019	MS 1033

At any time during the term of this Contract, the Sandia Delegated Representative (SDR) may assign work within the scope of this Contract's Statement of Work, authorize travel, approve invoices, approve time records and inspect/accept work in process or completed. The SDR serves as the technical liaison.

<u>NOTE</u>: The Sandia Contracting Representative (SCR) is the only person who can legally obligate Sandia for the expenditure of funds, change scope and/or level of effort and/or terms and conditions, negotiate, and sign documents legally binding Sandia. COMMITMENT, OBLIGATIONS OR PROMISES, IMPLIED OR EXPRESSED, BY SANDIA PERSONNEL OTHER THAN THE SCR DO NOT BIND SANDIA IN ANY MANNER.

CLAUSE 12 - TERMINATION OF DEFINED BENEFIT PENSION PLANS - 228-BP (02-92)

In the event this contract or any amendment, thereto, required Current Cost or Pricing Data to be submitted, the Contractor shall promptly notify the Sandia Contracting Representative (SCR) in writing when it determines that it will terminate a defined benefit pension plan or otherwise recapture such pension fund assets. If pension fund assets revert to the Contractor or are constructively received by it under a termination or otherwise, the Contractor shall make a refund or give a credit to Sandia or the Government for its equitable share. The Contractor shall include the substance of this clause in all subcontracts under this contract, which are subject to Current Cost or Pricing Data.

#### CLAUSE 13 - INCORPORATION OF SUPPLEMENTAL TERMS AND CONDITIONS - 840-SX

The following Clause(s) contained in the Supplemental Terms and Conditions, SF 6432-STD (10-92), are hereby incorporated into this contract.

Clause No.	Title
206-CX	Cost Accounting Standards Notices and Clauses for National Defense Contracts
301-RN	Patent and Technical Data Provision
412-SC	Service Contract Act of 1965, as Amended
614-CP	Contractor/Subcontractor Personnel List

826-OS Organizational Conflicts of Interest - Special

CLAUSE 14 - MODIFICATIONS TO SUPPLEMENTAL TERMS AND CONDITIONS

CLAUSE 301-RN - PATENT AND TECHNICAL DATA PROVISIONS, Section VII (g) <u>Protection of Limited Rights Data and Restricted Computer Software</u> has been changed to read as follows:

- (1) When data other than that listed in subparagraphs (b)(1)(i), (ii), and (iii) above are specified to be delivered under this contract and qualify as either limited rights data or restricted computer software, if the Contractor desires to continue protection of such data, the Contractor shall withhold such data and not furnish them to Sandia or the Government under this contract. As a condition to this withholding, the Contractor shall identify the data being withheld and furnish form, fit, and function data in lieu thereof. Limited rights data that are formatted as a computer data base for delivery to Sandia or the Government is to be treated as limited rights data and not restricted computer software.
- (2) [Reserved.]

(3) [Reserved.]

DOCUMENTS INCORPORATED BY REFERENCE, IN CONTRACTOR'S POSSESSION: Monthly Cost Status Report - SF 6432-CS Supplemental Terms and Conditions, SF 6432-STD (10-92) Attachment 1 - Summary of Shared Costs, 2 pages

	Sandia/DOE		Unocal
Location (site) work			
Prepare a level surface for rig	\$10,000		
Mobilization/Demobilization	\$127,000		
Casing			
7" (w/ special clearance couplings)	\$25,000		\$25,000
8 5/8" (w/ special clearance couplings)	\$5,000		\$5,000
Cement + Packers	\$7,500		\$7,500
7" wellhead (w/valves and hanger)	\$7,500		\$7,500
3 Days rig time to prepare well for coring	\$15,000		\$15,000
Bits			
Rotary and diamond coring	\$17,000		
Drilling Fluids	\$22,000		\$10,000
Rerun 7" casing for injector			
7" Perforated Casing			\$7,500
Cement + Plugs			\$5,000
1 Rig Day time to prepare well for injection			\$15,000
Geologic Service Co.	\$17,000		
20 days including supplies and trailer			
Wireline Coring			
16 Days: includes rig day rate, footage			
charge, and support equipment rental	\$145,000		
Core shipping			
(Geysers to Salt Lake City)	\$2,000		
Drilling Supervision			
For coring only (25 days)		*	\$15,000
Field Support			
mechanical, electrical, equipment, etc.		*	\$15,000
monanoai, oronnai, quipinoit, cu.		•	φ10,000

Lost Generation Revenue			
30 days @ 18 MWe/day		*	\$12,300
General and Administrative			
Logistics, accounting, reporting, etc.			
100 person-days		*	\$50,000
Total	\$400,000		\$189,800

### \* These figures represent in-kind costs borne by Unocal to permit additional core recovery