GL01919

Bruce

THERMAL POWER COMPANY
Santa Rosa Office

Project Title: Cascade Geothermal Drilling

CLACKAMAS 5000-FOOT THERMAL GRADIENT HOLE

Cooperative Agreement No. DE-FC07-85ID12614

Project Period: 9/30/85 thru 9/30/87

PROJECT MANAGEMENT PLAN
30 October 1985

Submitted by:
Thermal Power Company
3333 Mendocino Avenue
Santa Rosa, Calif. 95401

W. L. D'Olier
Participant
Project Manager

Approved by:
U.S. DOE, Idaho Operations Office
785 DOE Place
Idaho Falls Idaho 83402

Susan Prestwich
DOE Project Officer

PROJECT SUMMARY

Thermal Power Company, under a Cooperative Agreement dated 30 September 1985 with the U. S. Department of Energy - Idaho Operations Office, will drill and core the Clackamas 5000-Foot Thermal Gradient Hole during June and July 1986. Thermal will select all subcontractors, upon the completion of evaluations now in progress, to accomplish this Hole and its related important Data Collection Program in accordance with a Statement of Work included in both the Cooperative Agreement and this Project Management Plan.

Approximately 12 Thermal professional employees will be involved in the planning, prosecution and management of the work tasks, subcontractors and data collection for timely delivery to DOE. Milestone achievements, mutually determined by Thermal and DOE, will control payment of a maximum 50% DOE share of authorized costs, not to exceed $240,000. Thermal will provide a 12-month borehole access period to DOE following the expected August 1986 completion of the Thermal Gradient Hole. Thermal will provide its Final Technical Report to DOE before termination of the Cooperative Agreement on 30 September 1987. Thermal may elect to retain the Thermal Gradient Hole at its sole cost, risk and legal responsibility rather than to abandon it and restore the drillsite as allowed in the Cooperative Agreement.

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Project Management Plan
Clackamas 5000-Foot Thermal Gradient Hole

The Cooperative Agreement, effective as of 30 September 1985, between Thermal Power Company and U. S. Department of Energy - Idaho Operations Office (see Appendix 1), requires an approved Project Management Plan by 30 October 1985. Thermal Power Company has formulated this Project Management Plan based on the important Statement of Work included in the Cooperative Agreement (see Appendix 2).

Six major, sequential work sectors for Thermal are evident in this Project as follows:

1. Plan, permit and environmental approvals required of DOE, BLM, USFS, Oregon State and Marion County authorities.

2. Evaluate and select subcontractors for drilling-coring, geophysical logging and wellsite data collection.

3. Drilling-coring the 5000-foot Thermal Gradient Hole within time and cost estimates.

4. Data collection, its quality control and early delivery to DOE - Idaho Falls.

5. Providing the 12-month Hole access period to DOE.

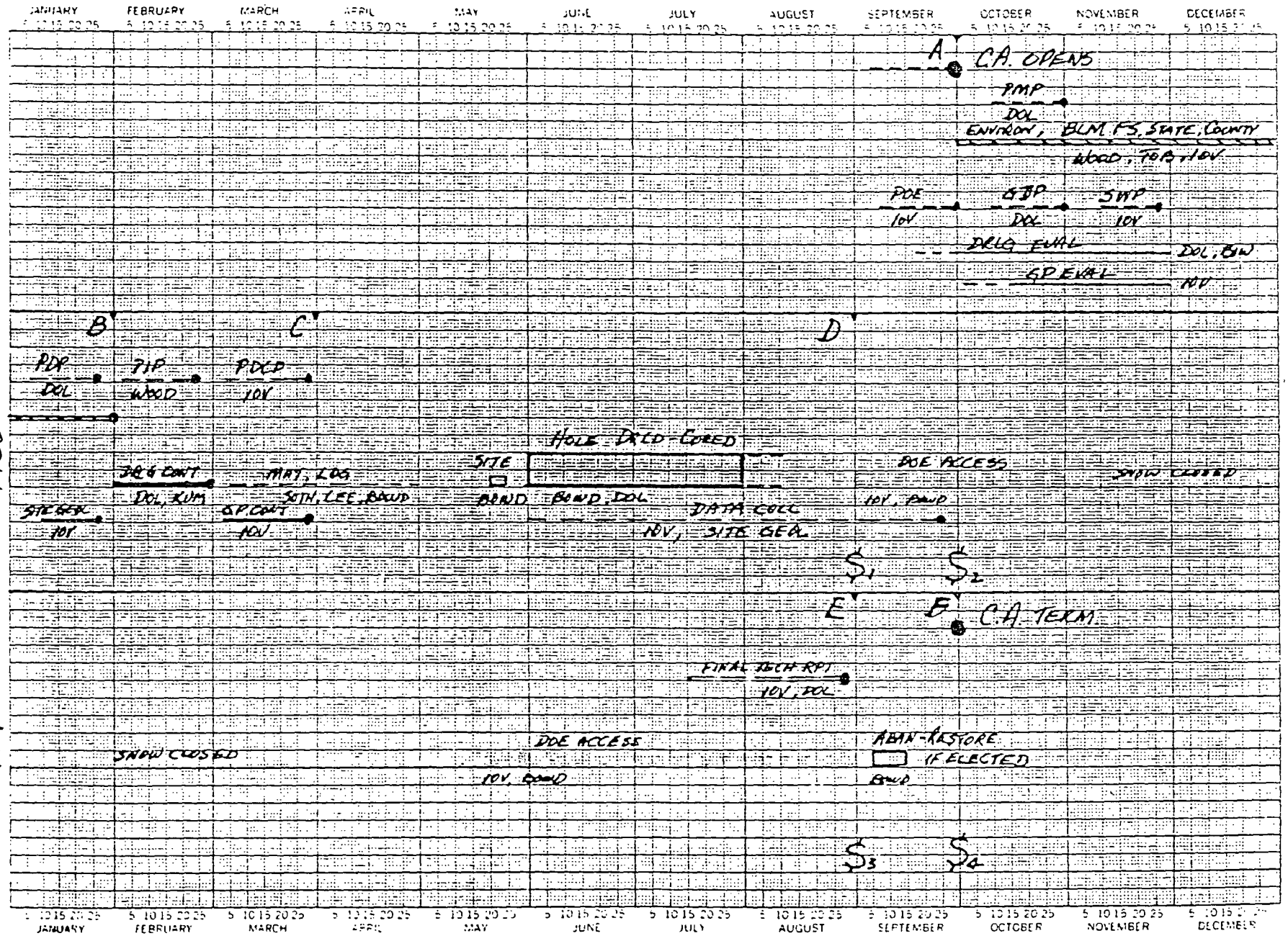
6. Submitting cost accounting, supported by subcontractor invoices for progress payments in accordance with the Payment Milestone Schedule.

7. Submit Final Technical Report, abandon Hole and restore drillsite if elected, and terminate Cooperative Agreement at the end of its 24-month term.

The foregoing sequential work sectors are presented in the following table of Activity Milestones and Work Tasks. The Work Tasks are also illustrated on the succeeding Project Schedule Timeline which additionally shows the key Thermal personnel accountable for each Work Task.

Term Month Time	Activity Milestones and Work Tasks
0	**A. MILESTONE: Cooperative Agreement Executed on 9/30/85**
	1. Prepare and submit multiple Plans, Reports, Permits:
	Plan of Exploration (POE) to BLM and USFS
	Project Management and Drilling Plans to DOE
	Environmental Evaluation (EE) Support to BLM and DOE
	Geothermal Drilling Permit (GDP) to BLM
	2. Conduct Subcontractor Evaluations
End 4	**B. MILESTONE: POE, GDP and EE Approved by 1/30/86**
	3. Project Institutional Data Collection Plans to DOE
	4. Make Subcontractor Selections and initial contract negotiations
End 6	**C. MILESTONE: Drilling & Geophysical Subcontracts Signed by 3/31/86**
	5. Integrate Subcontractors and logistics with Project Drilling Plan
	6. Prepare drillsite and water supply; move-in drilling rig
	7. Execute Drilling and Data Collection Plans in June-July
End 11	**D. MILESTONE: Complete Thermal Gradient Hole at 5000-feet by 8/31/86**
	8. Open and maintain borehole and drillsite for DOE 12-month access period
	9. Review-confirm full compliance, costs and payments
End 23	**E. MILESTONE: Close DOE Access Period by 8/30/87**
	10. If TPC elects, abandon the Thermal Gradient Hole and fully restore the drillsite to its original condition. Alternatively, TPC may elect to preserve the hole and drillsite at its sole cost, risk and legal responsibility.
End 24	**F. MILESTONE: Terminate Cooperative Agreement on 9/30/87**

PROJECT SCHEDULE TIMELINE
CLACKAMAS 5000 FOOT THERMAL GRADIENT HOLE



Thermal Power Company Personnel: Project Assignments

The Geothermal Exploration staff, located in Thermal's Santa Rosa, California office, (707/576-7022) will lead the twelve person group that will accomplish this Project. The key persons are:

W. L. D'Olier, Vice President - Geothermal Exploration

Joe Iovenitti, Senior Geologist

Royce Bowden, Geothermal Drilling Supervisor

D'Olier as Project Manager is the accountable person for the completion of all work under this Cooperative Agreement.

The following Work Task assignments are made for this Project.

Work Task	Persons Responsible	
Leases	Wood, Kumin	
Plans, Permits	D'Olier, Iovenitti, Wood	
Environmental	Tobias, Wood	
	Drilling/Coring	Data Objectives
Subcontractor Selection	D'Olier Bowden Sutherland Lee	D'Olier Iovenitti Lee
Contracts	D'Olier Kumin Walker	D'Olier Kumin Walker
Drillsite Preparation	Bowden Iovenitti	
Thermal Gradient Hole Drill-Core-Log	D'Olier Bowden	Iovenitti Hebein Goyal Wellsite Geologists
Cost Accounting	Scott, D'Olier	
DOE Access	Iovenitti, Bowden	
Final Report	Iovenitti, D'Olier	
Termination	D'Olier, Kumin	

Management Techniques

The Project Manager will establish a comprehensive understanding of the Project objectives and its integrated, sequential Work Tasks with the Thermal Power Company personnel group assigned. Each Work Task has an experienced lead person assigned to it and they are teamed with support persons to ensure its careful preparation and execution. A constant use and upgrading of the Project Schedule Guideline will guide the work inputs. At the achievement of each Activity Milestone (Events A thru E), the Thermal personnel group will meet to review work quality, problems, updated schedules and any Project modifications that may be required. The Project Manager and key employees will review and summarize Project progress both monthly and quarterly. A long practiced teamwork and a high level of internal, informal communications will allow the Thermal personnel to effectively prosecute all Work Tasks as required by the Project Schedule Guideline and the Statement of Work. A current Table of Organization for Thermal Power Company is included as Appendix 4 of this Plan.

Subcontractor Selection Process

The Thermal Power Company geothermal operations experience underscores the great importance of first class subcontractor participants in executing drilling programs and related field work for coherent results and success to be achieved.

For the Drilling and Geophysical Logging subcontractors, we will:

1. Interview managers and key persons to obtain measures of each firm's competence and geothermal specific experience. We will cross check these findings with other client geothermal operators, if possible. We are evaluating Boyles Bros., Tonto, Longyear and Jannsen as qualified Drilling Subcontractors. BPB Instruments, Inc., Colorado Well Logging, Inc., Georand, and Southwest Surveys are being evaluated as potential Geophysical Logging Subcontractors.

2. We are looking at the specific rigs and borehole logging equipment proposed to be used. We will attempt to additionally examine these critical items in on-site working modes.

3. The critical Project requirements will be examined with the most qualified candidates to select the best equipment and technical procedures at acceptable costs.

4. First Quarter 1986 cost estimates will be solicited for the basic work programs for further qualification of expected performance and cost values. This will not be worked as a competitive bidding for the lowest cost selection basis.

5. Selection of a final subcontractor will be based on TPC combined consideration of equipment, personnel, relevant experience and reasonable costs.

Project Cost Accounting and DOE Progress Payments

Thermal Power Company will submit invoices in accordance with Articles IV and V of the Schedules Articles attached to the Cooperative Agreement. The following table shows the Progress Payment Milestones and the DOE payable limits.

	Progress Payment Milestones	Maximum Cumulative Amount Payable by DOE	Probable Date
1.	Drilling and Hole Completed	$170,000	8/30/86
2.	Logs and Fluid Data Submitted to DOE	$202,500	9/30/86
3.	Remainder of Data and Final Report Submitted to DOE	$215,000	8/30/87
4.	Abandonment and Site Restoration Completed:		
	Total Maximum Payable by DOE	$240,000	9/30/87

These Progress Payment Milestones are also shown on the Project Schedule Timeline with the symbol "$". An additional, detailed Summary of Cost, Schedule and Deliverability is included as Appendix 3 of this Project Management Plan as a subordinate reference.

DOE F 4600.2
(7-81)

U.S. DEPARTMENT OF ENERGY

NOTICE OF FINANCIAL ASSISTANCE AWARD

(See Instructions on Reverse)

Under the authority of Public Law 93-410 and subject to legislation, regulations and policies applicable to *(cite legislative program title)*:
Geothermal Research, Development and Demonstration Act of 1977

1. PROJECT TITLE
Cascade Geothermal Drilling

2. INSTRUMENT TYPE
☐ GRANT ☒ COOPERATIVE AGREEMENT

4. INSTRUMENT NO.
DE-FC07-85ID12614

5. AMENDMENT NO.
--

3. RECIPIENT *(Name, address, zip code, area code and telephone no.)*
Thermal Power Co.
3333 Mendocino Ave, Suite 120
Santa Rosa, CA 95401

6. BUDGET PERIOD
FROM: 9/30/85 THRU: 9/30/87

7. PROJECT PERIOD
FROM: 9/30/85 THRU: 9/30/87

8. RECIPIENT PROJECT DIRECTOR *(Name and telephone No.)*
William L. D'Olier (707) 576-7040

10. TYPE OF AWARD
☒ NEW ☐ CONTINUATION ☐ RENEWAL
☐ REVISION ☐ SUPPLEMENT

9. RECIPIENT BUSINESS OFFICER *(Name and telephone No.)*
Philip Scott (415) 765-0329

12. ADMINISTERED FOR DOE BY *(Name, address, zip code, telephone No.)*
Ronald A. King (208) 526-0790
U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

11. DOE PROJECT OFFICER *(Name, address, zip code, telephone No.)*
Susan Prestwich (208) 526-1147
U.S. DOE, Idaho Operations Office
785 DOE Place, Idaho Falls, ID 83402

13. RECIPIENT TYPE
☐ STATE GOV'T ☐ INDIAN TRIBAL GOV'T ☐ HOSPITAL ☒ FOR PROFIT ORGANIZATION ☐ INDIVIDUAL
☐ LOCAL GOV'T ☐ INSTITUTION OF HIGHER EDUCATION ☐ OTHER NONPROFIT ORGANIZATION ☒ C ☐ P ☐ SP ☐ OTHER *(Specify)*

14. ACCOUNTING AND APPROPRIATIONS DATA

a. Appropriation Symbol	b. B & R Number	c. FT/AFP/OC	d. CFA Number
89X0224.19	AM101510	ID-54-91/250	

15. EMPLOYER I.D. NUMBER/SSN

16. BUDGET AND FUNDING INFORMATION

a. CURRENT BUDGET PERIOD INFORMATION		b. CUMULATIVE DOE OBLIGATIONS	
(1) DOE Funds Obligated This Action	$ 240,000	(1) This Budget Period *[Total of lines a.(1) and a.(3)]*	$ 240,000
(2) DOE Funds Authorized for Carry Over	$ -0-	(2) Prior Budget Periods	$ -0-
(3) DOE Funds Previously Obligated in this Budget Period	$ -0-		
(4) DOE Share of Total Approved Budget	$ 240,000		
(5) Recipient Share of Total Approved Budget	$ 240,000	(3) Project Period to Date *[Total of lines b. (1) and b. (2)]*	$ 240,000
(6) Total Approved Budget	$ 480,000		

17. TOTAL ESTIMATED COST OF PROJECT $ _____
(This is the current estimated cost of the project. It is not a promise to award nor an authorization to expend funds in this amount.)

18. AWARD/AGREEMENT TERMS AND CONDITIONS

This award/agreement consists of this form plus the following:

a. Special terms and conditions (if grant) or schedule, general provisions, special provisions (if cooperative agreement)

b. Applicable program regulations *(specify)* N/A *(Date)* _____

c. DOE Assistance Regulations, 10 CFR Part 600, as amended, Subparts A and ☐ B (Grants) or ☒ C (Cooperative Agreements).

d. Application/proposal dated 4/29/85, ☐ as submitted ☒ with changes as negotiated

19. REMARKS
This Agreement consists of this NFAA, Schedule Articles, General Provisions, Appendix A - Statement of Work, Appendis B - Labor Determination, DOE Order 1332.2, and Cost Principles FAR 31.2 and DEAR 931.2.

20. EVIDENCE OF RECIPIENT ACCEPTANCE
William L. D'Olier 9/30/85
(Signature of Authorized Recipient Official) *(Date)*
William L. D'Olier
Vice President *(Name)*
Geothermal Exploration
(Title)

21. AWARDED BY
William C. Drake 9/27/85
(Signature) *(Date)*
William C. Drake
(Name)
Contracting Officer
(Title)

TPC
Statement of Work

1.0 Introduction

The Cascade volcanic region has long been suspected to contain considerable geothermal potential, as evidenced by recent volcanism and other thermal expressions. There are few known surface manifestations of geothermal energy in spite of the obvious occurrence of heat sources. One possible explanation is that the downward percolation of the extensive regional cold ground water system suppresses surface evidence of underlying hydrothermal systems. However, there have been few wells drilled in the Cascades region to a sufficient depth to properly evaluate the temperature and hydrological conditions beneath the cold water zone. There is a great need for characterization identification of the deeper hydrothermal regime in order to more conclusively define the geothermal potential of the Cascades volcanic environment.

DOE's primary objectives for this cost-shared drilling project are to obtain and release to the public subsurface information to include but not limited to the following:

- o rock samples (core and/or drill chips),
- o equilibrium temperature profiles,
- o uncontaminated fluid samples,
- o evidence for the existence and depth of potentially producible aquifers,
- o geophysical well logs, and
- o information on drilling conditions and problems in the Cascades environment.

2.0 Scope

1. The Participant will drill a thermal gradient hole to an approximate target total depth of 5000 feet in Section 28, T8S, R8E Willamette Meridian, Marion County, Oregon. This primary task will be accomplished by 24 hours per day continuous work to achieve its completion in an estimated 60 days of rig operations.

2. The Participant will collect all required data both during and subsequent to drilling the thermal gradient hole.

3. The Participant will provide all data and information gathered under this Project to DOE.

4. The Participant will obtain all permits and approvals required by government regulatory agencies for the performance of this Project.

5. The Participant will perform all Project work in compliance with federal, state and local laws, rules and regulations and agency orders and guidelines.

3.0 Applicable Documents

Work performed by the Participant will be in compliance with all Federal, State, and local laws, rules and regulations, and agency orders and guidelines.

4.0 Technical Tasks

4.1 Project Management

A. The Participant will prepare and obtain DOE approval of a Project Management Plan within 30 days after award of this agreement. The plan will include a work breakdown structure and a list of deliverables by task, identify the individuals and subcontractors responsible for each task, discuss the management techniques to be used, and include a schedule that shows the period for performance of each subtask and identifies principal milestones and decision points for each. This plan will also designate an individual or individuals who will act as principal points of contact with DOE on behalf of the Participant.

B. The Participant will submit and obtain DOE approval of a Project Institutional Plan prior to initiation of site preparation. The plan will identify items required by governmental regulatory agencies for the performance of this work, the agency whose requirement the item fulfills, and the actual or projected submittal and agency approval dates. The plan will also discuss any legal, social, or institutional problems anticipated during performance of the project and planned solutions.

C. The Participant will prepare and obtain DOE approval of a Project Drilling Plan prior to drilling. The plan shall describe:

1. Surface and subsurface conditions anticipated to be encountered during drilling, including configuration of the resource.

2. Site access.

3. Site preparation.

4. Hole design including hole size, casing size, cementing, etc.

5. Rig and equipment specifications.

6. Well containment during and after drilling including applicable regulatory requirements).

7. Drilling fluids and disposal method.

8. Hole completion.

9. Plugging and abandonment.

10. Site restoration.

11. Anticipated hole problems, if any, and proposed solutions.

12. Health, safety and environmental considerations.

13. Site facilities, if any.

14. Drilling schedule including major activities and estimated duration.

15. On-site supervision to be used during drilling, including drilling supervisor(s) and geologist(s).

D. The Participant will prepare and obtain DOE approval of a Project Data Collection Plan prior to drilling. This plan will address data collection both during drilling and after drilling. The plan will identify the types of data to be collected, the depth(s) at which each type of data will be collected, the timing of collection, and the method by which the Participant plans to collect each type of data, including type of instrument and planned calibration, where appropriate. The plan will specifically identify all logs and samples of rock and fluid that are to be collected.

E. The Participant will conduct subcontractor evaluations, select subcontractors and complete contract negotiations with selected subcontractors.

F. The Participant will perform project management in accordance with the approved Project Management Plan. In addition to close general coordination with DOE, immediate and full disclosure of any project problem areas to DOE is required, so that timely corrective action may be taken with DOE technical support, if necessary.

Deliverables: Approved Project Management Plan, Project Institutional Plan, Project Drilling Plans and Project Data Collection Plan.

4.2 Permitting and Environmental Reporting

A. The Participant will prepare, submit and obtain approval of any documentation required by governmental regulatory agencies for the performance of this work, including a geothermal exploration permit and a plan of operations. A copy of all documentation provided to any governmental agency and pertinent to this project shall be provided to DOE.

B. An approved environmental document is required for this project prior to any ground disturbance. It is anticipated that an environmental assessment will be prepared by the Bureau of Land Management for this project. This environmental assessment may satisfy DOE's environmental reporting requirements. If DOE determines that a separate Environmental Evaluation Report is required prior to any ground disruptive activity, DOE will notify the Participant in writing. In that event, the Participant will prepare the Environmental Evaluation Report in accordance with DOE Environmental guidelines. If a DOE Environmental Assessment is required, the Participant will provide information to DOE as required for DOE's preparation of the Environmental Assessment.

If DOE determines that an Environmental Assessment is required, DOE will notify TPC in writing. Upon such notification, TPC will provide information to DOE as required for DOE's preparation of the Environmental Assessment.

Deliverables: Approved environmental document and regulatory documentation.

4.3 Drilling

A. The Participant will confirm logistics, services and vendors with requirements outlined in the approved Project Drilling Plan.

B. The Participant will prepare drill site, access and water supply and move in drilling rig in accordance with approved Project Drilling Plan.

C. The Participant will drill a thermal gradient hole to 5000 feet TD in accordance with the approved Project Drilling Plan. The Participant shall report on drilling status daily to the designated DOE representative, so that discussions concerning the drilling operation can be made in a timely manner.

4.4 Data Collection

A. The Participant will collect the following data as a minimum in accordance with the approved Project Data Collection Plan. These data shall be provided to DOE by the Participant as soon as acquired.

Rock Sampling - The drilling of the hole is designed such that a continuous core from bedrock to total depth will be obtained. It is anticipated that a 2.50" core will be recovered from the drilling of HQ (3.85" OD) size hole. If it is necessary to reduce to NQ (3.03") hole size, a 1.88" core will then be retrieved. Drill cuttings will also be

obtained from at least the upper 500 feet of the hole. The Participant's drill site geologist will provide data collection and on-site handling of samples. DOE will provide procedures for identification and splitting of core and cuttings and will coordinate disposition and storage of the samples with the Participant.

Fluid Sampling - Daily measurements of the hydraulic head (natural water level in the hole) will be obtained as allowed during the drilling operation. Lost circulation data will be collected. If artesian flow is encountered and the issued drilling permit allows the performance of a flow test, a short-term test will be conducted at total depth to obtain samples of the formation water and wellhead temperature and pressure. Drilling fluid samples will be collected as per SCAP. The drill site geologist will maintain a log of the daily water level and lost circulation data. If no artesian flow is encountered, the Participant will still endeavor to collect samples of uncontaminated aquifer fluids at locations in the hole at which fluid production would be anticipated on the basis of lost circulation, indications of fracturing in the core or chips, geophysical well logs or other standard indicators. Potential methods for collection of these samples include swabbing, bailing, air lift, drill stem tests and pumping. The Participant will examine these and/or other fluid sampling techniques and address collection of these samples in the Project Data Collection Plan.

Geophysical Borehole Logging - The complete suite of geophysical borehole logs identified in the SCAP (temperature, caliper, resistivity, self-potential, sonic velocity and density logs) along with natural gamma, will be run in the wellbore not more than three separate times. The three logging runs would correlate with the running of the surface casing at 3000' (if needed and a total depth (5000'). The open-hole logs (SP, caliper, resistivity and sonic) will only be run in the open-hole. Temperature logs will be run from surface to total depth. Gamma and/or density will only be run a couple hundred of feet into the cased-hole. The latter will allow cross-cablibration between the three intended logging runs. The Participant's geologist will direct and observe all logging operations. A comprehensive logging operation report will be prepared for each logging operation. One set of field prints will be sent to DOE as soon as available.

Maximum Temperature Reading - Three maximum recording thermometers will be run at every core recovery. These data will be collected by the drill site geologist.

Daily Drilling Report - A drilling report will be completed every day and submitted to DOE.

Directional Survey - A multi-shot direction survey will be made at total depth to allow for oriented core analysis. Specific hole conditions may require an additional survey.

"Mud" Log - A "Mud" log will be maintained during the drilling operation. This log will provide the following principal data, summarized at a vertical scale of 1' = 100':

1. geologic field description of core (including lithology, alteration minerology and fracture geometery assuming a vertical hole),

2. graph of penetration rate versus depth,

3. graph of measured water level versus depth,

4. lost circulation zones (including time/date, depth, total amount of fluid loss and rate of fluid loss), and

5. casing profile.

Temperature surveys

The Participant will conduct two temperature surveys. The first to be conducted at one week and the second at one month after the thermal gradient hole has been completed. These surveys will be from surface to total depth.

Deliverable: Data and samples.

4.5 Hole Completion and Maintenance

A. Upon satisfactory completion of drilling, open-hole geophysical logging and sampling, a steel tubing string will be hung or cemented in the borehole from surface to TD and the well completed by the Participant in accordance with the approved Project Drilling Plan.

B. Upon completion of the hole, DOE and the Participant shall review and discuss the data. The Participant will obtain Project Manager's agreement prior to releasing the rig.

C. The Participant shall provide to DOE within 15 days of completion of the hole a schematic of the actual completed hole configuration.

D. The Participant shall maintain the hole and site for a period of 12 months after hole completion in accordance with the approved Project Drilling Plan. The hole and site shall be

made available to DOE during this period for DOE's scientific use. The Participant will not attempt to preserve access to the site during the period of winter snow cover.

Deliverable: Completed hole configuration schematic.

4.6 Abandonment and Site Restoration

The Participant will plug and abandon the hole and fully restore the site in accordance with BLM regulations, Forest Service stipulations and the Project Drilling Plan. Alternatively, the Participant may elect to preserve the hole and drill site at its sole risk, cost and legal responsibility. In this instance, the Participant shall provide DOE with a copy of the plug and abandonment and site restoration plans from the approved Plan of Operations and shall provide confirmation of these activities. DOE will not cost-share costs incurred after the project period of this agreement.

Deliverables: Approved P&A and restoration plans.

5.0 Reports, Data and Other Deliverables

A. The Project Drilling Plan as required by Subtask 4.1.C.

B. The Project Data Collection Plan as required by Subtask 4.1.D.

C. The Project Management Plan as required by Subtask 4.1.A.

D. The Project Institutional Plan as required by Subtask 4.1.B.

E. All data collected by the Participant under Task 4.4.

F. Regulatory documentation and approved environmental document under Subtasks 4.2.A and 4.2.B.

G. Completed hole completion schematic as required by Subtask 4.5.C.

H. Approved plug and abandonment plan as required by Task 4.6.

I. Project status and management reports as identified on DOE Form CR-537, Reporting Requirements Checklist. The final technical report will include a description of drilling and completion and data will be presented and discussed.

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE REPORTING CHECKLIST

FORM EIA-459A (10-80)

FORM APPROVED OMB NO 1900-0127

1. Identification Number: DE-FC07-85ID12614	2. Program/Project Title: Cascade Geothermal Drilling

3. Recipient: Thermal Power Company

4. Reporting Requirements:	Frequency	No. of Copies	Addressees
PROGRAM/PROJECT MANAGEMENT REPORTING			
[X] Federal Assistance Milestone Plan	O	2,1,1	A,B,E
[ ] Federal Assistance Budget Information Form			
[X] Federal Assistance Management Summary Report	Q	1,1,1	A,B,C
[X] Federal Assistance Program/Project Status Report	Q	2,1.1	A,B,E
[X] Financial Status Report, OMB Form 269	Y,F	1,1	B,C
TECHNICAL INFORMATION REPORTING			
[XX] Notice of Energy RD&D	O,Y	1,1	B,D
[ ] Technical Progress Report			
[X] Topical Report	A	3,1,1,1	A,B,E,F
[X] Final Technical Report	F	*4,1,1,1	A,B,E,F

FREQUENCY CODES AND DUE DATES:

A - As Necessary; within 5 calendar days after events.
F - Final; ~~90 calendar days after the performance of the effort ends~~ Upon completion of agreement
Q - Quarterly; within 30 days after end of calendar quarter or portion thereof.
O - One time after project starts; within 30 days after award.
X - Required with proposals or with the application or with significant planning changes.
Y - Yearly; 30 days after the end of program year. (Financial Status Reports 90 days).
S - Semiannually; within 30 days after end of program fiscal half year.

5. Special Instructions:

A draft to the Final Technical Report shall be submitted for review to the contracting officer at least 60 days prior to the final due date. Comments resulting from this review shall be resolved and the report revised accordingly prior to final submission to DOE. The Final Technical Report shall be submitted with a camera-ready copy.

NOTE: Contracting officer copy shall list all distribution.

*Includes camera-ready copy.

6. Prepared by: (Signature and Date)	7. Reviewed by: (Signature and Date)

REPORT DISTRIBUTION LIST

DE-FC07-85ID12614

U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

A. Susan Prestwich
Geologist
Advanced Technology Division

B. Ronald A. King
Contract Specialist
Contracts Management Division

C. Earl G. Jones
Director
Financial Management Division

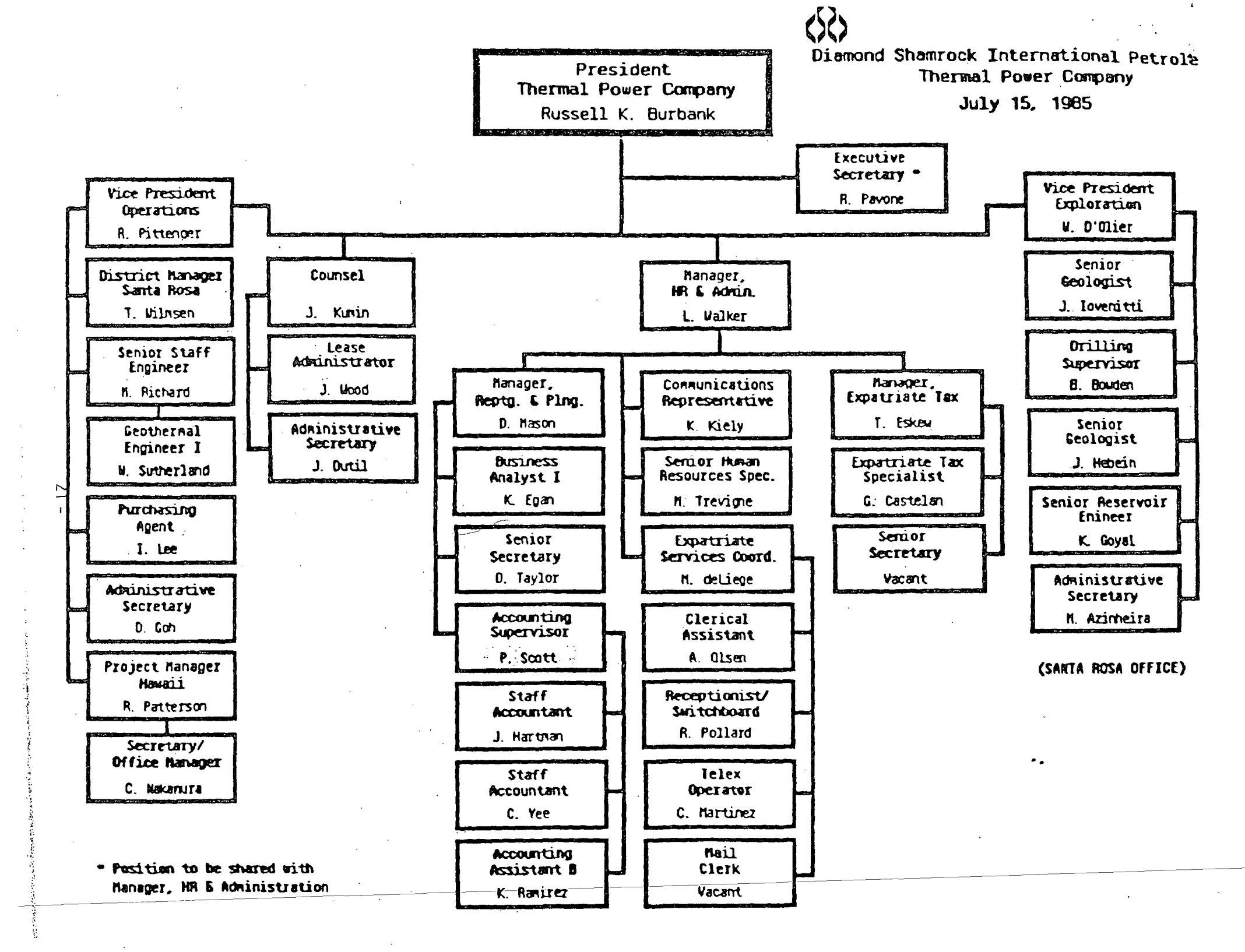
D. U. S. Department of Energy
Technical Information Center
Oak Ridge, TN 37830

E. P. M. Wright
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, UT 84108-1295

F. Marshall Reed
U. S. Department of Energy
CE-323 Forestal Building
1000 Independence Avenue, S.W.
Washington DC 20585

COST, SCHEDULE AND DELIVERABLE SUMMARY

TASK	ESTIMATED 100% COST	SCHEDULE START	SCHEDULE COMPLETE	MILESTONES & DELIVERABLES
1. Project Management	No CHARGE	10·1·85	10·31·85	1. Management Plan
2. Permitting and Environmental Reporting	No CHARGE	8·8·85	2·28·86	1. Institutional Plan 2. Regulatory Documentation 3. EER
3. Drilling SITE PREPARATION	$15,000	5·20·86	5·25·86	1. Drilling Plan 2. Daily Drilling Status Reports
DRILLING - CORING	343,000	6·1·86	7·31·86	
4. Data Collection (a) During Drilling				1. Data Collection Plan
GEOPHYS. LOGS	22,200	6·5·86	7·29·86	2. Rock & Fluid Results of Analyses Samples, & Data Reports
FLUID SAMPLES	3000	"	"	
FLOW TEST 3000'?	7000	6·29·86	6·30·86	
SITE GEOLOGISTS	22,000	6·1·86	7·31·86	
(b) After Drilling				
FLOW TEST 5000'	10,000	7·29·86	7·31·86	1. Well Legs 2. Fluid Samples
TWO TEMP. SURVEYS	7800	8·7·86	8·30·86	3. Other Data & Results
5. Completion & Maintanance TUBING ETC.	20,000	7·31·86	7·31·86	1. Completion Schematic
6. Abandonment IF ELECTED	25,000	9·5·87	9·10·87	1. Approved Abandonment Plan
7. Site Restoration IF ABANDONED	5000	9·10·87	9·15·87	1. Restoration Confirmation Report
8. Reporting	No CHARGE	10·31·85	9·30·87	1. As summarized in this table
9. Dissemination of Information	No CHARGE	10·1·85	9·30·87	1. Project sign, press release(s) 2. Final Technical Report
TOTAL ESTIMATED 100% COSTS	$480,000			


Diamond Shamrock International Petrole
Thermal Power Company
July 15, 1985
President
Thermal Power Company
Russell K. Burbank
Executive Secretary *
R. Pavone
Vice President Operations
R. Pittenger
District Manager Santa Rosa
T. Wilmsen
Senior Staff Engineer
M. Richard
Geothermal Engineer I
W. Sutherland
Purchasing Agent
I. Lee
Administrative Secretary
D. Goh
Project Manager Hawaii
R. Patterson
Secretary/ Office Manager
C. Nakamura
Counsel
J. Kunin
Lease Administrator
J. Wood
Administrative Secretary
J. Dutil
Manager, HR & Admin.
L. Walker
Manager, Reptg. & Plng.
D. Mason
Business Analyst I
K. Egan
Senior Secretary
D. Taylor
Accounting Supervisor
P. Scott
Staff Accountant
J. Hartman
Staff Accountant
C. Yee
Accounting Assistant B
K. Ramirez
Communications Representative
K. Kiely
Senior Human Resources Spec.
M. Trevigne
Expatriate Services Coord.
M. deLiege
Clerical Assistant
A. Olsen
Receptionist/ Switchboard
R. Pollard
Telex Operator
C. Martinez
Mail Clerk
Vacant
Manager, Expatriate Tax
T. Eskew
Expatriate Tax Specialist
G. Castelan
Senior Secretary
Vacant
Vice President Exploration
W. D'Olier
Senior Geologist
J. Iovenitti
Drilling Supervisor
B. Bowden
Senior Geologist
J. Hebein
Senior Reservoir Enineer
K. Goyal
Administrative Secretary
M. Azinheira
(SANTA ROSA OFFICE)
* Position to be shared with Manager, HR & Administration

Diamond Shamrock
Thermal Power Company

11 April 1986

Ms Susan Prestwich
DOE Project Officer
U. S. DOE, Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Re: Cooperative Agreement
No. DEFC07-851D12614
Project Drilling Plan

Dear Ms Prestwich:

Thermal Power Company herewith submits five copies of the Project Drilling Plan for the Clackamas 5000-Foot Thermal Gradient Hole.

Please accept our request for the earliest possible consideration for approval by DOE of this Plan. We are now holding very competitive drilling bids. We would like to obtain clear indications of Plan approval and of Geothermal Drilling Permit approval by BLM-Portland before signing the essential drilling contracts for our scheduled 1 June 1986 spud date.

Thank you for your early attention and assistance on the important drilling approvals required.

Yours very truly,

W. L. D'Olier
Vice President -
Geothermal Exploration

WLD036

cc R. K. Burbank - Thermal, SF
A. M. Cooper - Chevron, SF
Billy Kinsey - DSIP, Dallas

Thermal Power Company
A subsidiary of Diamond Shamrock, 3333 Mendocino Avenue, Suite 120, Santa Rosa, California 95401
Phone 707 576-7022

GEO-Newberry Crater, Inc.
A Subsidiary of Geothermal Resources International, Inc.

August 15, 1985

Mr. Ronald A. King
R & D Contracts Division
Contracts Management Division
U.S. Dept Energy
550 Second St.
Idaho Falls, Idaho 83401

RE: Solicitation # DE SC07-851D12580

Dear Ron:

Pursuant to your communication of July 18, 1985, GEO Operator Corporation submits the attached data collection Plan for your review and approval. The information is submitted in accordance with section 4.0 (Technical Tasks) subsection 4.4 (Data Collection). Subsections 4.1 (Project Management) 4.2 (Permitting and Environmental Reporting) and 4.3 (Drilling) have been transmitted to your office by Mike Cale dated 8/7/85 and Federal Expressed from our Bend office on 8/14/85. Please let me know ASAP if you need additional documentation from us.

Very truly yours,

Chandler A. Swanberg

Mr. Chandler A. Swanberg

CAS/rs
cc: M. Cale, w/encl.
J. Combs, w/encl.

6449 South Highway 97, Suite A, Bend, OR 97701 (503) 389-6681

4.4 DATA COLLECTION

The purpose of the Core Hole Program is the development of baseline geological and geochemical data to assist in evaluating the presence of and recovery potential of a geothermal resource in a virtually unexplored region. The following paragraphs describe the types of data to be collected and the methodology, including depths, timing/frequency, instrumentations, etc.

Rock sampling-cuttings: The first 400 feet of the hole will be rotary drilled. During this period, roughly 4 lbs of cuttings will be collected at 10 feet intervals, rinsed, logged, divided into two equal splits, bagged, labeled, and placed in temporary storage in Bend, Oregon.

Rock sampling-core: The remainder of the hole will be continuously cored. The core will be handled according to accepted industry standards. These standards are described in the drilling contract between Tonto Drilling and GEO Operator Corporation dated 8/14/85 and transmitted under separate cover to DOE on 8/14/85. The core will be logged daily on site with emphasis on litiology, fractures, joints, faults, alterations, and other gross features. Subsequently, the core will be split for more detailed description of minerology, texture, secondary mineralization, etc. At this point, small samples (up to 2 lbs) will be selected for mercury analysis, thin section preparation, age dating, or other use. Finally, both splits of the core will be removed from the site for temporary storage in Bend, Oregon.

Drilling Records: The driller will keep accurate records of all information pertaining to the drilling of the corehole including, but not limited to, drilling rate, mud and other additives, fluid entries, lost circulation, drilling conditions and/or problems, hole depth, and possibly lithology.

Temperature: Measurement of bottom hole temperature will be taken every 100' or as follows:

a) every 50' if temperatures exceed 125°F,
b) every 30' if temperatures exceed 175°F.

Hydraulic Head: The driller will attempt to locate the depth to water during each trip into the hole.

Drilling Fluid Samples: A sample of core hole fluid will be taken following each trip for a bit change or more frequently if warranted by geologic conditions. The samples will be taken with a Kuster, clock-operated, 1000 ml wireline sampler. Appropriate geochemical "fluid sampling kit" will be available on site including sample bottles, chemicals for stabilizing unstable species, filteration apparatus, etc. Artesian fluids will also be sampled if so warranted by hole conditions.

Data Collection continued

Geophysical well logging: Temperature,caliper, resistivity, gamma, and self-potential logs will be run in the interval between the surface casing and total depth. Density and sonic velocity logs will also be run if tools are available which can operate in the conditions encountered in the hole. The temperature tool will have a precision of 0.01°C. The corehole will be relogged until equilibrium has been obtained.

GEO-Newberry Crater, Inc.
A Subsidiary of Geothermal Resources International, Inc.

August 15, 1985

Mr. Ronald A. King
R & D Contracts Division
Contracts Management Division
U.S. Dept Energy
550 Second St.
Idaho Falls, Idaho 83401

RE: Solicitation # DE SC07-851D12580

Dear Ron:

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Very truly yours,

Chandler A. Swanberg

Mr. Chandler A. Swanberg

CAS/rs
cc: M. Cale, w/encl.
J. Combs, w/encl.

61419 South Highway 97, Suite A, Bend, OR 97701 (503) 389-6681

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Data Collection continued

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UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

November 25, 1985

MEMORANDUM

TO: Sue Prestwich

FROM: Bruce Sibbett

SUBJECT: Comments on Thermal Power Company Drilling Program, Clackamas Hole

There are some fundamental problems with the Clackamas 5000-foot thermal gradient hole drilling plan. It is unclear whether they really want a core hole with little casing or a 6" rotary hole cased to 4000'. I doubt that the budget can afford both. Also the program doesn't actually explain how a water sample would be obtained or how the well would be induced to flow.

The problems with the drilling program are listed below:

Bits 10" and 5 5/8" bits are not standard sizes. They would have to use 9 7/8 or 10 5/8 and 6 or 5 7/8.

Page 1,#2 Drilling 9 7/8" hole to 500' with an air hammer is a good idea. However, to allow for the couplings on the casing and have enough clearance in the annulus to cement the 7" casing a 10 5/8" hole would be preferred.

Page 1,#4 "Prepare diamond coring system" suggests they will move off the rotary rig and move in coring rig. I don't know of any rotary rig which can do wireline HQ coring. Core rigs don't have the power to rotary drill a 9 7/8" hole in basalt and don't have an air compressor system. Setting 500' of 7" casing is also very difficult with a core rig. Experience on Ascension Island and Newberry Crater suggest that drilling the upper large diameter hole with a rotary rig then moving in a core rig is most cost effective when possible.

Page 2,#5 If hole conditions become difficult drilling with HQ, opening the hole up to 6" with a rotary (?) bit will not solve the problems such as lost circulation or caving. Also they would have to switch drill rigs again because the core rig can't efficiently drill that

size hole to any depth. How will they run a "rig flow test"? It is not that easy.

Page 2, #7 I'm not sure a 50' lap between 7" and 4 1/2" casing is adequate. Also, how will they disconnect from the 4 1/2" casing? If they set the casing on the bottom cementing the annulus from the bottom is a problem. Normally a liner hanger is used which requires a greater overlap.

They can't cement 4 1/2" casing in a 6" hole because even flush joint 4 1/2" casing is 5 1/4" OD at the joins leaving only 3/8" clearance in the annulus. Irregularities in the hole and swelling clay zones, both will be there, will reduce the annulus more making it highly unlikely that cement could pass through 3500' of hole without plugging off. For a good cementing operation one would normally have 2" clearance in the annulus.

The 130 HP diesel engine for the drill rig is far to small.

RECOMMENDATIONS:

If Thermal Power really wants the hole cased to 4000 feet they should forget about coring and use a large rotary drill rig. With such an approach lost circulation will probably be a major problem. The section on "Geological...Conditions" (White, 1980) fails to mention that the drill site is mapped as Quarternary High Cascades basalt flows which may present major lost circulation problems.

The alternative is to design the hole strictly as a core hole. In that case the surface part of the hole could be rotary drilled with a 6 1/2" air hammer. This would require a good operator with a light touch to keep the hole straight which is important for the core drilling. Air drilling reduces the lost circulation problems. A 4 1/2" J55 casing would then be set and the hole cored with HQ (101mm hole).

A fluid sample may be obtained by pumping air down 2" liner pipe hung inside the HQ drill rod for air lift up the inside of the drill pipe. This method would lock control on where the produced fluids come from and puts the drill string at risk in the open hole but would be less costly than drilling a deep rotary hole and casing it.

REFERENCE:

White, C. M., 1980, Geology of the Breitenbush Hot Springs quadrangle, Oregon: Oregon Department fo Geology and Mineral Industries Special Paper 9, 26 p.

Bruce S. Sibbett

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

M E M O R A N D U M

TO: Mike Wright

FROM: Bruce Sibbett

SUBJECT: Comments of Clackamas Data Collection Plan

DATE: May 7, 1986

Appendix 1, #2 Core handling procedures. Fragmental or clay altered intervals may suffer significant degradation from the extra handling step during washing in a core trough and transfer to the core box. Therefore, at the drillsite geologist discretion, incompetent intervals should be placed directly into the core box from the core barrel to reduce handling damage.

Appendix I, #2 and #3 cuttings collection interval. #2 states cuttings will be collected at 10-foot intervals, #3 states cuttings will be described at 20-foot intervals. Is there a conflict or will they describe every other sample?

Appendix I, #6. On the mud log the type bit should be noted, i.e., blue impregnated, or stone inset, etc. This data with the lithology and total footaged drilled by a bit, could be valuable for determining performance of bit type. For this to be complete drill rpm's and weight on bit data could be taken off the daily drilling report when the evaluation is made.

Geophysical Borehole Logging

The second paragraph is a little vague. I assume it means that for the intermediate depth logging prior to setting casing. However, as stated it could be applied to the total depth log such that if casing went to 2000 ft and only core hole from 2000 to 5000 ft, only temperature logs would be run below 2100 ft. Is this the intent? Does "field calibration" include checking the mud resistivity in the mud pit, and would it be useful?

THERMAL POWER COMPANY

Project Title: Cascade Geothermal Drilling

CLACKAMAS 5000-FOOT THERMAL GRADIENT HOLE

Cooperative Agreement No. DE-FC07-851D12614

PROJECT DATA COLLECTION PLAN

Submitted by:

Thermal Power Company
3333 Mendocino Avenue, Suite 120
Santa Rosa, California 95401

J. I. Iovenittti
Senior Geologist
for Participant

Approved by:

U. S. DOE, Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Susan Prestwich
DOE Project Officer

TABLE OF CONTENTS

FIGURES

APPENDICES

PROJECT DATA COLLECTION PLAN

The Clackamas 5000-Foot Thermal Gradient Hole (CTGH-1) Data Collection Plan is described herein for all data collected during the drilling and coring operation, and after borehole completion. Complete lithologic, hydraulic head, and lost circulation data will be recorded on-site by two drillsite geologists. Additionally, formation liquid sampling, as well as, geophysical borehole logging will take place. The Data Collection Plan has been formulated to maximize high quality geotechnical data retrieval for the drillsite operation. This program will assist the characterization and comprehension of the geothermal setting of the High Cascades.

Data Collection During Drilling and Coring

Drillsite Geologists

Two wellsite geologists, each working 12 hours per day, will be utilized in the estimated 60-day drilling and coring operation (see Thermal Power Company Proposed Drilling Plan). Their responsibilities described in Appendix 1 are complete drillsite geotechnical data collection. The two geologists are Mr. D. Goodwin and Ms A. McDannel. Their respective resumes are given in Appendix 2. Additionally, Mr. A. Waibel of Columbia Geoscience would have intermittent involvement in the drillsite work due to his knowledge of the surface and subsurface geology of the area.

Rock Sampling

Rock sampling, one of the primary objectives of this operation, will be accomplished by diamond coring from approximately 500' to total depth. A 2.50" core will be recovered from the intended coring with a HQ (3.85" OD) size corehead. If hole conditions necessitate borehole size reduction to a NQ (3.03") hole, a 1.88" core will then be retrieved. Drill cuttings will also be obtained from at least, the upper 500 feet of this hole and whenever else possible.

Fluid Sampling/Measurements

Daily measurements of the hydraulic head in the borehole will be obtained as allowed during the drilling and coring operation. Lost circulation data will be collected. The drillsite geologist is responsible for logging these data (Appendix 1).

If artesian flow is encountered, a short-term test (less than 1 day) will be conducted at total depth to obtain samples of formation water and to record flowing wellhead temperature and pressure. Depending on hole conditions, a flow test may also be conducted prior to reaching total depth. If no artesian flow is encountered, a flow test will be attempted at total depth or some other interval as dictated by hole conditions, analysis and interpretation of drillsite geotechnical data. Potential methods for initiating flow are swabbing, bailing and/or airlifting. The technique(s) utilized will depend on existing hole conditions.

The flow test set-up is shown in Figure 1. A 2" pipeline will be used to flow fluids from the borehole to a Baker tank. The drilling sump will be a back-up to the Baker tank, if necessary and feasible. Fluids will be sampled at Point A, Figure 1. Temperature and pressure measurements will be made at the wellhead. An estimate of flow rate will be made by fluid level differences within the Baker tank.

DOE will be responsible for supplying collection bottles, sample collection procedures, and chemical analysis of the liquid samples. Selected on-site analysis (i.e., pH, specific conductance and temperature) and sample collection will be conducted by Thermal Power Company personnel. Each sample collected will consist of at least two liters. A total of seven samples will be collected for each discrete, one-day flow test, at the following time intervals after flow initiation: 15, 30, 60, 120, 300, 600 and 1440 minutes (assuming a 24-hour flow period). Not all these samples collected, need be analyzed nor retained. This decision will be made by the TPC Senior Geologist in conjunction with DOE.

Geophysical Borehole Logging

Temperature, resistivity, caliper, self-potential, sonic velocity, density, and natural gamma will be run in the drillhole up to, but not exceeding, three separate occasions. These time periods are referred to as the shallow, intermediate and deep logging runs. Respectively, these runs would be conducted prior to setting surface casing at 500 feet*, prior to setting intermediate casing (depth dictated by actual hole conditions), and at total depth (5000').

Open hole logs (SP, caliper, resistivity and sonic) will be run approximately 50 feet into the cored hole. Temperature logs will be run from the surface to total depth. Gamma and density logs will only be run about 100 feet into the cored hole. The latter will allow for cross-calibration between runs. Tool calibration would be conducted by the geophysical borehole logging contractor prior to the actual field operation as well as performing field calibrations both before and after the executed logging runs.

Two potential contractors are currently being evaluated: Colorado Well Logging, Inc. and Dresser Atlas. Depending on final contractor selection, supplemental logs may be run in this Program. These are fluid resistance and guard resistivity, and a compensated neutron log, respectively.

The Thermal Power Company Senior Geologist associated with this project will be directing and observing all logging operations. A comprehensive logging report will be prepared for each logging operation.

*It was indicated in the TPC/DOE contractual agreement for CTGH-1 that the sonic velocity log would be run at 500 feet. However, running this log is both cost-prohibitive and marginal value at best at this shallow depth. An agreement was reached by TPC, DOE and its geotechnical consultant UURI for the program change as described above.

Maximum Temperature Reading

Three maximum recording thermometers will be run at 100-foot intervals**. As the bottomhole temperature attains 125°F and 175°F, the recording intervals will be decreased to every 50 feet and 30 feet, respectively. These data will be collected by the drillsite geologist and reported on the mud log (Appendix 1).

Daily Drilling Report

A drilling and coring report will be completed every day. A sample form is presented in Appendix 3.

Mud Log

A "mud" log (Appendix 1, Form 4) will be maintained during the drilling operation. This log will provide the following principal data, summarized at a vertical scale of 1" = 100":

1. geologic field description of core (including lithology, alteration mineralogy and fracture geometry assuming a vertical hole);

2. graph of penetration rate versus depth;

3. graph of measured water level versus depth;

4. lost circulation zones (including time/date, depth, total amount of fluid loss and rate of fluid loss);

5. casing profile; and

6. appropriate comments (i.e., bit type, bit change, etc.) as they related to enhanced interpretation of the borehole data.

Deviation Survey

The borehole deviation will be surveyed at total depth and prior to setting any 4-1/2" casing.

Data Collection After Borehole Completion

Temperature Surveys

Two temperature surveys are planned to be conducted one week and one month after the CTGH-1 has been completed. These surveys will be run from surface to total depth. Pruett Wireline Industries, Inc. of Bakersfield, California, will provide this service.

**It was indicated in the TPC/DOE contractual agreement for CTGH-1 that maximum recording thermometers will be run at every core recovery. This intended procedure would prove to be unnecessarily time consuming. An agreement was reached between TPC and DOE and its geotechnical consultant UURI, for the program change as described above.

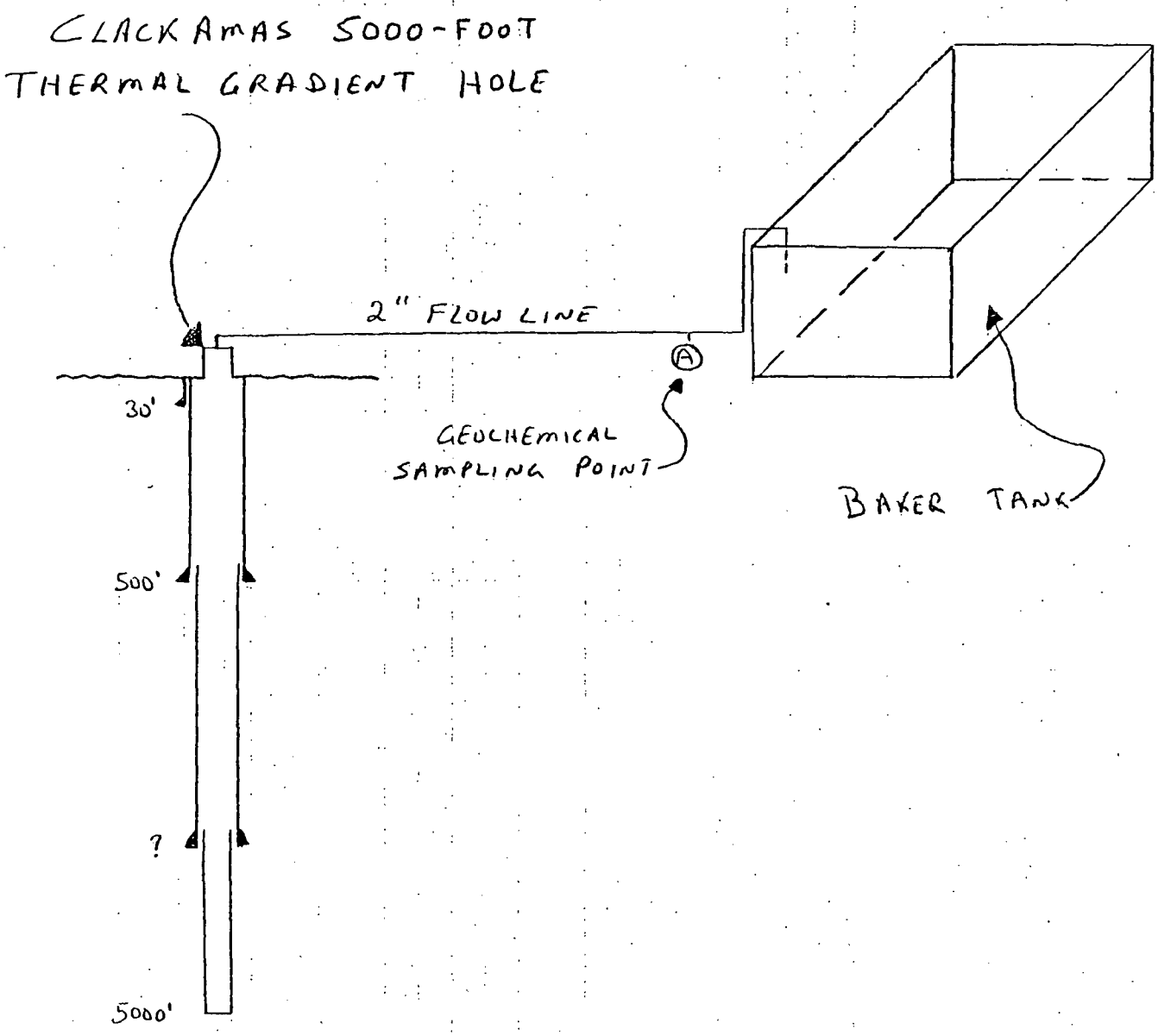


FIGURE 1: SCHEMATIC OF CTGH-1 FLOW TEST

APPENDIX 1: DUTIES OF A DRILLSITE GEOLOGIST

The primary responsibilities of the drillsite geologist is to complete an accurate, continuous (24 hours per day), geotechnical compilation in accordance with the Project Data Collection Program, to observe and to record all other pertinent data, to promptly report critical borehole observations, and to provide the Thermal Power Company Drilling Supervisor with the required geotechnical data support to effectively drill and/or core the hole. These activities will be supervised on a daily contact basis by the Senior Geologist of Thermal Power Company. The drillsite geologist duties follow.

1. Notify Thermal Power Company (contacts below) daily of all activities related to data collection from the borehole. Reports to Mr. Waibel of Columbia Geoscience will be provided as requested by Thermal Power Company.

Principal Contact:		Joe Iovenitti Senior Geologist	707/576-7232
Secondary Contact:	1.	Jeff Hebein Senior Geologist	707/576-1398
	2.	W. L. (Bill) D'Olier Vice President-Geothermal Exploration	707/576-7040

2. Collecting, washing, labelling and boxing of all rock samples as described below. Procedures follow directly from DOE policy with minor modification by Thermal Power Company.

   Drill Cuttings: Will be collected whenever available at 10-foot intervals. Each sample will weight approximately one kilogram. Samples will be collected at the end of a flow line with a bucket acting as a screening device. Drilling cuttings will be washed of drilling mud as needed. Sample will be placed in a bag labelled with the Hole name, Prospect name, State, Section, Township and Range, and drilling depth interval. Two sets of one kilogram each will be collected at each sample interval.

   Core: The core will be transferred from a core barrel to a core trough where it will be washed. Care will be taken to ensure that all pieces of core remain in their original orientation and sequence. All core pieces with length equal to or greater than core diameter will be marked with an arrow pointing downhole using a permanent felt tip marker. Core will be transferred from the core trough to core box.

   When the core is placed in the core box, a wooden block labelled with the bottom depth of the core run will be placed at the end of the core from the run. If a core run did not directly follow the previous core run because of some non-coring operation, a wooden block labelled with the beginning depth of the core run will be placed at the top of the run such at the

beginning and ending depth of each will be indicated. All core will be placed in core boxes following a uniform system: with the box orientation label on the left, the box will be filled from upper left to lower right (Figure A1-1). The label on each core box will be completely filled out using care to ensure that lettering is easily legible, as large as practical and done with an appropriate permanent marker. The drillsite geologist will be responsible for marking orientation arrows on the core, placing the depth labelled blocks at the top and bottom of each core run, and labelling core boxes.

3. Provide detailed geologic descriptions as described below of all cuttings at 20-foot intervals. Core will be described at a scale of one inch is equal to five feet (1" = 5'). Form sheets 1 and 2, respectively, are to be utilized.

   Geologic Description: For both drill cuttings and core consist of complete lithologic, alteration mineralogic, and structural (e.g., fractures, joints and fracture) descriptions. Where appropriate, rock units will be identified along with their upper and lower contacts. Core size, bit type, drilling fluid and lost circulation material will be noted insofar as it affects sample conditions.

4. Maintain the core recovery log (Form 3).

5. Maintain a temperature log both for drilling fluid temperature in/out and MRT readings.

6. Maintain a depth penetration log.

7. Maintain measured hydraulic head log which will be recorded daily.

8. Maintain a lost circulation log which includes time, depth, amount and rate.

9. Summarize all field drilling data (above) onto a "mud" log (Form 4) at a maximum scale of 1" = 100'.

10. Collect fluid samples, record wellhead temperature and pressure, and measure pH, temperature and specific conductance of recovered samples as appropriate.

11. Observe geophysical well logging operation with Thermal Power Company Senior Geologist.

12. Coordinate and discuss geotechnical data collection program with Thermal Power Company Drilling Supervisor, as appropriate.

Diamond Shamrock
Thermal Power Company

CUTTING DESCRIPTION

HOLE _____ GEOLOGIST (S) _____

FIELD _____ BASIS _____

DEPTH INTERVAL	LITHOLOGIC DESCRIPTION

Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE _____ GEOLOGIST(S) _____
FIELD _____ BASIS _____

DEPTH INTERVAL	DESCRIPTION
_____	
_____	

Form 2

Diamond Shamrock
Thermal Power Company

PAGE ___ of ___

CORE RECOVERY LOG

HOLE _____ FIELD _____ GEOLOGIST(S) _____

_____

DEPTH INTERVAL CORED (ft)	RUN / BOX NUMBER	CORE BARREL MEASUREMENT	AMOUNT RECOVERED (%)	COMMENTS

Form 3

Diamond Shamrock
Thermal Power Company

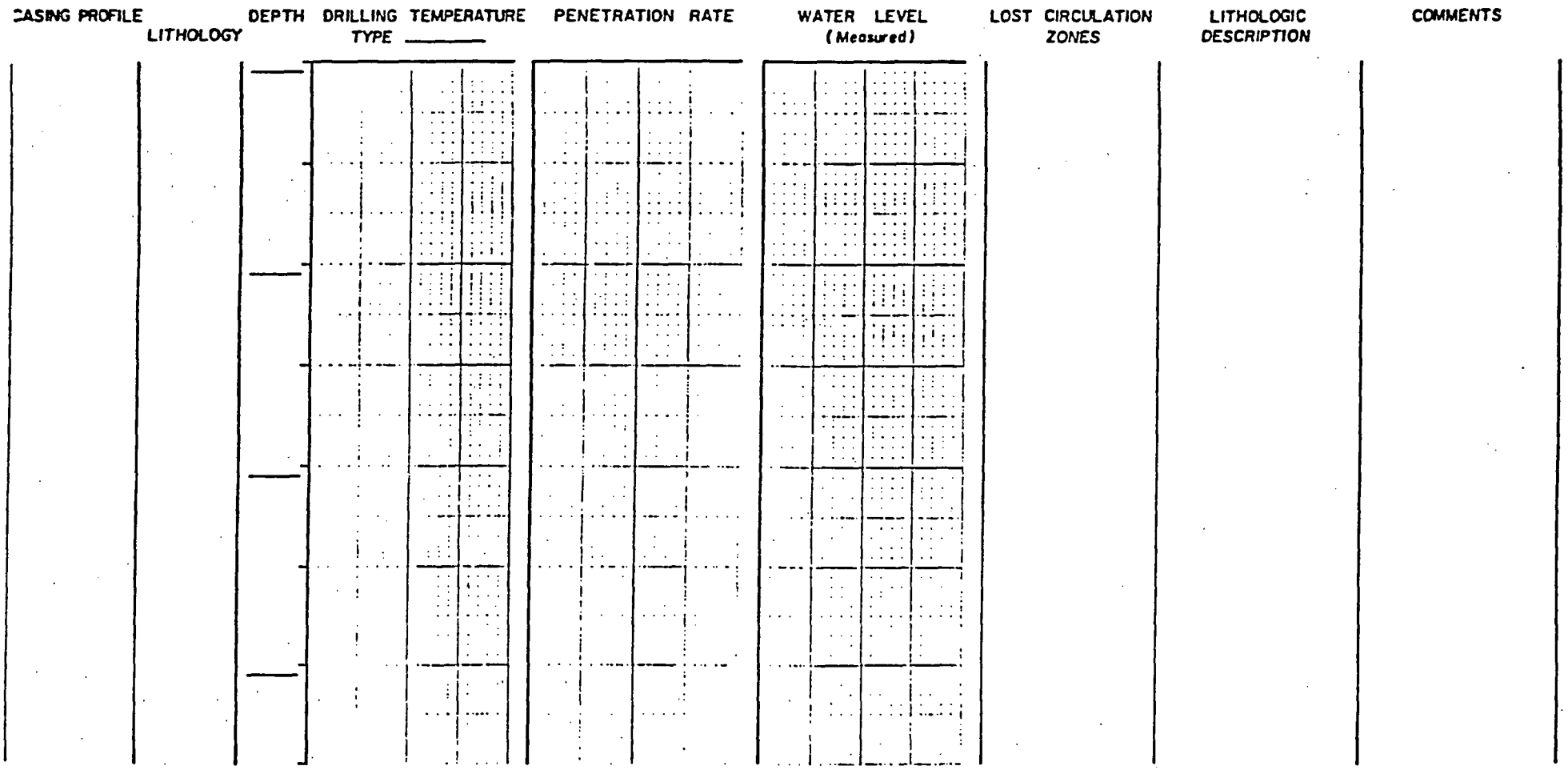
PAGE ___ of ___

HOLE _____ SPUD DATE _____ COMPLETION DATE _____ TOTAL DEPTH _____

FIELD _____ COUNTY _____ STATE _____ TOTAL VERTICAL DEPTH _____

LOCATION _____ ELEVATION _____ ☐ KB of ___ ☐ GL BOTTOM HOLE LOCATION _____

CONTRACTOR / RIG _____ GEOLOGIST (S) _____



Form 4

Appendix 2: Drillsite Geologist Resumes

ANGELA K. McDANNEL

44 N. W. 27th
Corvallis, OR 97330
(503) 758-5101

OBJECTIVE Career as a geologist in geothermal exploration/production

EDUCATION

Oregon State University	M. S., Geology, in progress
Oregon State University	B. S., Geology, March, 1980 overall GPA 3.4, major 3.5
Georgia State University	B. S., Urban Studies, June, 1973 overall GPA 3.2

EXPERIENCE AND EMPLOYMENT

6/85--10/85, 6/84--11/84, 6/83--10/83 Union Geothermal Division, Union Oil Company of California, 2099 Range Ave., Santa Rosa, CA 95401, (707) 542-9543.
During the 1983 and 1984 field seasons, I was Union's on site geologist for exploration wells drilled in northern California and Oregon. My responsibilities included making decisions regarding drilling technique and procedure, keeping accurate records of drilling progress, well temperature, lithology and alteration mineralogy. My most recent assignment was in the Santa Rosa office where my work focused on structural and stratigraphic analyses of two geothermal prospects.

6/82---8/82 The 1982 field season was dedicated to field work which provided a foundation for my thesis project. This work included mapping numerous Pliocene and Pleistocene lava and pyroclastic flows, epiclastic sedimentary rocks, and structure in sixty square miles of volcanic terrane within the Deschutes Basin of central Oregon.

3/81---9/81, 9/80--11/80 Freeport Exploration Inc., Mt. City Star Route, Elko, NV 89801, (704) 738-9221
During these field seasons I worked with Freeport Gold's Jerritt Canyon Project exploring for satellite ore bodies of fine-grained gold. My responsibilities included: geologic field mapping, geochemical sampling, logging drill chips, and writing reports of field work and drilling results.

4/80---8/80 Freeport Exploration Inc., 50 W. Liberty, Reno, NV 98505 (704) 323-2251
As an assistant geologist working in precious metal exploration, I engaged in reconnaissance scale mapping and geochemical sampling throughout northern Nevada.

ACTIVITIES AND INTERESTS member, Geological Society of America
member, Oregon Academy of Science
Leisure activities: climbing Cascade peaks, hiking, bicycling, ballet.

REFERENCES John M. Bodel, Geologist, Union Geothermal, 2099 Range Ave., Santa Rosa, CA 95406, (707) 542-9543

Edward M. Taylor, Associate Professor, Oregon State University, Corvallis, OR 97331, (503) 754-2484

William H. Taubeneck, Professor Emeritus, Oregon State University, Corvallis OR 97331, (503) 754-2484

DOUGLAS GOODWIN
232-1/2 Holtby Road
Bakersfield, CA 93304
(805)322-9534

EMPLOYMENT OBJECTIVE — Seeking an opportunity for resource exploration and development with a dynamic, growing organization

SUMMARY — Eight year's practical experience in the exploration and development of mineral and geothermal resources using state-of-the-art geology, geochemistry and geophysics

EXPERIENCE

Geologist — Bakersfield, CA

11/84 - 11/85 Santa Fe Geothermal, Inc., Exploration Dept.
11/80 - 11/84 Occidental Geothermal, Inc. Exploration Dept.

Responsible for prospect generation, resource characterization and evaluation, SW U.S. Developed and supervised phased regional and prospect geothermal exploration programs consisting of geology, geochemistry, and geophysics leading to reservoir testing.

Field Geologist — Billings, MT

8/77 - 9/80 Johns-Manville Corp., Mining Division, Exploration Department

Explored for/delineated reserves of platinum, uranium, asbestos, diatomite, and perlite at prospects/mines in U.S., Mexico, Canada, and Sudan. Responsible for prospecting, claimstaking, gridding, geologic mapping, core logging, performing geochemical and geophysical surveys, surveying, drilling supervision, coring, blasting, logistics, construction. Reported results of research, field work and prospect/mine evaluations.

EDUCATION

1/76 - 6/77 University of California, Santa Cruz
1/75 - 3/75 B. S. Earth Science 12/77 General College Honors

9/75 - 12/75 University of California, Los Angeles
9/72 - 12/74

AFFILIATIONS

Geothermal Resources Council	1981-1985
Northwest Mining Association	1978-1980

REFERENCES — Available upon Request

REFERENCES

Dr. Robert A. Crewdson
General Manager
Sierra Scientific Services
2446 Hasti Acres Drive
Bakersfield, CA 93309
(805) 831-5121

Mr. John F. Arestad
Exploration Manager/Senior Geophysicist
Santa Fe Geothermal, Inc.
3333 Lee Parkway
Dallas, Texas 75219-5199
(214) 521-3151 ext. 732

Dr. Robert W. Potter
Senior Geochemist
Santa Fe Geothermal, Inc.
3333 Lee Parkway
Dallas, Texas 75219-5199
(214) 521-3151 ext. 684

Dr. Stan J. Todd
Johns-Manville Sales Corporation
Exploration Department
1826 Grand Avenue, Suite #1
Billings, Montana 59102
(406) 656-1531

Mr. Graeme R. Driver
Geothermal Energy New Zealand Ltd.
P. O. Box 37-231
3 Broadway
New Market
Auckland 1, New Zealand

Appendix 3: Daily Drilling Report Form

THERMAL POWER COMPANY

WELL NO. _____ AFE NO. _____
REPORT NO. _____ DATE _____
TOTAL RIG DAYS _____ TIME FROM SPUD _____
DEPTH @ 2400 HRS. _____ FOOTAGE DRLD. _____
HRS. DRILLED _____ HRS. TRIPPED _____
HRS. OTHER _____ COOLING TOWER IN USE, YES ☐ NO ☐
MUD WT. _____ VIS. _____ W.L. _____ CK. _____ PH _____ CHL _____ YP _____
P.V. _____ GELS _____ % SAND _____ % SOLIDS _____ % LOST CIRC. MTL. _____
GALVONIC PROBE _____ CORRATOR _____ SULPHIDE _____ OXY. _____ AIR-H_2O RATIO _____/1
FORM. DRLD. _____ FLOW LINE TEMP. _____ °F. SUCTION TEMP. _____ °F.
MAX. TEMP. _____ °F. DEVIATION SURVEYS: _____

CSG
" CSG. _____
" CSG. _____
" CSG. _____
LINER _____
TIE-BACK _____
HRS. REPAIR _____ RIG NO. _____

BIT #	SIZE	MAKE	TYPE	SER. NO.	JETS	IN	OUT	FT.	HRS.	WT.	RPM	COND.
												T B G
												T B G
												T B G

PUMP	LINER	STROKE	SPM	GPM	PSI	TOTAL GPM	NOZZLE VEL.	ANNULUS VEL.

AIR COMP. NO ___ CFM _____ PSI ____ TEMP. °F ____ CHEM. _____ RATIO ___/___ RATE ____
DRILLING ASSEMBLY, TOTAL LENGTH AND DESCRIPTION: _____

TOTAL STRING WT. _____ TOTAL PICKUP WT. _____ ROTARY TORQUE HIGH AVERAGE LOW
STEAM ENTRIES, DEPTH, LBS. _____

REMARKS FOR 24 HOUR PERIOD:

OPERATION @ 0600 HOURS FOLLOWING DAY:

INOPERATIVE EQUIP'T. EXPLAIN

COSTS

TANGIBLES
- CASING _____
- VALVES _____
- FLANGES _____
- OTHER _____

INTANGIBLE
- LOCATION _____
- RIG MOVES _____
- RIG _____
- ABATEMENT _____
- BITS _____
- DRILL EQUIP. MAIN. _____
- DRILL. EQUIP. RENTAL _____
- FUEL, WATER POWER _____
- MUD _____
- SUPERVISION & LABOR _____
- CEMENT SERVICES _____
- TRANSPORTATION _____
- LOGGING SERVICES _____
- FISHING & DIRECTIONAL _____
- OTHER _____

DAILY TOTAL _____
FORWARD _____
ACCU. TOTAL _____
AFE _____

UNIVERSITY OF UTAH RESEARCH INSTITUTE
UURI
EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

TO:

FROM: Mike Wright
Bruce Sibbett

MEMORANDUM

April 17, 1986

SUBJECT: Thermal Power Company's Drilling Plan for the Clackamas Hole

Comments:

Hole Design c & d: Drilling with HQ rod with an O.D. of 3.7", through the 7" surface casing will allow the drill rods to "whip around" within the 500' of surface casing subjecting it to continuous bending stresses. 4-1/2" casing placed within the 7" casing would provide stabilization for the HQ drill string. The statement in d) "use 4-1/2" core guide casing as required." may indicate that the drilling plan does call for stabilization with 4-1/2" casing within the 7" casing during coring but it is not clear. In Appendix I, p. 1, #4, the drilling program does state that the 7" surface casing will be temporarily sleeved with 4-1/2" casing. Failure to sleeve the HQ rods to educe the annulus in the surface casing could result in the HQ twisting off d loss of the hole.

A casing shoe could be used to drill the 4-1/2" casing into the hole at 500', and the 4-1/2"-7" annulus filled with drilling mud (to e the casing) before the HQ coring begins. The 500' of 4-1/2" casing lled out later if it is necessary to ream out the corehole to 6" or ion of the hole.

" casing is set to some depth to control either hole conditions aquifers below the 500' of surface casing to facilitate possible /2" casing within the 7" surface casing should be considered. mp upon completion of the hole should be considered. s planned in the drilling plan the possibility of removing sumes that the piezometric surface of the thermal aquifer of the surface such that a pump could be placed in the 7" ples if the thermal aquifer does not flow spontaneously.

Idaho National Engineering Laboratory

June 2, 1986

Mrs. Susan M. Prestwich
Advanced Technology Division
Idaho Operations Office -DOE
Idaho Falls, ID 83401

REVIEW OF THERMAL POWER PLANS -SGS-16-86

Dear Susan:

At your request, I have reviewed the institutional plan, the drilling plan and the data collection plan for Thermal Power's Clackamas hole. Thermal Power should be commended for preparing a good set of plans that I feel meet the intent of DOE's requirements. I have the following specific comments:

Institutional Plan

Thermal Power has obtained all required permits and approvals for this thermal gradient hole. The final outstanding permit, the water appropriation permit, was approved in late May. This permit is based on a temporary rule allowing limited duration geothermal exploration in the Clackamas basin, and the original restrictions will apply when the permit expires in 180 days. Thermal Power's drilling schedule will require extension of the DOGAMI drilling permit which expires on July 8. Thermal Power has completed the cultural and botanical surveys required by the BLM special stipulations. No sensitive areas were identified. The Oregon Dept. of Environmental Quality will require an analyses of the drilling fluids and cuttings prior to giving approval to Thermal Power's disposal plans.

The institutional plan references DOE's requirement for an EER. Has DOE notified Thermal Power that they waive this requirement?

Drilling Plan

I did not see any problems with Thermal Power's drilling program as outlined in the plan. Their site restoration plans appear to be sufficient to meet Forest Service and BLM requirements. There are no additional restoration requirements that I think DOE should request.

EG&G Idaho, Inc. P.O. Box 1625 Idaho Falls, ID 83415

Data Collection Plan

With the Thermal Power-UURI resolution of disposition of the cuttings and core, the data collection plan should meet the requirements as outlined in the scope of work. If a high-temperature resource is encountered and the attempt to flow the hole is successful, the flow rate estimates will have to be back-calculated to the bottomhole temperature. For this reason, I would recommend that the flow test be correlated with a temperature survey.

Sincerely,

Susan

Susan G. Stiger
Renewable Energy Programs

ks

cc: J. O. Zane, EG&G Idaho

Bruce

Diamond Shamrock
Thermal Power Company

11 October 1985

Ms Susan Prestwich
DOE Project Officer
U.S. DOE, Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Re: Cooperative Agreement
No. DE FC07-85ID12614

Dear Ms Prestwich:

We appreciate your willingness to examine a draft of the Project Management Plan for the Clackamas 5000-foot Thermal Gradient Hole. Your comments will be much appreciated. We might best discuss them by telephone and I propose to call on October 18th or 22nd. Our final Plan should reach your office shortly thereafter.

Separately, Thermal filed the Plan of Exploration with BLM-Portland on September 30th. When we file the Geothermal Drilling Permit application, expectedly by October 30th, copies of both documents will be provided to you.

Yours very truly,

W. L. D'Olier
Vice President
Geothermal Exploration

WLD/ma

OCT 15 1985

Thermal Power Company
A subsidiary of Diamond Shamrock, 3333 Mendocino Avenue, Suite 120, Santa Rosa, California 95401
Phone 707 576-7022

DRAFT

THERMAL POWER COMPANY
Santa Rosa Office

Project Title: Cascade Geothermal Drilling

CLACKAMAS 5000-FOOT THERMAL GRADIENT HOLE

Cooperative Agreement No. DE-FC07-85ID12614

Project Period: 9/30/85 thru 9/30/87

PROJECT MANAGEMENT PLAN
30 October 1985

Submitted by:
Thermal Power Company
3333 Mendocino Avenue
Santa Rosa, Calif. 95401

W. L. D'Olier
Participant
Project Manager

Approved by:
U.S. DOE, Idaho Operations Office
785 DOE Place
Idaho Falls Idaho 83402

Susan Prestwich
DOE Project Officer

PROJECT SUMMARY

Thermal Power Company, under a Cooperative Agreement dated 30 September 1985 with the U. S. Department of Energy - Idaho Operations Office, will drill and core the Clackamas 5000-Foot Thermal Gradient Hole during June and July 1986. Thermal will select all subcontractors, upon the completion of evaluations now in progress, to accomplish this Hole and its related important Data Collection Program in accordance with a Statement of Work included in both the Cooperative Agreement and this Project Management Plan.

Approximately 12 Thermal professional employees will be involved in the planning, prosecution and management of the work tasks, subcontractors and data collection for timely delivery to DOE. Milestone achievements, mutually determined by Thermal and DOE, will control payment of a maximum 50% DOE share of authorized costs, not to exceed $240,000. Thermal will provide a 12-month borehole access period to DOE following the expected August 1986 completion of the Thermal Gradient Hole. Thermal will provide its Final Technical Report to DOE before termination of the Cooperative Agreement on 30 September 1987. Thermal may elect to retain the Thermal Gradient Hole at its sole cost, risk and legal responsibility rather than to abandon it and restore the drillsite as allowed in the Cooperative Agreement.

TABLE OF CONTENTS

Project Management Plan
Clackamas 5000-Foot Thermal Gradient Hole

The Cooperative Agreement, effective as of 30 September 1985, between Thermal Power Company and U. S. Department of Energy - Idaho Operations Office (see Appendix 1), requires an approved Project Management Plan by 30 October 1985. Thermal Power Company has formulated this Project Management Plan based on the important Statement of Work included in the Cooperative Agreement (see Appendix 2).

Six major, sequential work sectors for Thermal are evident in this Project as follows:

1. Plan, permit and environmental approvals required of DOE, BLM, USFS, Oregon State and Marion County authorities.

2. Evaluate and select subcontractors for drilling-coring, geophysical logging and wellsite data collection.

3. Drilling-coring the 5000-foot Thermal Gradient Hole within time and cost estimates.

4. Data collection, its quality control and early delivery to DOE - Idaho Falls.

5. Providing the 12-month Hole access period to DOE.

6. Submitting cost accounting, supported by subcontractor invoices for progress payments in accordance with the Payment Milestone Schedule.

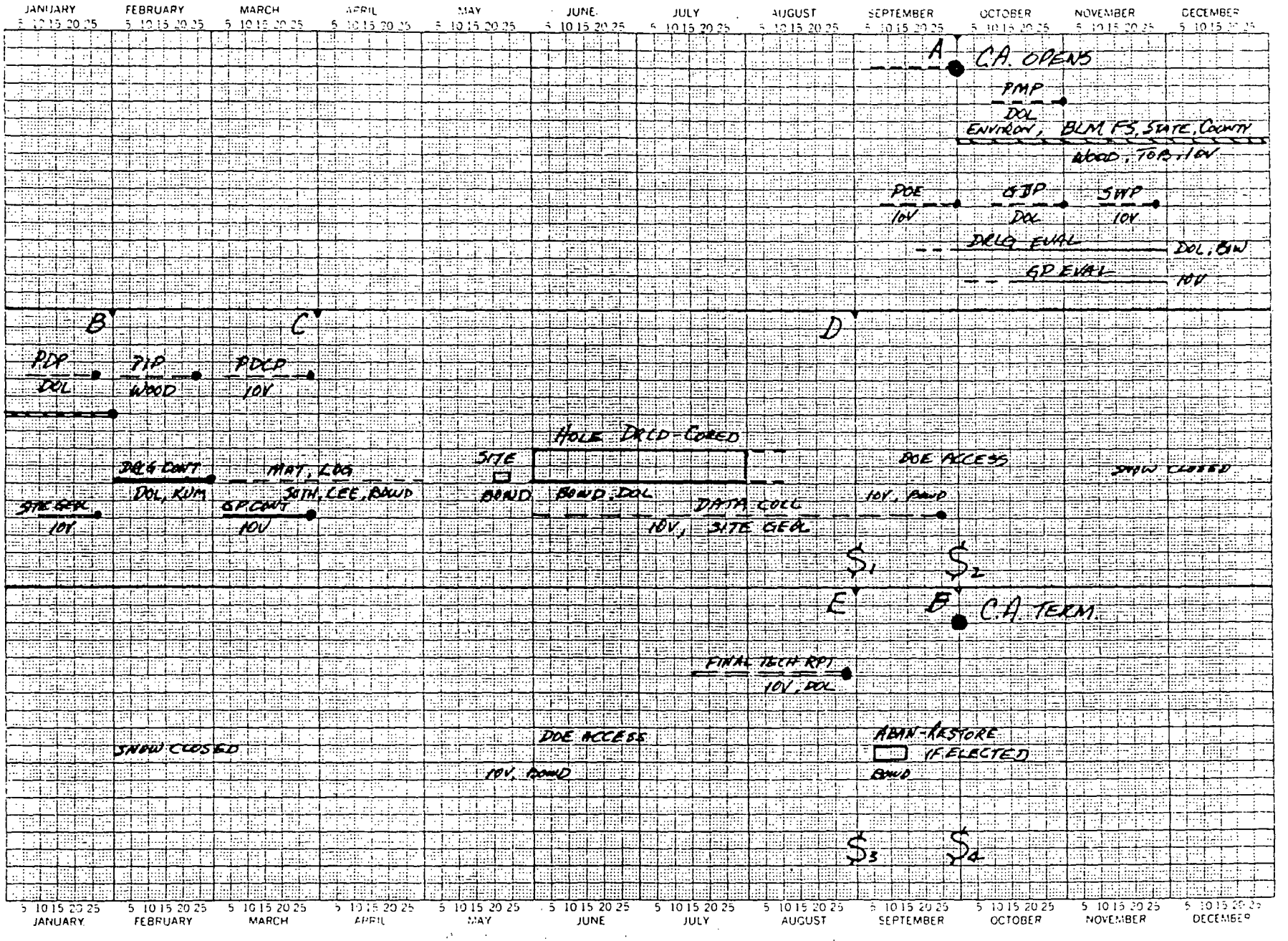
7. Submit Final Technical Report, abandon Hole and restore drillsite if elected, and terminate Cooperative Agreement at the end of its 24-month term.

The foregoing sequential work sectors are presented in the following table of Activity Milestones and Work Tasks. The Work Tasks are also illustrated on the succeeding Project Schedule Timeline which additionally shows the key Thermal personnel accountable for each Work Task.

Term Month Time	Activity Milestones and Work Tasks
0	**A. MILESTONE: Cooperative Agreement Executed on 9/30/85**
	1. Prepare and submit multiple Plans, Reports, Permits:
	Plan of Exploration (POE) to BLM and USFS
	Project Management and Drilling Plans to DOE
	Environmental Evaluation (EE) Support to BLM and DOE
	Geothermal Drilling Permit (GDP) to BLM
	2. Conduct Subcontractor Evaluations
End 4	**B. MILESTONE: POE, GDP and EE Approved by 1/30/86**
	3. Project Institutional Data Collection Plans to DOE
	4. Make Subcontractor Selections and initial contract negotiations
End 6	**C. MILESTONE: Drilling & Geophysical Subcontracts Signed by 3/31/86**
	5. Integrate Subcontractors and logistics wiht Project Drilling Plan
	6. Prepare drillsite and water supply; move-in drilling rig
	7. Execute Drilling and Data Collection Plans in June-July
End 11	**D. MILESTONE: Complete Thermal Gradient Hole at 5000-feet by 8/31/86**
	8. Open and maintain borehole and drillsite for DOE 12-month access period
	9. Review-confirm full compliance, costs and payments
End 23	**E. MILESTONE: Close DOE Access Period by 8/30/87**
	10. If TPC elects, abandon the Thermal Gradient Hole and fully restore the drillsite to its original condition. Alternatively, TPC may elect to preserve the hole and drillsite at its sole cost, risk and legal responsibility.
End 24	**F. MILESTONE: Terminate Cooperative Agreement on 9/30/87**

46 2890

PROJECT SCHEDULE TIMELINE
CLACKAMAS 5000 FOOT THERMAL GRADIENT HOLE



Thermal Power Company Personnel: Project Assignments

The Geothermal Exploration staff, located in Thermal's Santa Rosa, California office, (707/576-7022) will lead the twelve person group that will accomplish this Project. The key persons are:

W. L. D'Olier, Vice President - Geothermal Exploration

Joe Iovenitti, Senior Geologist

Royce Bowden, Geothermal Drilling Supervisor

D'Olier as Project Manager is the accountable person for the completion of all work under this Cooperative Agreement.

The following Work Task assignments are made for this Project.

Work Task	Persons Responsible	
Leases	Wood, Kumin	
Plans, Permits	D'Olier, Iovenitti, Wood	
Environmental	Tobias, Wood	
	Drilling/Coring	Data Objectives
Subcontractor Selection	D'Olier Bowden Sutherland Lee	D'Olier Iovenitti Lee
Contracts	D'Olier Kumin Walker	D'Olier Kumin Walker
Drillsite Preparation	Bowden Iovenitti	
Thermal Gradient Hole Drill-Core-Log	D'Olier Bowden	Iovenitti Hebein Goyal Wellsite Geologists
Cost Accounting	Scott, D'Olier	
DOE Access	Iovenitti, Bowden	
Final Report	Iovenitti, D'Olier	
Termination	D'Olier, Kumin	

The above assignments are also reflected on the Project Schedule Timeline. Each Work Task has both a lead person accountable and a work team assigned to ensure its careful preparation and execution. An initial Project personnel group meeting will be held in Thermal's San Francisco headquarters office on or about 21 October 1985 to introduce, explain and critique this Project Management Plan. Subsequent Project personnel group meetings will be held at the achievement of each Activity Milestone (Events A thru E) to review asccomplishments, problems, updated schedules and any Plan modification that may be required. Effective teamwork and high frequency of internal informal communications will effectively prosecute all activity required by the Statement of Work. A current Table of Organization for Thermal is included as Appendix 4 of this Plan.

Subcontractor Selection Process

The Thermal Power Company geothermal operations experience underscores the great importance of first class subcontractor participants in executing drilling programs and related field work for coherent results and success to be achieved.

For the Drilling and Geophysical Logging subcontractors, we will:

1. Interview managers and key persons to obtain measures of each firm's competence and geothermal specific experience. We will cross check these findings with other client geothermal operators, if possible. We are evaluating Boyles Bros., Tonto, Longyear and Jannsen as qualified Drilling Subcontractors. BPB Instruments, Inc., Colorado Well Logging, Inc., Georand, and Southwest Surveys are being evaluated as potential Geophysical Logging Subcontractors.

2. We are looking at the specific rigs and borehole logging equipment proposed to be used. We will attempt to additionally examine these critical items in on-site working modes.

3. The critical Project requirements will be examined with the most qualified candidates to select the best equipment and technical procedures at acceptable costs.

4. First Quarter 1986 cost estimates will be solicited for the basic work programs for further qualification of expected performance and cost values. This will not be worked as a competitive bidding for the lowest cost selection basis.

5. Selection of a final subcontractor will be based on TPC combined consideration of equipment, personnel, relevant experience and reasonable costs.

Project Cost Accounting and DOE Progress Payments

Thermal Power Company will submit invoices in accordance with Articles IV and V of the Schedules Articles attached to the Cooperative Agreement. The following table shows the Progress Payment Milestones and the DOE payable limits.

	Progress Payment Milestones	Maximum Cumulative Amount Payable by DOE	Probable Date
1.	Drilling and Hole Completed	$170,000	8/30/86
2.	Logs and Fluid Data Submitted to DOE	$202,500	9/30/86
3.	Remainder of Data and Final Report Submitted to DOE	$215,000	8/30/87
4.	Abandonment and Site Restoration Completed:		
	Total Maximum Payable by DOE	$240,000	9/30/87

These Progress Payment Milestones are also shown on the Project Schedule Timeline with the symbol "$". An additional, detailed Summary of Cost, Schedule and Deliverability is included as Appendix 3 of this Project Management Plan as a subordinate reference.

DOC F 4600.2
(7-81)

U.S. DEPARTMENT OF ENERGY

N CE OF FINANCIAL ASSISTANCE AWARD

(See Instructions on Reverse)

Under the authority of Public Law 93-410 and subject to legislation, regulations and policies applicable to *(cite legislative program title)*:
Geothermal Research, Development and Demonstration Act of 1977

1. PROJECT TITLE
Cascade Geothermal Drilling

2. INSTRUMENT TYPE
☐ GRANT ☒ COOPERATIVE AGREEMENT

4. INSTRUMENT NO.
DE-FC07-85ID12614

5. AMENDMENT NO.
--

3. RECIPIENT *(Name, address, zip code, area code and telephone no.)*
Thermal Power Co.
3333 Mendocino Ave, Suite 120
Santa Rosa, CA 95401

6. BUDGET PERIOD
FROM: 9/30/85 THRU: 9/30/87

7. PROJECT PERIOD
FROM: 9/30/85 THRU: 9/30/87

8. RECIPIENT PROJECT DIRECTOR *(Name and telephone No.)*
William L. D'Olier (707) 576-7040

10. TYPE OF AWARD
☒ NEW ☐ CONTINUATION ☐ RENEWAL
☐ REVISION ☐ SUPPLEMENT

9. RECIPIENT BUSINESS OFFICER *(Name and telephone No.)*
Philip Scott (415) 765-0329

12. ADMINISTERED FOR DOE BY *(Name, address, zip code, telephone No.)*
Ronald A. King (208) 526-0790
U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

11. DOE PROJECT OFFICER *(Name, address, zip code, telephone No.)*
Susan Prestwich (208) 526-1147
U.S. DOE, Idaho Operations Office
785 DOE Place, Idaho Falls, ID 83402

13. RECIPIENT TYPE
☐ STATE GOV'T ☐ INDIAN TRIBAL GOV'T ☐ HOSPITAL ☒ FOR PROFIT ORGANIZATION ☐ INDIVIDUAL
☐ LOCAL GOV'T ☐ INSTITUTION OF HIGHER EDUCATION ☐ OTHER NONPROFIT ORGANIZATION ☒ C ☐ P ☐ SP ☐ OTHER *(Specify)*

14. ACCOUNTING AND APPROPRIATIONS DATA

a. Appropriation Symbol	b. B & R Number	c. FT/AFP/OC	d. CFA Number
89X0224.19	AM101510	ID-54-91/250	

15. EMPLOYER I.D. NUMBER/SSN

16. BUDGET AND FUNDING INFORMATION

a. CURRENT BUDGET PERIOD INFORMATION		b. CUMULATIVE DOE OBLIGATIONS	
(1) DOE Funds Obligated This Action	$ 240,000	(1) This Budget Period *[Total of lines a.(1) and a.(3)]*	$ 240,000
(2) DOE Funds Authorized for Carry Over	$ -0-	(2) Prior Budget Periods	$ -0-
(3) DOE Funds Previously Obligated in this Budget Period	$ -0-		
(4) DOE Share of Total Approved Budget	$ 240,000		
(5) Recipient Share of Total Approved Budget	$ 240,000	(3) Project Period to Date *[Total of lines b. (1) and b. (2)]*	$ 240,000
(6) Total Approved Budget	$ 480,000		

17. TOTAL ESTIMATED COST OF PROJECT $ _____

(This is the current estimated cost of the project. It is not a promise to award nor an authorization to expend funds in this amount.)

18. AWARD/AGREEMENT TERMS AND CONDITIONS

This award/agreement consists of this form plus the following:

a. Special terms and conditions (if grant) or schedule, general provisions, special provisions (if cooperative agreement)

b. Applicable program regulations *(specify)* N/A *(Date)* _____

c. DOE Assistance Regulations, 10 CFR Part 600, as amended, Subparts A and ☐ B (Grants) or ☒ C (Cooperative Agreements).

d. Application/proposal dated 4/29/85, ☐ as submitted ☒ with changes as negotiated

19. REMARKS
This Agreement consists of this NFAA, Schedule Articles, General Provisions, Appendix A - Statement of Work, Appendis B - Labor Determination, DOE Order 1332.2, and Cost Principles FAR 31.2 and DEAR 931.2.

20. EVIDENCE OF RECIPIENT ACCEPTANCE
for William L. D'Olier 9/30/85
(Signature of Authorized Recipient Official) *(Date)*
William L. D'Olier
Vice President *(Name)*
Geothermal Exploration
(Title)

21. AWARDED BY
William C. Drake 9/27/85
(Signature) *(Date)*
William C. Drake
(Name)
Contracting Officer
(Title)

TPC
Statement of Work

1.0 Introduction

The Cascade volcanic region has long been suspected to contain considerable geothermal potential, as evidenced by recent volcanism and other thermal expressions. There are few known surface manifestations of geothermal energy in spite of the obvious occurrence of heat sources. One possible explanation is that the downward percolation of the extensive regional cold ground water system suppresses surface evidence of underlying hydrothermal systems. However, there have been few wells drilled in the Cascades region to a sufficient depth to properly evaluate the temperature and hydrological conditions beneath the cold water zone. There is a great need for characterization identification of the deeper hydrothermal regime in order to more conclusively define the geothermal potential of the Cascades volcanic environment.

DOE's primary objectives for this cost-shared drilling project are to obtain and release to the public subsurface information to include but not limited to the following:

- o rock samples (core and/or drill chips),
- o equilibrium temperature profiles,
- o uncontaminated fluid samples,
- o evidence for the existence and depth of potentially producible aquifers,
- o geophysical well logs, and
- o information on drilling conditions and problems in the Cascades environment.

2.0 Scope

1. The Participant will drill a thermal gradient hole to an approximate target total depth of 5000 feet in Section 28, T8S, R8E Willamette Meridian, Marion County, Oregon. This primary task will be accomplished by 24 hours per day continuous work to achieve its completion in an estimated 60 days of rig operations.

2. The Participant will collect all required data both during and subsequent to drilling the thermal gradient hole.

3. The Participant will provide all data and information gathered under this Project to DOE.

4. The Participant will obtain all permits and approvals required by government regulatory agencies for the performance of this Project.

5. The Participant will perform all Project work in compliance with federal, state and local laws, rules and regulations and agency orders and guidelines.

3.0 Applicable Documents

Work performed by the Participant will be in compliance with all Federal, State, and local laws, rules and regulations, and agency orders and guidelines.

4.0 Technical Tasks

4.1 Project Management

A. The Participant will prepare and obtain DOE approval of a Project Management Plan within 30 days after award of this agreement. The plan will include a work breakdown structure and a list of deliverables by task, identify the individuals and subcontractors responsible for each task, discuss the management techniques to be used, and include a schedule that shows the period for performance of each subtask and identifies principal milestones and decision points for each. This plan will also designate an individual or individuals who will act as principal points of contact with DOE on behalf of the Participant.

B. The Participant will submit and obtain DOE approval of a Project Institutional Plan prior to initiation of site preparation. The plan will identify items required by governmental regulatory agencies for the performance of this work, the agency whose requirement the item fulfills, and the actual or projected submittal and agency approval dates. The plan will also discuss any legal, social, or institutional problems anticipated during performance of the project and planned solutions.

C. The Participant will prepare and obtain DOE approval of a Project Drilling Plan prior to drilling. The plan shall describe:

1. Surface and subsurface conditions anticipated to be encountered during drilling, including configuration of the resource.

2. Site access.

3. Site preparation.

4. Hole design including hole size, casing size, cementing, etc.

5. Rig and equipment specifications.

6. Well containment during and after drilling including applicable regulatory requirements).

7. Drilling fluids and disposal method.

8. Hole completion.

9. Plugging and abandonment.

10. Site restoration.

11. Anticipated hole problems, if any, and proposed solutions.

12. Health, safety and environmental considerations.

13. Site facilities, if any.

14. Drilling schedule including major activities and estimated duration.

15. On-site supervision to be used during drilling, including drilling supervisor(s) and geologist(s).

D. The Participant will prepare and obtain DOE approval of a Project Data Collection Plan prior to drilling. This plan will address data collection both during drilling and after drilling. The plan will identify the types of data to be collected, the depth(s) at which each type of data will be collected, the timing of collection, and the method by which the Participant plans to collect each type of data, including type of instrument and planned calibration, where appropriate. The plan will specifically identify all logs and samples of rock and fluid that are to be collected.

E. The Participant will conduct subcontractor evaluations, select subcontractors and complete contract negotiations with selected subcontractors.

F. The Participant will perform project management in accordance with the approved Project Management Plan. In addition to close general coordination with DOE, immediate and full disclosure of any project problem areas to DOE is required, so that timely corrective action may be taken with DOE technical support, if necessary.

Deliverables: Approved Project Management Plan, Project Institutional Plan, Project Drilling Plans and Project Data Collection Plan.

4.2 Permitting and Environmental Reporting

A. The Participant will prepare, submit and obtain approval of any documentation required by governmental regulatory agencies for the performance of this work, including a geothermal exploration permit and a plan of operations. A copy of all documentation provided to any governmental agency and pertinent to this project shall be provided to DOE.

B. An approved environmental document is required for this project prior to any ground disturbance. It is anticipated that an environmental assessment will be prepared by the Bureau of Land Management for this project. This environmental assessment may satisfy DOE's environmental reporting requirements. If DOE determines that a separate Environmental Evaluation Report is required prior to any ground disruptive activity, DOE will notify the Participant in writing. In that event, the Participant will prepare the Environmental Evaluation Report in accordance with DOE Environmental guidelines. If a DOE Environmental Assessment is required, the Participant will provide information to DOE as required for DOE's preparation of the Environmental Assessment.

If DOE determines that an Environmental Assessment is required, DOE will notify TPC in writing. Upon such notification, TPC will provide information to DOE as required for DOE's preparation of the Environmental Assessment.

Deliverables: Approved environmental document and regulatory documentation.

4.3 Drilling

A. The Participant will confirm logistics, services and vendors with requirements outlined in the approved Project Drilling Plan.

B. The Participant will prepare drill site, access and water supply and move in drilling rig in accordance with approved Project Drilling Plan.

C. The Participant will drill a thermal gradient hole to 5000 feet TD in accordance with the approved Project Drilling Plan. The Participant shall report on drilling status daily to the designated DOE representative, so that discussions concerning the drilling operation can be made in a timely manner.

4.4 Data Collection

A. The Participant will collect the following data as a minimum in accordance with the approved Project Data Collection Plan. These data shall be provided to DOE by the Participant as soon as acquired.

Rock Sampling - The drilling of the hole is designed such that a continuous core from bedrock to total depth will be obtained. It is anticipated that a 2.50" core will be recovered from the drilling of HQ (3.85" OD) size hole. If it is necessary to reduce to NQ (3.03") hole size, a 1.88" core will then be retrieved. Drill cuttings will also be

obtained from at least the upper 500 feet of the hole. The Participant's drill site geologist will provide data collection and on-site handling of samples. DOE will provide procedures for identification and splitting of core and cuttings and will coordinate disposition and storage of the samples with the Participant.

Fluid Sampling - Daily measurements of the hydraulic head (natural water level in the hole) will be obtained as allowed during the drilling operation. Lost circulation data will be collected. If artesian flow is encountered and the issued drilling permit allows the performance of a flow test, a short-term test will be conducted at total depth to obtain samples of the formation water and wellhead temperature and pressure. Drilling fluid samples will be collected as per SCAP. The drill site geologist will maintain a log of the daily water level and lost circulation data. If no artesian flow is encountered, the Participant will still endeavor to collect samples of uncontaminated aquifer fluids at locations in the hole at which fluid production would be anticipated on the basis of lost circulation, indications of fracturing in the core or chips, geophysical well logs or other standard indicators. Potential methods for collection of these samples include swabbing, bailing, air lift, drill stem tests and pumping. The Participant will examine these and/or other fluid sampling techniques and address collection of these samples in the Project Data Collection Plan.

Geophysical Borehole Logging - The complete suite of geophysical borehole logs identified in the SCAP (temperature, caliper, resistivity, self-potential, sonic velocity and density logs) along with natural gamma, will be run in the wellbore not more than three separate times. The three logging runs would correlate with the running of the surface casing at 3000' (if needed and a total depth (5000'). The open-hole logs (SP, caliper, resistivity and sonic) will only be run in the open-hole. Temperature logs will be run from surface to total depth. Gamma and/or density will only be run a couple hundred of feet into the cased-hole. The latter will allow cross-cablibration between the three intended logging runs. The Participant's geologist will direct and observe all logging operations. A comprehensive logging operation report will be prepared for each logging operation. One set of field prints will be sent to DOE as soon as available.

Maximum Temperature Reading - Three maximum recording thermometers will be run at every core recovery. These data will be collected by the drill site geologist.

Daily Drilling Report - A drilling report will be completed every day and submitted to DOE.

Directional Survey - A multi-shot direction survey will be made at total depth to allow for oriented core analysis. Specific hole conditions may require an additional survey.

"Mud" Log - A "Mud" log will be maintained during the drilling operation. This log will provide the following principal data, summarized at a vertical scale of 1' = 100':

1. geologic field description of core (including lithology, alteration minerology and fracture geometery assuming a vertical hole),

2. graph of penetration rate versus depth,

3. graph of measured water level versus depth,

4. lost circulation zones (including time/date, depth, total amount of fluid loss and rate of fluid loss), and

5. casing profile.

Temperature surveys

The Participant will conduct two temperature surveys. The first to be conducted at one week and the second at one month after the thermal gradient hole has been completed. These surveys will be from surface to total depth.

Deliverable: Data and samples.

4.5 Hole Completion and Maintenance

A. Upon satisfactory completion of drilling, open-hole geophysical logging and sampling, a steel tubing string will be hung or cemented in the borehole from surface to TD and the well completed by the Participant in accordance with the approved Project Drilling Plan.

B. Upon completion of the hole, DOE and the Participant shall review and discuss the data. The Participant will obtain Project Manager's agreement prior to releasing the rig.

C. The Participant shall provide to DOE within 15 days of completion of the hole a schematic of the actual completed hole configuration.

D. The Participant shall maintain the hole and site for a period of 12 months after hole completion in accordance with the approved Project Drilling Plan. The hole and site shall be

U.S DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE REPORTING CHECKLIST

FORM EIA 459A
(10 80)

FORM APPROVED
OMB NO 1900 0177

1. Identification Number: DE-FC07-85ID12614	2. Program/Project Title: Cascade Geothermal Drilling

3. Recipient: Thermal Power Company

4. Reporting Requirements:	Frequency	No. of Copies	Addressees
PROGRAM/PROJECT MANAGEMENT REPORTING			
[X] Federal Assistance Milestone Plan	O	2,1,1	A,B,E
[ ] Federal Assistance Budget Information Form			
[X] Federal Assistance Management Summary Report	Q	1,1,1	A,B,C
[X] Federal Assistance Program/Project Status Report	Q	2,1.1	A,B,E
[X] Financial Status Report, OMB Form 269	Y,F	1,1	B,C
TECHNICAL INFORMATION REPORTING			
[XX] Notice of Energy RD&D	O,Y	1,1	B,D
[ ] Technical Progress Report			
[X] Topical Report	A	3,1,1,1	A,B,E,F
[X] Final Technical Report	F	*4,1,1,1	A,B,E,F

FREQUENCY CODES AND DUE DATES:

A - As Necessary; within 5 calendar days after events.
F - Final; ~~90 calendar days after the performance of the effort ends~~ Upon completion of agreement
Q - Quarterly; within 30 days after end of calendar quarter or portion thereof.
O - One time after project starts; within 30 days after award.
X - Required with proposals or with the application or with significant planning changes.
Y - Yearly; 30 days after the end of program year. (Financial Status Reports 90 days).
S - Semiannually; within 30 days after end of program fiscal half year.

5. Special Instructions:

A draft to the Final Technical Report shall be submitted for review to the contracting officer at least 60 days prior to the final due date. Comments resulting from this review shall be resolved and the report revised accordingly prior to final submission to DOE. The Final Technical Report shall be submitted with a camera-ready copy.

NOTE: Contracting officer copy shall list all distribution.

*Includes camera-ready copy.

6. Prepared by: (Signature and Date)	7. Reviewed by: (Signature and Date)

made available to DOE during this period for DOE's scientific use. The Participant will not attempt to preserve access to the site during the period of winter snow cover.

Deliverable: Completed hole configuration schematic.

4.6 Abandonment and Site Restoration

The Participant will plug and abandon the hole and fully restore the site in accordance with BLM regulations, Forest Service stipulations and the Project Drilling Plan. Alternatively, the Participant may elect to preserve the hole and drill site at its sole risk, cost and legal responsibility. In this instance, the Participant shall provide DOE with a copy of the plug and abandonment and site restoration plans from the approved Plan of Operations and shall provide confirmation of these activities. DOE will not cost-share costs incurred after the project period of this agreement.

Deliverables: Approved P&A and restoration plans.

5.0 Reports, Data and Other Deliverables

A. The Project Drilling Plan as required by Subtask 4.1.C.

B. The Project Data Collection Plan as required by Subtask 4.1.D.

C. The Project Management Plan as required by Subtask 4.1.A.

D. The Project Institutional Plan as required by Subtask 4.1.B.

E. All data collected by the Participant under Task 4.4.

F. Regulatory documentation and approved environmental document under Subtasks 4.2.A and 4.2.B.

G. Completed hole completion schematic as required by Subtask 4.5.C.

H. Approved plug and abandonment plan as required by Task 4.6.

I. Project status and management reports as identified on DOE Form CR-537, Reporting Requirements Checklist. The final technical report will include a description of drilling and completion and data will be presented and discussed.

REPORT DISTRIBUTION LIST

DE-FC07-851D12614

U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

A. Susan Prestwich
Geologist
Advanced Technology Division

B. Ronald A. King
Contract Specialist
Contracts Management Division

C. Earl G. Jones
Director
Financial Management Division

D. U. S. Department of Energy
Technical Information Center
Oak Ridge, TN 37830

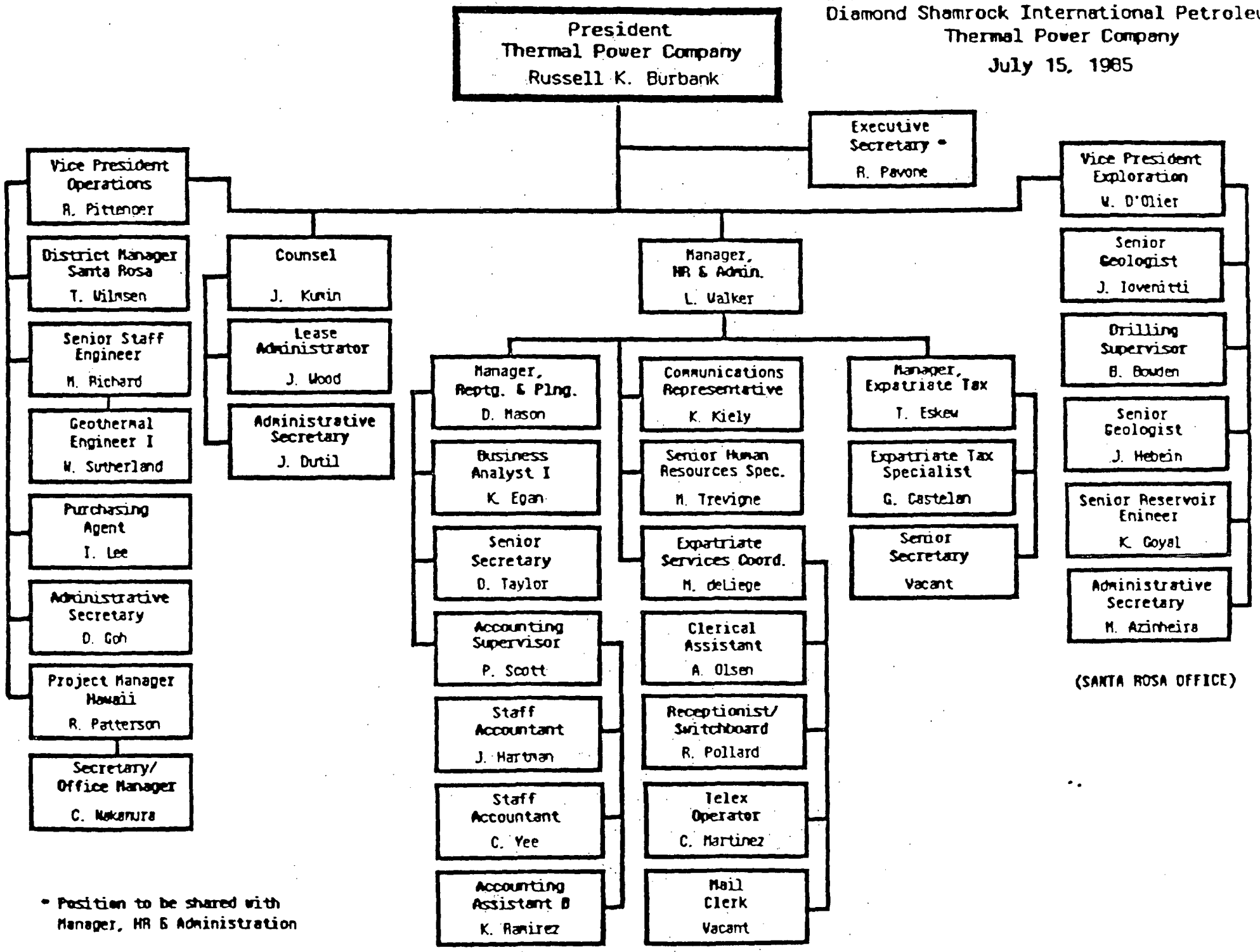
E. P. M. Wright
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, UT 84108-1295

F. Marshall Reed
U. S. Department of Energy
CE-323 Forestal Building
1000 Independence Avenue, S.W.
Washington DC 20585

COST, SCHEDULE AND DELIVERABLE SUMMARY

TASK	ESTIMATED 100% COST	SCHEDULE START	SCHEDULE COMPLETE	MILESTONES & DELIVERABLES
1. Project Management	NO CHARGE	10·1·85	10·31·85	1. Management Plan
2. Permitting and Environmental Reporting	NO CHARGE	8·8·85	2·28·86	1. Institutional Plan 2. Regulatory Documentation 3. EER
3. Drilling				1. Drilling Plan 2. Daily Drilling Status Reports
SITE PREPARATION	$15,000	5·20·86	5·25·86	
DRILLING - CORING	343,000	6·1·86	7·31·86	
4. Data Collection				1. Data Collection Plan 2. Rock & Fluid Results of Analyses Samples, & Data Reports
(a) During Drilling				
GEOPHYS. LOGS	22,200	6·3·86	7·29·86	
FLUID SAMPLES	3000	"	"	
FLOW TEST 3000'?	7000	6·29·86	6·30·86	
SITE GEOLOGISTS	22.000	6·1·86	7·31·86	
(b) After Drilling				1. Well Legs 2. Fluid Samples 3. Other Data & Results
FLOW TEST 5000'	10.000	7·29·86	7·31·86	
TWO TEMP. SURVEYS	7800	8·7·86	8·30·86	
5. Completion & Maintanance TUBING ETC.	20.000	7·31·86	7·31·86	1. Completion Schematic
6. Abandonment IF ELECTED	25.000	95·87	9·10·87	1. Approved Abandonment Plan
7. Site Restoration IF ABANDONED	5000	9·10·87	9·15·87	1. Restoration Confirmation Report
8. Reporting	NO CHARGE	10·31·85	9·30·87	1. As summarized in this table
9. Dissemination of Information	NO CHARGE	10·1·85	9·30·87	1. Project sign, press release(s) 2. Final Technical Report
TOTAL ESTIMATED 100% COSTS	$480.000			

Diamond Shamrock International Petroleum
Thermal Power Company
July 15, 1985



* Position to be shared with Manager, HR & Administration

Diamond Shamrock
Thermal Power Company

13 August 1985

U. S. Department of Energy
Idaho Operations Office
550 Second Street
Idaho Falls, Idaho 83401

Attention: Ronald A. King
R&D Contracts Branch
Contracts Mgmt. Div.

Ref: SCAP Number
DE-SC07-851D12580
DOE Letter 8/5/85

Gentlemen:

Thermal Power Company has examined the DOE's draft revision of the Statement of Work and our comments are restricted to the Geophysical Borehole Logging element on page 5 of your draft. Our proposed wording for this element is Enclosure 1 to this letter. All other portions of the revised Statement of Work presented in your letter of August 5, 1985 are acceptable to us.

Enclosure 2 of this letter is your Cost Schedule and Deliverable Summary, as completed by Thermal, which should assist payment schedules.

Yours very truly,

W. L. D'Olier
Vice President
Geothermal Exploration

WLD/ma

Enclosures 1 and 2

Thermal Power Company
A subsidiary of Diamond Shamrock, 3333 Mendocino Avenue, Suite 120, Santa Rosa, California 95401
Phone 707 576-7022

ENCLOSURE I

THERMAL POWER COMPANY
Santa Rosa Office

PROPOSED CHANGE IN REVISED TPC STATEMENT OF WORK

Geophysical Borehole Logging: The complete suite of geophysical borehole logs identified in the SCAP (temperature, caliper, resistivity, self-potential, sonic velocity and density logs) along with natural gamma, will be run in the wellbore not more than three separate times. The three logging runs would correlate with the running of the surface casing planned at 500', of intermediate casing at 3000' (if needed) and at total depth (5000'). The open-hole logs (SP, caliper, resistivity and sonic) will only be run in the open-hole. Temperature logs will be run from surface to total depth. Gamma and/or density will only be run a couple hundred of feet into the cased-hole. The latter will allow cross-calibration between the three intended logging runs. The Thermal Power Company geologist will direct and observe all logging operations. A comprehensive logging operation report will be prepared for each logging operation. One set of field prints will be sent to DOE as soon as available.

JLI/ma
8/13/85

COST, SCHEDULE AND DELIVERABLE SUMMARY

TASK	ESTIMATED 100% COST	SCHEDULE START	SCHEDULE COMPLETE	MILESTONES & DELIVERABLES
1. Project Management	No CHARGE	10·1·85	10·31·85	1. Management Plan
2. Permitting and Environmental Reporting	No CHARGE	8·8·85	2·28·86	1. Institutional Plan 2. Regulatory Documentation 3. EER
3. Drilling SITE PREPARATION DRILLING - CORING	$15,000 343,000	5·20·86 6·1·86	5·25·86 7·31·86	1. Drilling Plan 2. Daily Drilling Status Reports
4. Data Collection (a) During Drilling				1. Data Collection Plan
GEOPHYS. LOGS	22,200	6·5·86	7·29·86	2. Rock & Fluid Results of Analyses Samples, & Data Reports
FLUID SAMPLES	3000	"	"	
FLOW TEST 3000'?	7000	6·29·86	6·30·86	
SITE GEOLOGISTS	22,000	6·1·86	7·31·86	
(b) After Drilling				1. Well Legs
FLOW TEST 5000'	7000	7·29·86	7·31·86	2. Fluid Samples
TWO TEMP. SURVEYS	7800	8·7·86	8·30·86	3. Other Data & Results
5. Completion & Maintanance TUBING ETC.	20,000	7·31·86	7·31·86	1. Completion Schematic
6. Abandonment IF ELECTED	25,000	95·87	9·10·87	1. Approved Abandonment Plan
7. Site Restoration IF ABANDONED	5000	9·10·87	9·15·87	1. Restoration Confirmation Report
8. Reporting	No CHARGE	10·31·85	9·30·87	1. As summarized in this table
9. Dissemination of Information	No CHARGE	10·1·85	9·30·87	1. Project sign, press release(s) 2. Final Technical Report
TOTAL ESTIMATED 100% COSTS	$477,000			

5000"

TPC · 13 AUG 85

GEO-Newberry Crater, Inc.
A Subsidiary of Geothermal Resources International, Inc.

Aug. 19, 1985

Mr. Bruce Sibbett
Univ. of Utah Research Inst.
391 Chipeta Way Suite "C"
Salt lake City, Utah 84108

Dear Bruce:

Attached are the various "Plans" that we have submitted to DOE as part of our Cascades drilling project.

Very truly yours,

Chandler A. Swanberg

CAS/rs
enclosure
cc: Jim Combs w/o encl

61419 South Highway 97, Suite A, Bend, OR 97701 (503) 389-6681

Bruce

Diamond Shamrock
Thermal Power Company

14 November 1985

U. S. Department of the Interior
Bureau of Land Management
Division of Mineral Resources
P. O. Box 2965
Portland, Oregon 97201

Attention: Mr. Robert Fujimoto

Subject: Geothermal Drilling Permit Application
Clackamas 5000-Foot Thermal Gradient Hole
Federal Geothermal Lease OR 12344

Gentlemen:

We submit herewith our application for Geothermal Drilling Permit, on USGS Form 9-1957, for the Clackamas 5000-Foot Thermal Gradient Hole. This application supplements our Plan of Exploration which was delivered to your office under our letter dated September 26, 1985. We would proceed under an approved Permit, with drilling operations in June-July 1986, after obtaining additional approvals from the U. S. Department of Energy which is supporting this Thermal Gradient Hole under a Cooperative Agreement with Thermal Power Company.

Our Detailed Drilling Program is deliberately flexible in order to best respond to the actual thermal and fluid conditions found at depth and to obtain the highest quality information on the geothermal resource, if encountered.

Please contact the undersigned at 707/576-7040 for all additional comments, explanation or information which you may require in considering this application, its approval and issuance as a Permit. Your early attention will be greatly appreciated.

Yours very truly,

W. L. D'Olier
Vice President
Geothermal Exploration

RECEIVED
NOV 18 1985
ADVANCED TECHNOLOGY
BRANCH

WLD/ma

Enclosures: 5 Application Documents

Thermal Power Company
A subsidiary of Diamond Shamrock, 3333 Mendocino Avenue, Suite 120, Santa Rosa, California 95401
Phone 707 576-7022

USGS 9-1957

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY, CONSERVATION DIVISION

Form Approved
Budget Bureau No. _____

GEOTHERMAL DRILLING PERMIT

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

Clackamas 5000' Thermal Gradient Hole (CTGH)

4. LEASE SERIAL NO.: OR 12344

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

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

6. UNIT AGREEMENT NAME: N/A

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

7. WELL NO.: CTGH-1

8. PERMIT NO.:

1c. WELL STATUS: Proposed

2. NAME OF LESSEE/OPERATOR: Thermal Power Company

9. FIELD OR AREA: Squirrel Creek

3. ADDRESS OF LESSEE/OPERATOR: 3333 Mendocino Avenue, Suite 120
Santa Rosa, California 95401

10. SEC., T., R., B.& M.: Sec. 28 T8S R8E
Willamette Meridian

15. LOCATION OF WELL
At surface: Approximately 2200' N and 1500' W of SE Corner of Sec. 28
At proposed prod. zone: Same as Surface Location

11. COUNTY: Marion

16. DISTANCE FROM PROPOSED LOCATION TO NEAREST PROPERTY OR LEASE LINE: 1500' W of East Line of Sec. 28

12. STATE: Oregon

17. DISTANCE FROM PROPOSED LOCATION TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR ON THIS LEASE: No previous well drilled or applied for on this lease.

13. APPROX. STARTING DATE: 1 June 1986

14. ACRES ASSIGNED (WELL SPACING): N/A

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

19. PROPOSED DEPTH: MEASURED: 5000 TRUE VERTICAL: 5000

20. ELEVATIONS: ESTIMATED (X) FINAL ( )
REFERENCE DATUM: GR (X) MAT ( ) DF ( ) KB ( ) RT ( ) CASINGHEAD FLANGE ( ) OTHER ( )

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

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	COUPLING (Collars & Threads)	GRADE	SETTING DEPTH Top	SETTING DEPTH Bottom	QUANTITY OF CEMENT
14-3/4"	11-3/4"	28 lbs.	N/A	1/4" Wall	0	30	25 cu. ft.
10" or 9-7/8"	7"	26 lbs.	Buttress	K-55	0	500	266 cu. ft.
6" or 5-5/8"	4-1/2"	11.6 lbs.	Long	K-55	450	4000	605 cu. ft.

22. PROPOSED WORK SUMMARY

Prepare 160' x 200' drillsite pad and lined sump adjacent to existing access road into clear cut parcel 30. Move in truck mounted rig. Drill 14-3/4" hole to 30' depth, run 11-3/4" conductor to bottom and cement to surface. Drill 10" hole to 500' depth; run 7" K-55 26 pound Buttress casing to bottom and cement to surface. Install casing head on 7" casing, then BOPE consisting of a double control gate and Hydril. Test BOPE per BLM regulations. Diamond core with HQ heads to 5000'. Run geophysical borehole log suite to 5000'. Open HQ hole with 6" bit to 4000' or other selected depth; run 4-1/2" K-55 11.6 pound LT&C casing to 4000', cement solid from shoe to lap in 7" casing at 450'-500' depth. Briefly flow well to obtain expected geothermal fluid samples. Hang 2-7/8" J-55 tubing string to 5000'; fill same with water. Release rig; leave CTGH-1 shut-in awaiting DOE high precision temperature log.

This will be a vertical borehole; no directional drilling/coring practices will be applied. However, borehole directional surveys will be run with the geophysical logging suite.

This deep thermal gradient hole would be drilled under a Cooperative Agreement between Thermal Power Company and the U. S. Department of Energy as part of the DOE program to 1) gather data to characterize the deep hydrothermal resource of the Cascades volcanic region and 2) transfer this data to the public in order to stimulate further development of hydrothermal resources.

(Use additional space on reverse side of form)

23.

SIGNED W.L. D'Olier TITLE Vice President, Geothermal Exploration DATE 14 November 1985

(This space for Federal use)

APPROVED BY _____ TITLE _____ DATE _____

CONDITIONS OF APPROVAL, IF ANY:

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

(See instructions on reverse side)

THERMAL POWER COMPANY, Operator
Santa Rosa Office

14 November 1985

DETAILED DRILLING PROGRAM: CLACKAMAS 5000-FOOT THERMAL GRADIENT HOLE

Prepare the drillsite pad and lined sump in late May 1986. Install 5' x 5' x 4' deep board cellar. Move in truck mounted drill rig by 1 June 1986.

1. Drill 14-3/4" hole with tricone bit and clay-water based mud through overburden to 30-foot depth. Run 11-3/4" conductor and cement solid to surface with construction cement top poured outside the conductor.

2. Drill 9-7/8" hole with tricone bit and clay-water based mud to 500 feet depth. Use air hammer if possible. Run geophysical borehole logs. Run 7", K-55, 26 pound, Buttress coupled surface casing to 500 feet and cement solid from shoe to surface. Use Class G cement plus 40% silica flour. Pump 266 cubic feet of cement slurry, which is 250% of annulus volume to be filled.

3. Install 7" Larkin 4000 psig casing head with two side ports on 7" surface casing. Install temporary 6", 3000 psig head flange on casing head. Install BOPE consisting of a double control gate, bolted to the head flange, a MSP-2000 Hydril bolted above the gate, a hydraulic accumulator, control panel and rig floor activator. Pressure test and verify reliable BOPE operation and compliance with BLM regulations. Propose 1000 psig for 30 minutes to pressure test BOPE, casing head, weld and 7" casing. Notice BLM-Portland representative timely to allow observation/approval of this pressure test. Rig choke manifold line on one side port and kill line on other side port. See Figures 1a and 1b.

4. Prepare diamond coring system and continuously core with HQ diamond heads (3.85" outside diameter and 2.5" core diameter) to 5000 feet or greatest depth possible. This coring will be done with polymeric-water based drilling fluids which may be completely lost to the rock formations. Temporarily sleeve the 7" surface casing with 4-1/2" core guide casing to preclude rod whip.

5. If hole conditions become difficult, open corehole with 6" or 5-5/8" bit, run geophysical borehole logs and sample formation fluids by rig flow test before hanging or cementing 4-1/2", K-55, 11.6 pound casing as intermediate protection string (see 7 below re cementing). Resume HQ coring to 5000 feet or greatest depth possible. If required, reduce to NQ diamond heads (3.032" outside diameter) and continuously core to 5000 feet.

6. At 5000 feet (or more) total depth, run geophysical borehole logs from TD to 4-1/2" or 7" casing shoe. Have adequate water supply on site to pump into borehole for cooling in order not to exceed geophysical tool temperature limitations.

4¼ cuplings Flush joins. 9/16" clearance - normally have 2" or more clearance for set & cementing.

7. If 4-1/2" casing was not required for borehole protection to achieve 5000-foot depth, be prepared to open diamond corehole with a 6" bit and cement 4-1/2" casing at the top of the deep geothermal zone, if encountered and prospective for improved evaluation as an isolated zone. Use Class G cement, 40% silica flour and perlite. Pump 605 cu. ft. of cement slurry which is 200% of annulus volume to be filled between a 4000-foot casing shoe depth and a 4-1/2" to 7" casing lap between 450 and 500 feet.

3.965 I.D

8. Remove BOPE stack and temporary head flange. Blind flange the casing head. Obtain geothermal fluid samples from the prospective geothermal zone by short term flow test through the casing head side port and choke manifold line. Contain the geothermal fluid samples on the drillsite and in a Baker steel tank for toxicity evaluations to guide in subsequent disposals.

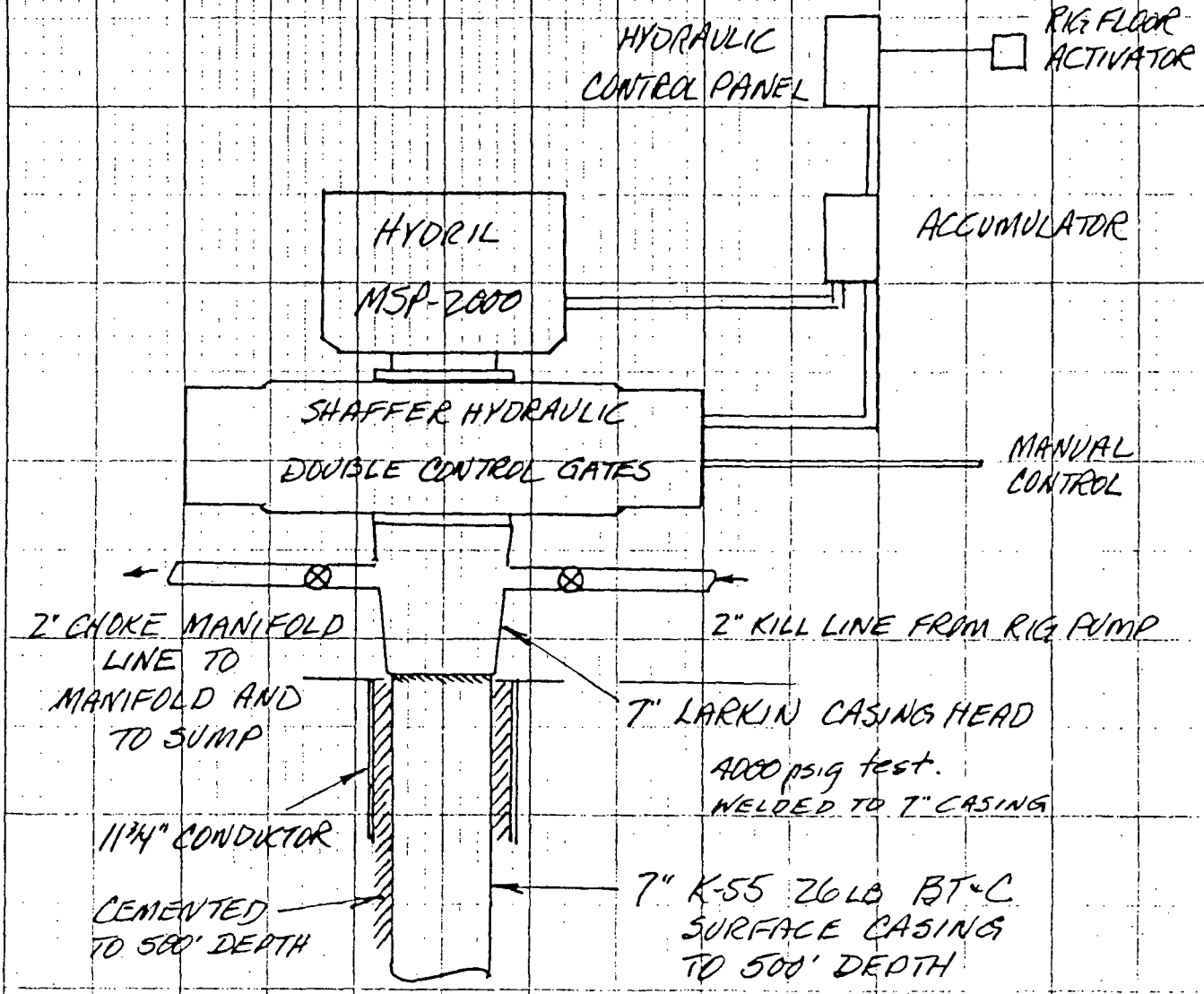
9. Run 2.875" OD J-55 tubing (solid string-water filled) to total depth and hang tubing in casing head if required for DOE high precision temperature log. Put 3" gate and lubricator connection on tubing or casing head. Release rig, fence the sump, clean and post the drillsite. Chain and lock the 3" and side port gates in the closed position. See Figure 2.

WLD/RJB/ma

Attachments - Supplemental Information and 5 Figures

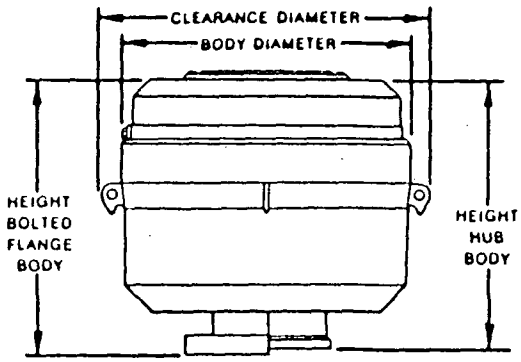
CLACKAMAS 5000' THERMAL GRADIENT HOLE

BOPE & SURFACE CONTROLS: DRILLING-CORING MODE



Diamond Shamrock
Thermal Power Company

FIGURE 1a



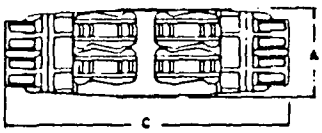
HYDRIL TYPE MSP-2000

ENGINEERING AND DIMENSIONAL DATA

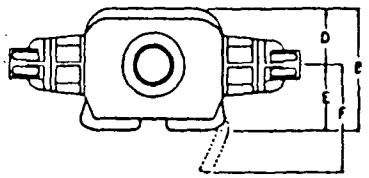
Connector Size and Pressure Rating (PSI)	Open Bore, In.	Approx. Weight, Pounds	Height Flange Body, In.	Height Hub Body, In.	Clearance Diam., In.	Body Diam., In.	U.S. Gallons for Full Piston Stroke	Piston Stroke Inches
6"-2000	7 1/16	1,850	25 1/4	...	29 1/4	25 1/2	2.85	4 1/2
8"-2000	8 1/16	2,450	30 1/4	...	32	27 1/2	4.57	5 1/2
10"-2000	11	3,520	31 1/4	...	37 1/2	32 1/2	7.43	6 1/2
20"-2000	21 1/4	14,900	52 1/2	51	58 1/2	31.05	11 1/2	

*MSP 2000 Blowout Preventers are furnished with 1" opening and closing ports. 1 1/2" or 1 1/2" are available on special request.

DIMENSIONAL AND ENGINEERING DATA ON SHAFFER TYPE E HYDRAULIC DOUBLE CONTROL GATES



Dimensional Elevation of Shaffer Type E Hydraulic Double Control Gate



Dimensional Plan of Shaffer Type E Hydraulic Double Control Gate

TYPE E DOUBLE

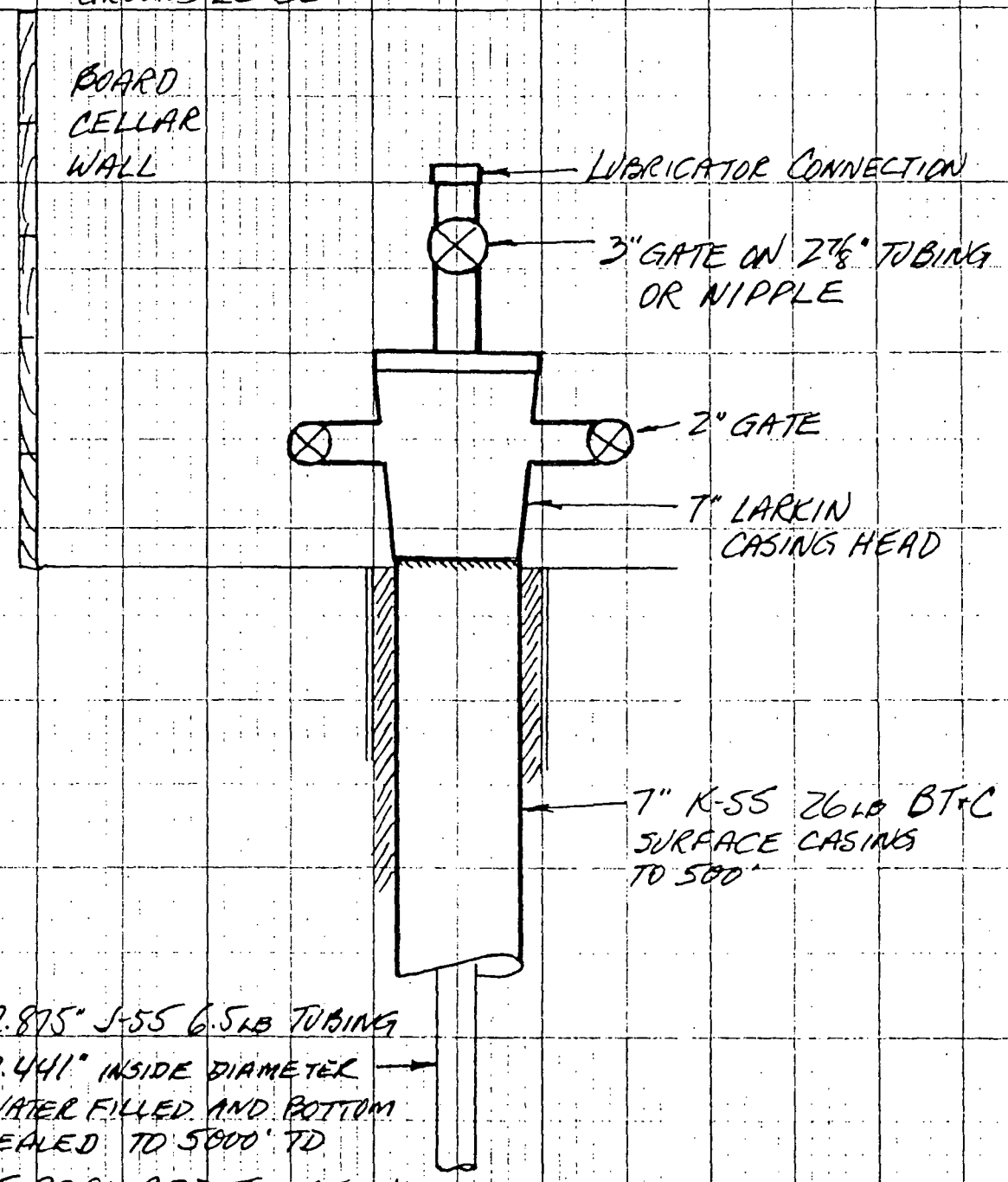
Size	Max. Service Pressure Rating, PSI	Test Pressure, PSI	Vertical Bore	Approx. Weight, Lbs.	Ram Size	A Height	B Width	C Length	D Center to Rear	E Center to Front	F Doors Open to Change Rams	Closing Ratio	Opening Ratio	U.S. Gals. Fluid to Close Rams	U.S. Gals. Fluid to Open Rams
6"	3,000	6,000	7 1/16"	4,915	C.S.O. thru 5 1/16" O.D.	25"	27 1/2"	73 1/2"	13"	14 1/2"	24 1/2"	6 to 1	2.57 to 1	2.75	2.3
6"	5,000	10,000	7 1/16"	5,735	C.S.O. thru 5 1/16" O.D.	26 1/2"	31 1/2"	74 1/2"	14"	17 1/2"	25 1/2"	6 to 1	2.57 to 1	2.75	2.3
8"	3,000	6,000	9"	5,525	C.S.O. thru 7" O.D.	25 1/2"	30 1/2"	75"	13 1/2"	16 1/2"	26 1/2"	6 to 1	1.89 to 1	2.75	2.3
8"	5,000	10,000	9"	6,705	C.S.O. thru 7" O.D.	27 1/2"	34"	79"	15 1/2"	18 1/2"	27 1/2"	6 to 1	1.89 to 1	2.75	2.3
10"	3,000	6,000	11"	8,966	C.S.O. thru 8 1/2" O.D.	27 1/2"	34 1/2"	80 1/2"	15 1/2"	18 1/2"	29 1/2"	6 to 1	1.61 to 1	3.25	2.7
10"	5,000	10,000	11"	9,465	C.S.O. thru 9 1/2" O.D.	30 1/2"	36 1/2"	85 1/2"	17 1/2"	21"	31 1/2"	6 to 1	1.35 to 1	3.25	2.7
12"	3,000	6,000	13 1/2"	10,105	C.S.O. thru 10 1/2" O.D.	30"	40 1/2"	94 1/2"	18 1/2"	22"	36 1/2"	6 to 1	1.14 to 1	3.55	2.9
14"	5,000	10,000	13 1/2"	12,245	C.S.O. thru 10 1/2" O.D.	34"	42 1/2"	94 1/2"	19 1/2"	23 1/2"	37 1/2"	6 to 1	1.14 to 1	3.55	2.9
16"	2,000	3,000	16"	8,300	C.S.O. thru 13 1/2" O.D.	27 1/2"	37 1/2"	98 1/2"	17 1/2"	20 1/2"	34 1/2"	6 to 1	1.06 to 1	3.85	3.0

Diamond Shamrock
Thermal Power Company

FIGURE 16

CLACKAMAS 5000' THERMAL GRADIENT HOLE

SURFACE COMPLETION: DOE 12-MONTH ACCESS PERIOD



- IF REQUIRED TO OBTAIN DOE HIGH PRECISION TEMPERATURE LOG

FIGURE 2

Diamond Shamrock
Thermal Power Company

THERMAL POWER COMPANY
Santa Rosa Office

Supplemental Information for Geothermal Drilling Permit
Clackamas 5000-Foot Thermal Gradient Hole

Formation Evaluation

This thermal gradient hole will be diamond cored (HQ size or 2.5" core diameter) from 500 feet to 5000 feet total depth. An 80% core recovery or better is anticipated. The geophysical wireline logs to be run from surface to total depth include hole caliper resistivity, self-potential, sonic velocity, density, natural gamma ray and temperature. A borehole deviation survey will be run at total depth to record the actual course of this intended vertical hole.

Drilling Hazards

The risk of blowout, consequent to drilling without returns, is the only significant drilling hazard posed for this thermal gradient hole. However, the prospective geothermal zone, if present and at high temperature, is confidently expected to be deeper than 3000 feet. The BOPE stack, consisting of a double control gate and Hydril, anchored to 500 feet of cemented 7" surface casing, will be in place, tested and periodically retested, ready for immediate activation at both the rig floor and at the control panel distant from the head of the borehole. Additionally, both a choke manifold line and a kill line will be connected to the casing head side ports while all drilling and coring operations proceed below 500 feet.

Drilling Equipment

A truck-mounted rig, with diamond coring depth capacity not less than 7000 feet, will be utilized on this borehole. A mast hoisting capacity of 75,000 pounds or more would be backed by a diesel engine of 130 HP. Duplex mud pumps of approximately 230 gpm capacity would be included. To small

Geothermal Fluid Sampling

A short term flow test will be conducted at total depth (5000'), and possibly at intermediate depth, for the collection of uncontaminated fluid samples. Surface flow measurements will be taken in the process. The choke manifold line connected to a two-inch side port on the casing head will be used to flow geothermal fluid from the borehole to a large portable steel tank (e.g. Baker Tank). The drilling sump will be used for back-up containment. At completion, the fluids in the tank and sump will be chemically analyzed. If no hazardous constitutents are present, the fluids will be sprayed along existing logging roads as directed by the U. S. Forest Service. If hazardous constitutents are indicated, a joint recommendation on disposal will be formulated by the Oregon Department of Environmental Quality and Thermal Power Company. Disposition of the fluids will be coordinated with the Forest Service, if appropriate.

Abandonment

Abandonment, if elected by the Operator as an integral part of the DOE Project, would be accomplished in September, 1987. Following removal of the tubing string from the borehole, 50-foot cement plugs would be placed across the shoe of the 4-1/2" casing, across the top of the lap between the 4-1/2" and 7" casings and from 10-foot depth to the surface. The casing head would be cut off, the board cellar removed and the cellar hole filled to ground level. The sump would be filled to ground level and the drillsite restored to a natural state as existed before drilling. Abandonment may occur at a much later date, as allowed under the terms of the existing Federal lease under the drillsite, and in such other manner as approved by the BLM.

Location

The drillsite for the proposed thermal gradient hole is located approximately 2200 feet north and 1500 feet west of the southeast corner of projected Section 28, T8S, R8E, Willamette Meridian as shown in Figure 3. Section corners are not present on this unsurveyed land. Drillsite elevation is approximately 3900 feet above sea level, as read from the Breitenbush Hot Springs 15 minute topographic map (1961). The drillsite location is within clear cut parcel 30 of the Mount Hood National Forest. Surface and bottomhole locations of the intended vertical 5000-foot borehole should be similar.

Geological, Geophysical, Hydrological Conditions

The drillsite is situated in the High Cascades portion of the Cascade Range ten miles north of the major Quaternary stratovolcano, Mt. Jefferson. This 5000-foot hole would evaluate the Clackamas geothermal prospect which lies in the northern portion of the heat flow anomaly which exceeds 100 milliwatts per meter square (Black et al, 1983). The drillsite lies in the Olallie Lake Plateau which consists of the relatively uneroded composite cones of Olallie Butte, Sisi Butte and Pinhead Butte. None of the rocks in this area exhibit reversed magnetism indicating that they are at least younger than the last magnetic reversal: 690,000 years ago. Petrochemical data for this area suggests that this region may be a growing stratovolcano. A contemporary magmatic intrusion, postulated under Olallie Butte, is taken to be the heat source for the Clackamas geothermal project.

rock type? Ba.

The borehole will penetrate a sequence of volcanic rocks which are expected to contain cold water flows to depths of 3000 or 4000 feet. Below this, prospective geothermal fluids may be contained in the Miocene-Oligocene pyroclastic volcanic rocks of the Breitenbush Formation. Three principal fault directions have either been mapped or inferred (linear analysis) as offsetting these volcanic rocks. North-south trending normal faults define the Western Cascade/High Cascade boundary and control the alignment of the major volcanic cones and a conjugate set of shear faults, trending approximately N60^{o}W and N50^{o}E result from the present day north-south compression. The northwest trending faults are clearly the dominant failure plane direction and they assist thermal waters, originating at depth under the High Cascades, to migrate westward and updip to Austin and Breitenbush Hot Springs. The Clackamas 5000-foot Thermal Gradient Hole is situated at a fault intersection northwest of Olallie Butte. Maximum bottom hole temperatures of 550^{o}F are considered possible as shown in Figure 4. The reservoir, if intersected, may be of the two-phase liquid dominated type. If such a system is found, the produced fluid will have a high-steam quality. Salinities are expected to be moderate.

CLACKAMAS 5000' THERMAL GRADIENT HOLE

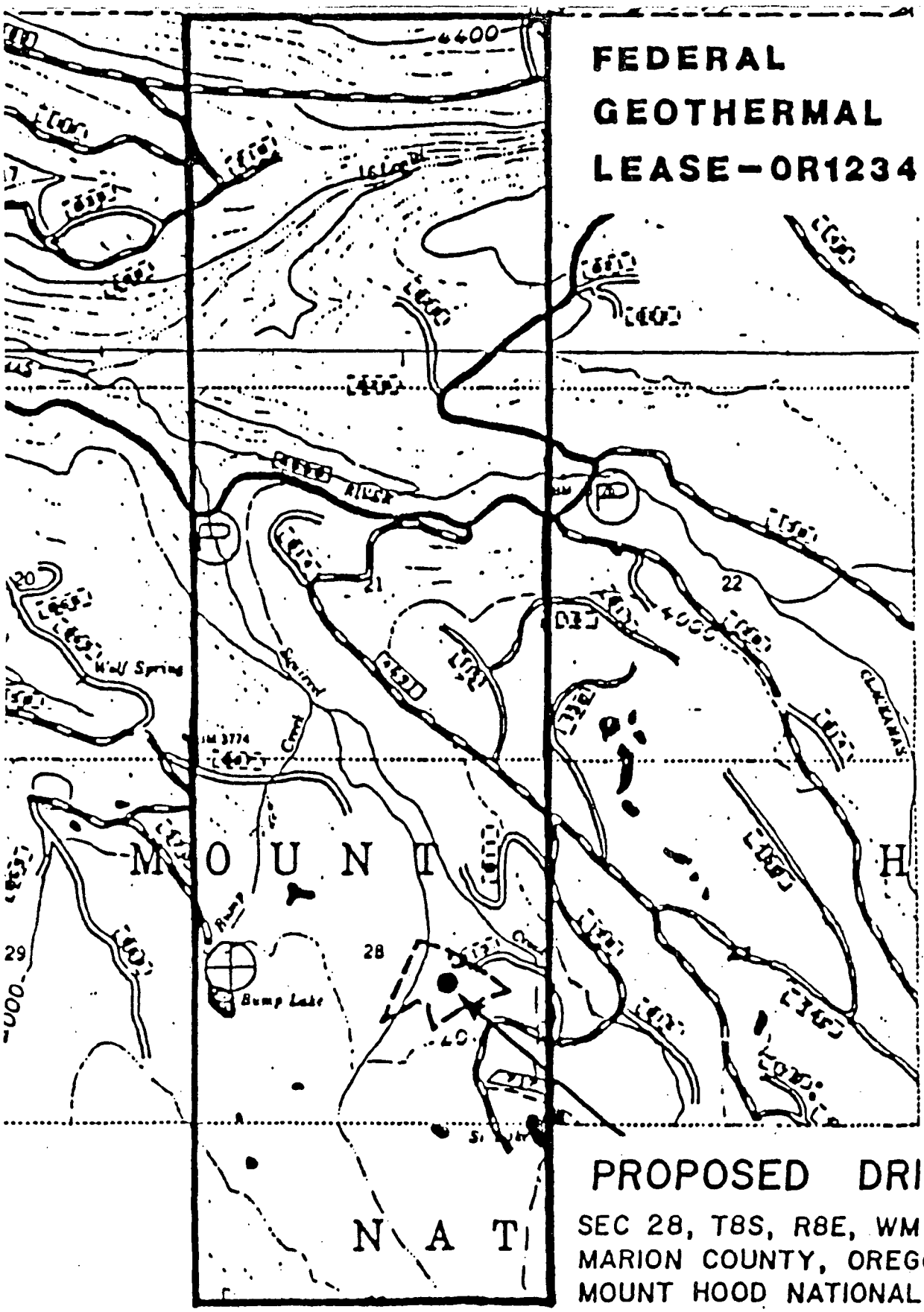


FIGURE 3

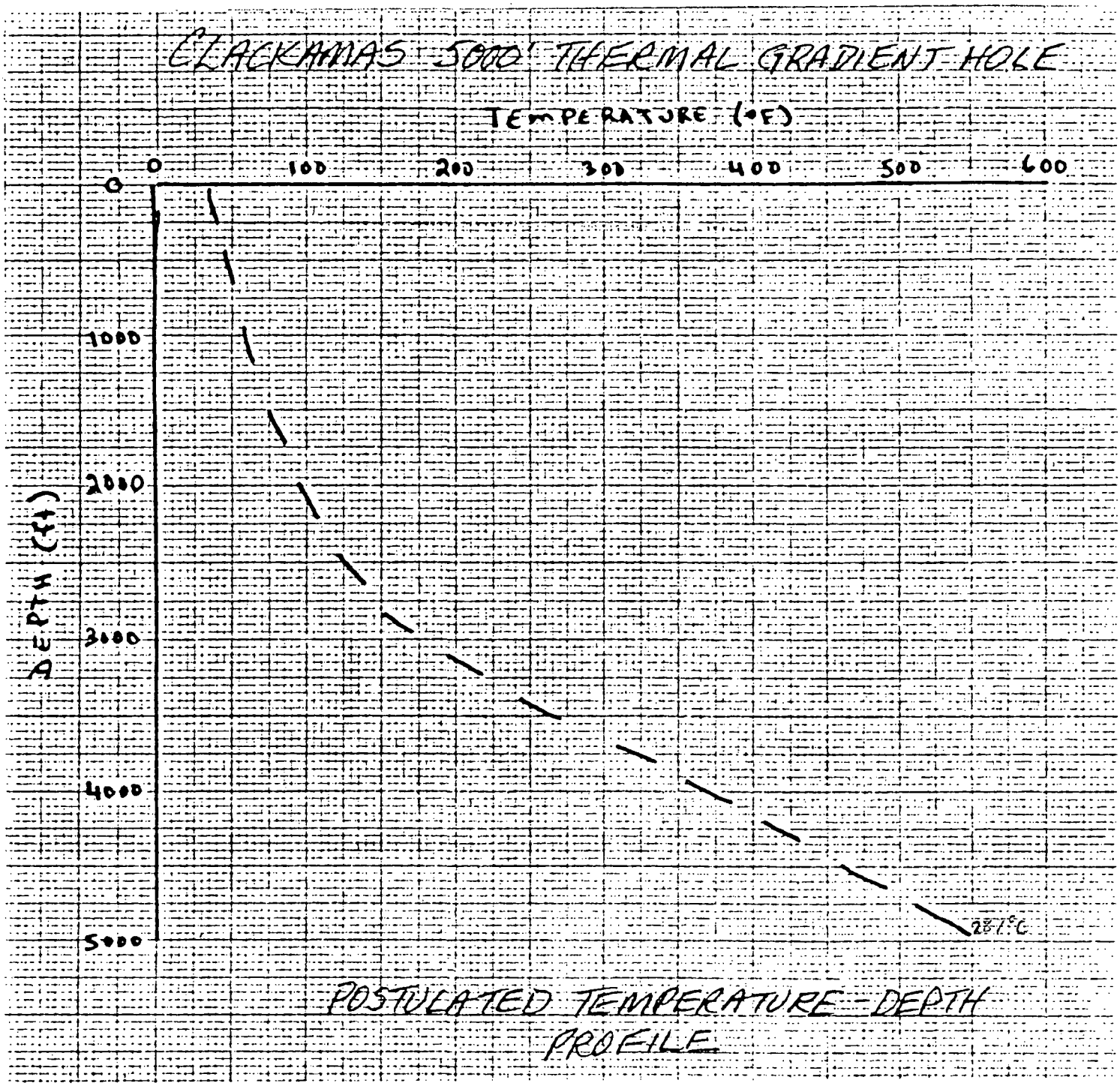


FIGURE 4

Diamond Shamrock
Thermal Power Company

THERMAL POWER COMPANY

Santa Rosa Office

Project Title: Cascade Geothermal Drilling

CLACKAMAS 5000-FOOT THERMAL GRADIENT HOLE

Cooperative Agreement No. DE-FC07-851D12614

Project Period: 9/30/85 thru 9/30/87

PROJECT DRILLING PLAN

10 April 1986

Submitted by:
Thermal Power Company
3333 Mendocino Ave., Suite 120
Santa Rosa, California 95401

W. L. D'Olier
Participant
Project Manager

Approved by:
U.S. DOE, Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Susan Prestwich
DOE Project Officer

TABLE OF CONTENTS

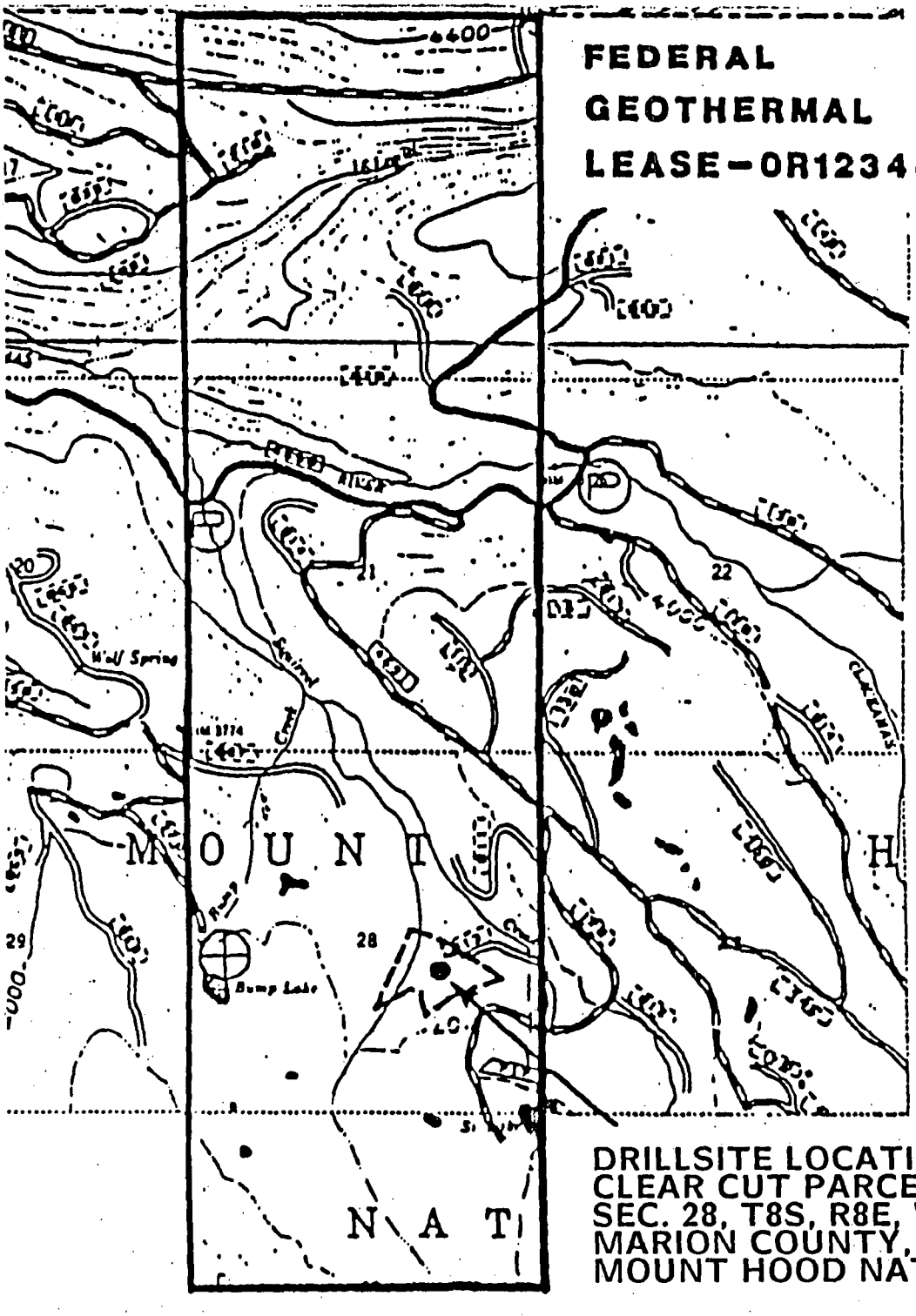
SUMMARY OF PROJECT DRILLING PLAN

Thermal Power Company, Operator, will drill and core the Clackamas 5000-Foot Thermal Gradient Hole on an issued Federal geothermal lease, OR 12344, at a location within a logged area of the Mt. Hood National Forest. The chief objective is to evaluate a possible deep geothermal resource potential hidden under a cover of cold meteoric waters. The drillsite, situated in Marion County, Oregon, is approximately 75 miles southeast of the City of Portland and the drillsite is accessible by existing roads. The small drillsite will be prepared in late May 1986, if not delayed by snowmelt at this 4000-foot elevation. Rig operations will commence about 1 June 1986 in a scheduled 60-day drilling and coring program to reach 5000-foot total depth. Continuous diamond coring between 500 and 5000 feet will be supplemented by geophysical borehole logging and by sampling of the fluids encountered. The U. S. Department of Energy (DOE) is supporting this activity with partial funding under a Cooperative Agreement to provide a prompt release to the public of all information from this Thermal Gradient Hole.

All drilling activities on the Clackamas Thermal Gradient Hole will comply with this Project Drilling Plan, as approved by DOE-Idaho Falls, and with the Geothermal Drilling Permits as approved by the U. S. Bureau of Land Management and the State of Oregon. All of the regulations of the Mt. Hood National Forest and the requirements of other Federal and State laws will be met.

Upon completion of the drilling activities, the Clackamas Thermal Gradient Hole will be retained in a 12-month DOE Access Period, September 1986-1987, for selected borehole technical surveys scheduled by DOE. Subsequently, at the election of Thermal Power Company, the Hole may be abandoned by 30 September 1987 under the specific requirements of the BLM - Portland. Alternatively, Thermal Power Company may elect to retain the Clackamas Thermal Gradient Hole and accept all responsibility for it under the provisions of the existing Federal geothermal lease.

CLACKAMAS 5000' THERMAL GRADIENT HOLE



DRILLSITE LOCATION
CLEAR CUT PARCEL 30
SEC. 28, T8S, R8E, WM
MARION COUNTY, OREGON
MOUNT HOOD NATIONAL FOREST

Diamond Shamrock
Thermal Power Company

PROJECT DRILLING PLAN FIGURE A

INTRODUCTION

The requirement for continuous diamond coring below 500 feet in the Clackamas 5000-Foot Thermal Gradient Hole (CTGH-1) forced careful analysis of drilling equipment, procedures and materials. This work was completed by Thermal Power Company before preparation of the Detailed Drilling Program as submitted to BLM-Portland in November 1985. Because BLM approval is expected late in April 1986, the Detailed Drilling Program and all other documents comprising the application for Geothermal Drilling Permit for CTGH-1 are incorporated in this Project Drilling Plan as Appendix 1.

The Project Drilling Plan can be best comprehended against the objectives of the Clackamas 5000-Foot Thermal Gradient Hole which are summarized as follows:

a) To penetrate and evaluate a geothermal resource, if encountered, in the 5000-foot borehole.

b) By continuous HQ and NQ diamond coring, borehole geophysical logging and fluid sampling, obtain high quality and integrated technical information in accordance with the Project Data Collection Plan.

c) To attempt an isolated completion across the anticipated deep geothermal zone, if encountered, to obtain least contaminated geothermal fluid samples, reservoir pressure-temperature parameters and an optimal basis for additional borehole surveys during the ensuing 12-month DOE Access Period.

d) Maintain safety and control of the 5000-foot borehole during its drilling, completion, retention and possible abandonment under the provisions of this Project Drilling Plan.

PROJECT DRILLING PLAN

1. Surface and Subsurface Conditions Anticipated

The drillsite, as shown on the Drillsite Location map, is situated in a clear cut parcel surrounded by older forest stands within the Mt. Hood National Forest. The drillsite is floored with loose soils and rock under patches of shrubs and small 6' - 10' trees. An unknown thickness of soil and rock overburden is expected above bedrock at this location. Initial groundwater flows may be first evident when the borehole encounters the top of hard, volcanic bedrock. The top 500-feet of hole will be rotary drilled with mud fluid to accommodate a 7" casing string cemented back to the surface. Diamond coring, proceeding from 500-foot depth, may encounter additional water flows

or rock stability problems which may require a 4-1/2" protective casing string to 1500 or 2000-foot depths. Varied volcanic rocks, ranging from hard, crystalline flows to bedded clastic deposits, are expected to be penetrated by the 5000-foot borehole. In the deeper intervals, discrete dikes or masses of younger intrusive rocks may be recognized. The geothermal resource evidence sought is an expected sharp temperature increase somewhere between 3000 and 5000 feet. This phenomena would mark a transition zone between overlying cold waters of the postulated rain cap and the deeper hot fluids of a prospective geothermal regime. The temperature increase may not be first perceived while actually coring the borehole. A loss of drilling fluids, into expectable fractures, correlated with a temperature increase and a favorable hydrothermal mineral assemblage in the cores would be the most encouraging finding in terms of the primary objective of the Project.

The configuration of the geothermal resource which is the target of the Clackamas 5000-Foot Thermal Gradient Hole, is related to a postulated magma heat source located approximately under the young volcanic structure of Olallie Butte. This magma body is "shallow" in that we believe it has risen a significant vertical distance above a larger "deep heat source" predicted at depths of 7 to 10 kilometers by Blackwell from regional heat flow data for this area of the Cascades. The shallow magma body under Olallie Butte is taken to be the thermal driver of a large fluid convection cell which would upflow and radially disperse from its core under the Butte. The Clackamas 5000-Foot Thermal Gradient Hole is sited on the northwest periphery of the postulated geothermal fluid convection cell. From this upflow locale, substantial lateral flows of hot fluids could move through Miocene formations, both west and northwestward to provide the thermal fluids which escape at both Austin and Breitenbush Hot Springs. It is believed that cold meteoric waters, present to depths of 3000' or 4000', could hide all of this perceived geothermal resource except for the long established and distal thermal fluid leakages at the two hot springs.

2. Site Access

A long practiced logging industry has created a substantial road network in this portion of the Mt. Hood National Forest. The specific site chosen for the Clackamas 5000-Foot Thermal Gradient Hole is in clear cut Parcel 30 as shown on the Drillsite Location map. The drillsite adjoins an existing logging truck trail which accesses the clear cut area, then transits an existing forest stand before connecting with the permanent gravel road in the southeast quarter of Section 28. At the approximate 4000-foot elevation of this drillsite and its immediate, existing access trail and road, winter snow cover of 6-10 foot thickness will preclude vehicle access during the five month interval, November to March.

3. Site Preparation

A roughly rectangular 200' by 200' site will be cleared of any logged cuttings trash for the drillsite. Care will be taken to minimize the toll of young second growth trees and drainage changes in the existing land surface.

4. Hole Design

A proposed hole design for the Clackamas 5000-Foot Thermal Gradient Hole is reflected in the following drilling-coring program and illustrated in the following Figure B.

a) Drill 14-3/4" hole with tricone bit and mud through overburden to 30-foot depth. Cement 11-3/4" conductor casing back to surface.

b) Drill 10" hole with tricone bit and mud to 500 foot depth. Run geophysical borehole logs. Run 7" surface casing to 500 feet and cement it in from shoe to surface.

c) Install head flange on 7" casing; install CSO ram above flange and install MSP Hydril above CSO ram. Test and verify reliable BOP equipment operation and compliance with BLM regulations.

d) Continuously core with HQ diamond heads (3.85" outside diameter) to 5000 feet or greatest depth possible. Use 4-1/2" core guide casing as required. If hole conditions become difficult, open corehole with 6" bit and run geophysical borehole logs before cementing 4-1/2" K-55 casing as intermediate protection string.

e) If required, reduce to NQ diamond heads (3.032" outside diameter) and continuously core to 5000 feet. Run geophysical borehole logs.

f) If a very prospective geothermal zone is encountered and 4-1/2" protective casing has not been run as in (d) above, consider reaming the core hole and running-cementing 4-1/2" K-55 casing to top of the geothermal zone (say at 4000-feet).

g) Consequent to findings at 5000-foot depth, and possible accomplishment of (f) above, consider hanging a 2-7/8" J-55 tubing string from surface to total depth, bottom sealed and water filled.

5. Rigs and Equipment Specifications

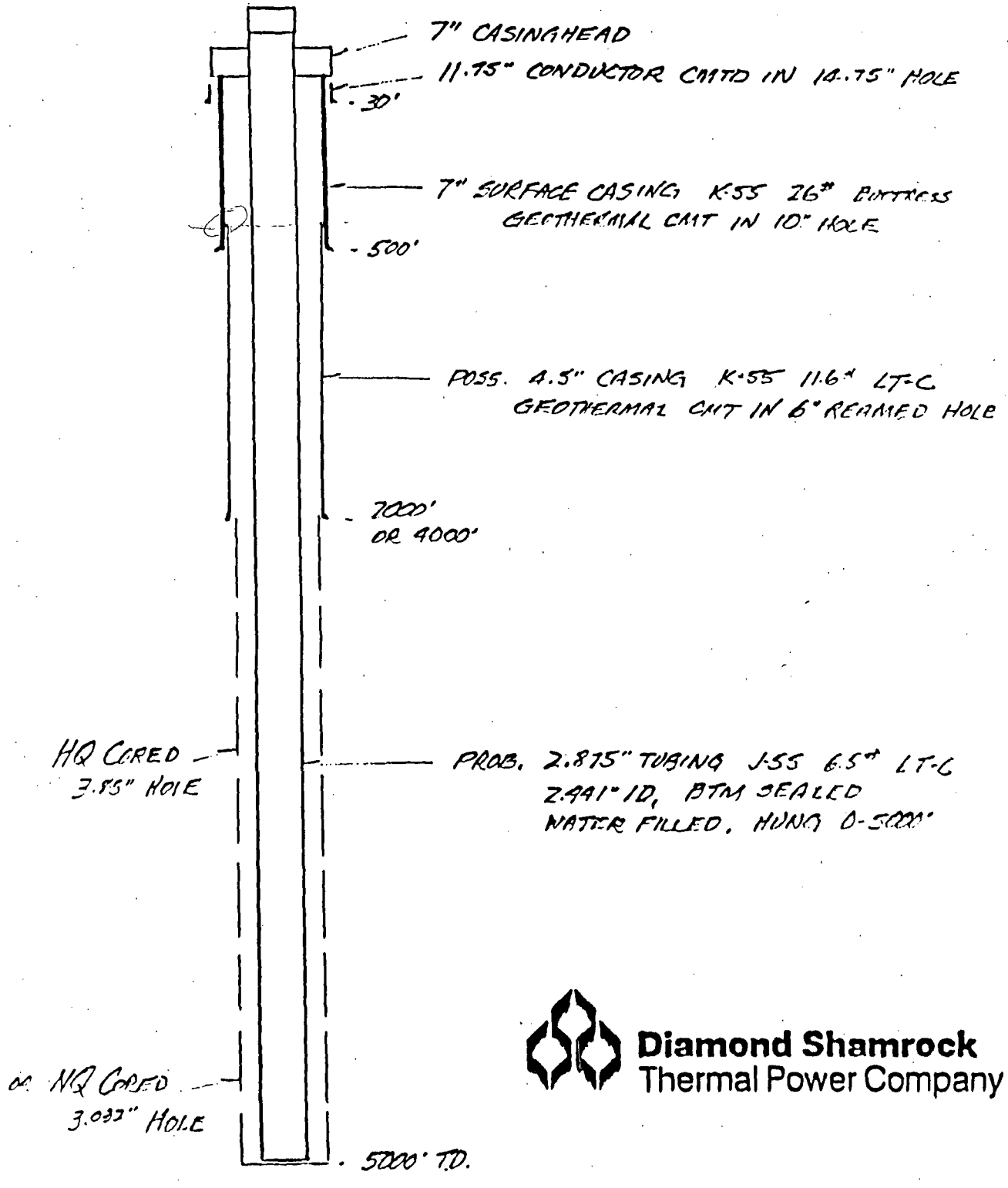
Six reputable subcontractors for drilling and coring the proposed Thermal Gradient Hole have submitted cost estimates and bids to Thermal Power Company during March 1986. We are now evaluating the bids, rigs and crew quality. We will use a rotary truck mounted rig on the tophole, through 7" surface casing placement. We will use a truck mounted heavy diamond core rig (CP50 or HD600) to continuously core the proposed Hole, with a 7000-foot depth capacity in this mode of operation.

6. Hole Containment

A double element (rams and Hydril) BOP stack would be secured to 500 feet of 7" casing, fully cemented from shoe to surface (see Figures 1a and 1b of Appendix 1). The details and operating verification checks of this critical equipment will be as approved by the BLM authority for operations on Federal geothermal leases. Containment after drilling is described in Hole Completion below.

HOLE DESIGN

CLACKAMAS 5000' THERMAL GRADIENT HOLE



Diamond Shamrock
Thermal Power Company

PROJECT DRILLING PLAN FIGURE B

7. Drilling Fluids and Disposal

The drilling and coring fluids, which will range between clay-water muds, water only and special polymer fluid, will be confined and recirculated in the borehole to the maximum extent possible. Loss of drilling fluids into shallow aquifers and deeper prospective fractures is to be expected but will be mitigated by the diamond coring procedure. Storage of excess or waste drilling fluids will be contained in an excavated sump immediate to the rig while the drilling-coring operations proceed. After completion of the Thermal Gradient Hole, the drilling-coring fluid remainder will be disposed of as required by BLM and Forest Service and the sump will be closed by earth fill, compacted and levelled to the drillsite grade.

8. Hole Completion During DOE Access Period

It is contemplated that a 2-7/8" J-55, 6.5 pounds per foot, tubing string, from surface to total depth, will be hung in the borehole. The inside diameter of such steel tubing is 2.441". A gate or valve, selected to contain the wellhead pressure that may occur, will be fixed to the casing head flange on the 7" casing and will allow full closure or full opening of the borehole. The casing head gate will be chained closed and locked. A prominent sign will identify the borehole, its purpose, telephone number and party to contact if upset conditions occur. Periodic inspections of the hole site and access roads will allow TPC's Santa Rosa Office to advise and assist DOE in its intended Access Interval activities. TPC will not attempt to preserve access to the Thermal Gradient Hole during the period of winter snow cover.

9. Plugging and Abandonment

Estimated costs for plugging and abandonment are included in TPC's proposal to DOE; however, TPC shall have the right not to abandon the hole within the terms of the Cooperative Agreement. If electing to abandon, TPC will complete these actions in the 24th month (September 1987) of the Cooperative Agreement, and in accordance with the BLM regulations and Forest Service stipulations in the Geothermal Exploration Permit and in the Plan of Operations. After an intended full recovery of any tubing string, we would anticipate that cement plugs will be required across the 4-1/2" and 7" casing shoes and a 20' cement plug just below the surface. If TPC elects not to abandon, DOE will escape its cost share of these actions and TPC will assume full legal responsibility and all future abandonment and site restoration costs.

10. Site Restoration

The 7" casing would be cut about 3-feet below the ground surface level and the casing head removed. The cellar would also be removed and the cellar excavation closed. No surface marker or evidence of the abandoned borehole would remain. The level drillsite bench would be cleaned and tilled to receive any low cost wild seed sowing recommended by the Forest Service. All berms and drainage trenches built to protect the occupied bench would be levelled or closed. A final survey of the site and adjoining area would ensure that no debris or trash would remain from the thermal gradient hole operations.

11. Anticipated Hole Problems

Loss of drilling fluid circulation is the chief problem anticipated. Lost circulation material, additives or cement plugs may be utilized in resolving lost circulation events above the 500-foot depth. Below the 4-1/2" casing shoe, the continuous coring methods can proceed without fluid returns if an adequate water supply is used (continuously pumped into the coring string) to lubricate and cool the diamond core head.

12. Health, Safety, and Environmental Considerations

TPC will fully comply with the special stipulations of the Federal geothermal lease containing the drillsite, its Geothermal Exploration Permit as issued by the BLM, and the Plan of Operations required and approved by both BLM and the Forest Service. TPC will give special attention to drinking and natural water safeguards, drilling fluid and human waste disposal and the fire risks posed by the drilling operation.

13. Site Facilities

After completion of the expected 60-day drilling-coring operations on the Thermal Gradient Hole, no additional site facilities of any kind are contemplated. The locked casing head gates, the identification signs and the clean, level one acre location bench will be the expected visual conditions on the site during the Access Interval required under the Cooperative Agreement.

14. Drilling Schedule

The anticipated 60-day drilling schedule for the Clackamas 5000-Foot Thermal Gradient Hole is shown in the following Figure C.

15. On-Site Supervision

On-site supervision for the Clackamas 5000-Foot Thermal Gradient Hole will be exclusively provided by three Thermal Power Company professional employees as follows:

1. Royce "Buddy" Bowden, Geothermal Drilling Supervisor

   Resident on drillsite, Bowden will execute the DOE approved Project Drilling Plan and BLM approved Detailed Drilling Program by supervising the drilling contractor, all third party services, safety and regulation compliances and required logistics.

2. Joe Iovenitti, Senior Geologist

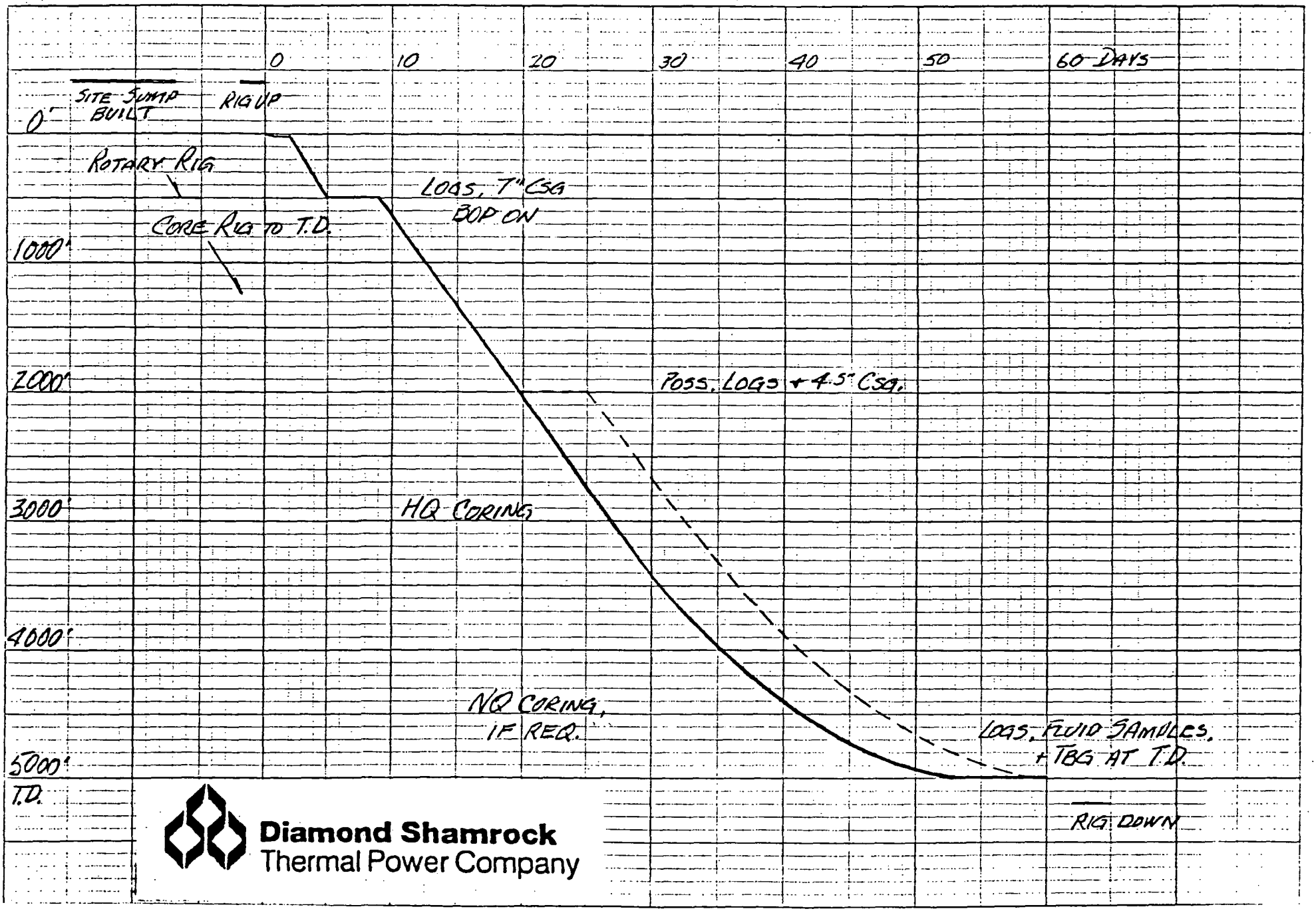
   On-site as needed or at Santa rosa Office, 707/576-7232, or residence, 415/798-8449. Iovenitti will personally schedule, direct and observe all critical technical evaluations, diamond core processing by two drillsite geologists, geophysical borehole logging and fluid sampling in accordance with the Project Data Collection Plan.

3. W. L. D'Olier, Vice President - Geothermal Exploration

On-site as needed or at Santa Rosa Office, 707/576-7232, or residence, 415/585-7677. D'Olier, as Project Manager for Thermal Power Company and specific author of the Project Management Plan, this Project Drilling Plan and the application for Geothermal Drilling Permit, will personally manage daily the required operations through Bowden and Iovenitti; make or approve the action decisions, consulting with the DOE Project Officer as required, and insure that all data and reporting requirements to DOE-Idaho Falls and UURI are being achieved.

WLD030

CLACKAMAS 5000' THERMAL GRADIENT HOLE



PROJECT DRILLING PLAN FIGURE C DRILLING SCHEDULE

Diamond Shamrock
Thermal Power Company

14 November 1985

U. S. Department of the Interior
Bureau of Land Management
Division of Mineral Resources
P. O. Box 2965
Portland, Oregon 97201

Attention: Mr. Robert Fujimoto

Subject: Geothermal Drilling Permit Application
Clackamas 5000-Foot Thermal Gradient Hole
Federal Geothermal Lease OR 12344

Gentlemen:

We submit herewith our application for Geothermal Drilling Permit, on USGS Form 9-1957, for the Clackamas 5000-Foot Thermal Gradient Hole. This application supplements our Plan of Exploration which was delivered to your office under our letter dated September 26, 1985. We would proceed under an approved Permit, with drilling operations in June-July 1986, after obtaining additional approvals from the U. S. Department of Energy which is supporting this Thermal Gradient Hole under a Cooperative Agreement with Thermal Power Company.

Our Detailed Drilling Program is deliberately flexible in order to best respond to the actual thermal and fluid conditions found at depth and to obtain the highest quality information on the geothermal resource, if encountered.

Please contact the undersigned at 707/576-7040 for all additional comments, explanation or information which you may require in considering this application, its approval and issuance as a Permit. Your early attention will be greatly appreciated.

Yours very truly,

W. L. D'Olier
Vice President
Geothermal Exploration

WLD/ma

Enclosures: 5 Application Documents

APPENDIX I

Thermal Power Company
A subsidiary of Diamond Shamrock, 3333 Mendocino Avenue, Suite 120, Santa Rosa, California 95401
Phone 707 576-7022

USGS 9-1957

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY, CONSERVATION DIVISION

Form Approved
Budget Bureau No. _____

GEOTHERMAL DRILLING PERMIT

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

Clackamas 5000' Thermal Gradient Hole (CTGH)

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

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

1c. WELL STATUS: Proposed

2. NAME OF LESSEE/OPERATOR: Thermal Power Company

3. ADDRESS OF LESSEE/OPERATOR: 3333 Mendocino Avenue, Suite 120, Santa Rosa, California 95401

15. LOCATION OF WELL
At surface: Approximately 2200' N and 1500' W of SE Corner of Sec. 28
At proposed prod. zone: Same as Surface Location

16. DISTANCE FROM PROPOSED LOCATION TO NEAREST PROPERTY OR LEASE LINE: 1500' W of East Line of Sec. 28

17. DISTANCE FROM PROPOSED LOCATION TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR ON THIS LEASE: No previous well drilled or applied for on this lease.

4. LEASE SERIAL NO.: OR 12344

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

6. UNIT AGREEMENT NAME: N/A

7. WELL NO.: CTGH-1

8. PERMIT NO.:

9. FIELD OR AREA: Squirrel Creek

10. SEC., T., R., B.& M.: Sec. 28 T8S R8E Willamette Meridian

11. COUNTY: Marion

12. STATE: Oregon

13. APPROX. STARTING DATE: 1 June 1986

14. ACRES ASSIGNED (WELL SPACING): N/A

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

19. PROPOSED DEPTH: MEASURED: 5000 TRUE VERTICAL: 5000

20. ELEVATIONS: ESTIMATED (XX) FINAL ( )
REFERENCE DATUM: GR (X) MAT ( ) DF ( ) KB ( ) RT ( ) CASINGHEAD FLANGE ( ) OTHER ( )

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

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	COUPLING (Collars & Threads)	GRADE	SETTING DEPTH Top	SETTING DEPTH Bottom	QUANTITY OF CEMENT
14-3/4"	11-3/4"	28 lbs.	N/A	1/4" Wall	0	30	25 cu. ft.
10" or 9-7/8"	7"	26 lbs.	Buttress	K-55	0	500	266 cu. ft.
6" or 5-5/8"	4-1/2"	11.6 lbs.	Long	K-55	450	4000	605 cu. ft.

22. PROPOSED WORK SUMMARY

Prepare 160' x 200' drillsite pad and lined sump adjacent to existing access road into clear cut parcel 30. Move in truck mounted rig. Drill 14-3/4" hole to 30' depth, run 11-3/4" conductor to bottom and cement to surface. Drill 10" hole to 500' depth; run 7" K-55 26 pound Buttress casing to bottom and cement to surface. Install casing head on 7" casing, then BOPE consisting of a double control gate and Hydril. Test BOPE per BLM regulations. Diamond core with HQ heads to 5000'. Run geophysical borehole log suite to 5000'. Open HQ hole with 6" bit to 4000' or other selected depth; run 4-1/2" K-55 11.6 pound LT&C casing to 4000', cement solid from shoe to lap in 7" casing at 450'-500' depth. Briefly flow well to obtain expected geothermal fluid samples. Hang 2-7/8" J-55 tubing string to 5000'; fill same with water. Release rig; leave CTGH-1 shut-in awaiting DOE high precision temperature log.

This will be a vertical borehole; no directional drilling/coring practices will be applied. However, borehole directional surveys will be run with the geophysical logging suite.

This deep thermal gradient hole would be drilled under a Cooperative Agreement between Thermal Power Company and the U. S. Department of Energy as part of the DOE program to 1) gather data to characterize the deep hydrothermal resource of the Cascades volcanic region and 2) transfer this data to the public in order to stimulate further development of hydrothermal resources.

(Use additional space on reverse side of form)

23.

SIGNED W. J. D'Olier TITLE Vice President, Geothermal Exploration DATE 14 November 1985

(This space for Federal use)

APPROVED BY _____ TITLE _____ DATE _____

CONDITIONS OF APPROVAL, IF ANY:

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

(See instructions on reverse side)

THERMAL POWER COMPANY, Operator
Santa Rosa Office

14 November 1985

DETAILED DRILLING PROGRAM: CLACKAMAS 5000-FOOT THERMAL GRADIENT HOLE

Prepare the drillsite pad and lined sump in late May 1986. Install 5' x 5' x 4' deep board cellar. Move in truck mounted drill rig by 1 June 1986.

1. Drill 14-3/4" hole with tricone bit and clay-water based mud through overburden to 30-foot depth. Run 11-3/4" conductor and cement solid to surface with construction cement top poured outside the conductor.

2. Drill 9-7/8" hole with tricone bit and clay-water based mud to 500 feet depth. Use air hammer if possible. Run geophysical borehole logs. Run 7", K-55, 26 pound, Buttress coupled surface casing to 500 feet and cement solid from shoe to surface. Use Class G cement plus 40% silica flour. Pump 266 cubic feet of cement slurry, which is 250% of annulus volume to be filled.

3. Install 7" Larkin 4000 psig casing head with two side ports on 7" surface casing. Install temporary 6", 3000 psig head flange on casing head. Install BOPE consisting of a double control gate, bolted to the head flange, a MSP-2000 Hydril bolted above the gate, a hydraulic accumulator, control panel and rig floor activator. Pressure test and verify reliable BOPE operation and compliance with BLM regulations. Propose 1000 psig for 30 minutes to pressure test BOPE, casing head, weld and 7" casing. Notice BLM-Portland representative timely to allow observation/approval of this pressure test. Rig choke manifold line on one side port and kill line on other side port. See Figures 1a and 1b.

4. Prepare diamond coring system and continuously core with HQ diamond heads (3.85" outside diameter and 2.5" core diameter) to 5000 feet or greatest depth possible. This coring will be done with polymeric-water based drilling fluids which may be completely lost to the rock formations. Temporarily sleeve the 7" surface casing with 4-1/2" core guide casing to preclude rod whip.

5. If hole conditions become difficult, open corehole with 6" or 5-5/8" bit, run geophysical borehole logs and sample formation fluids by rig flow test before hanging or cementing 4-1/2", K-55, 11.6 pound casing as intermediate protection string (see 7 below re cementing). Resume HQ coring to 5000 feet or greatest depth possible. If required, reduce to NQ diamond heads (3.032" outside diameter) and continuously core to 5000 feet.

6. At 5000 feet (or more) total depth, run geophysical borehole logs from TD to 4-1/2" or 7" casing shoe. Have adequate water supply on site to pump into borehole for cooling in order not to exceed geophysical tool temperature limitations.

7. If 4-1/2" casing was not required for borehole protection to achieve 5000-foot depth, be prepared to open diamond corehole with a 6" bit and cement 4-1/2" casing at the top of the deep geothermal zone, if encountered and prospective for improved evaluation as an isolated zone. Use Class G cement, 40% silica flour and perlite. Pump 605 cu. ft. of cement slurry which is 200% of annulus volume to be filled between a 4000-foot casing shoe depth and a 4-1/2" to 7" casing lap between 450 and 500 feet.

8. Remove BOPE stack and temporary head flange. Blind flange the casing head. Obtain geothermal fluid samples from the prospective geothermal zone by short term flow test through the casing head side port and choke manifold line. Contain the geothermal fluid samples on the drillsite and in a Baker steel tank for toxicity evaluations to guide in subsequent disposals.

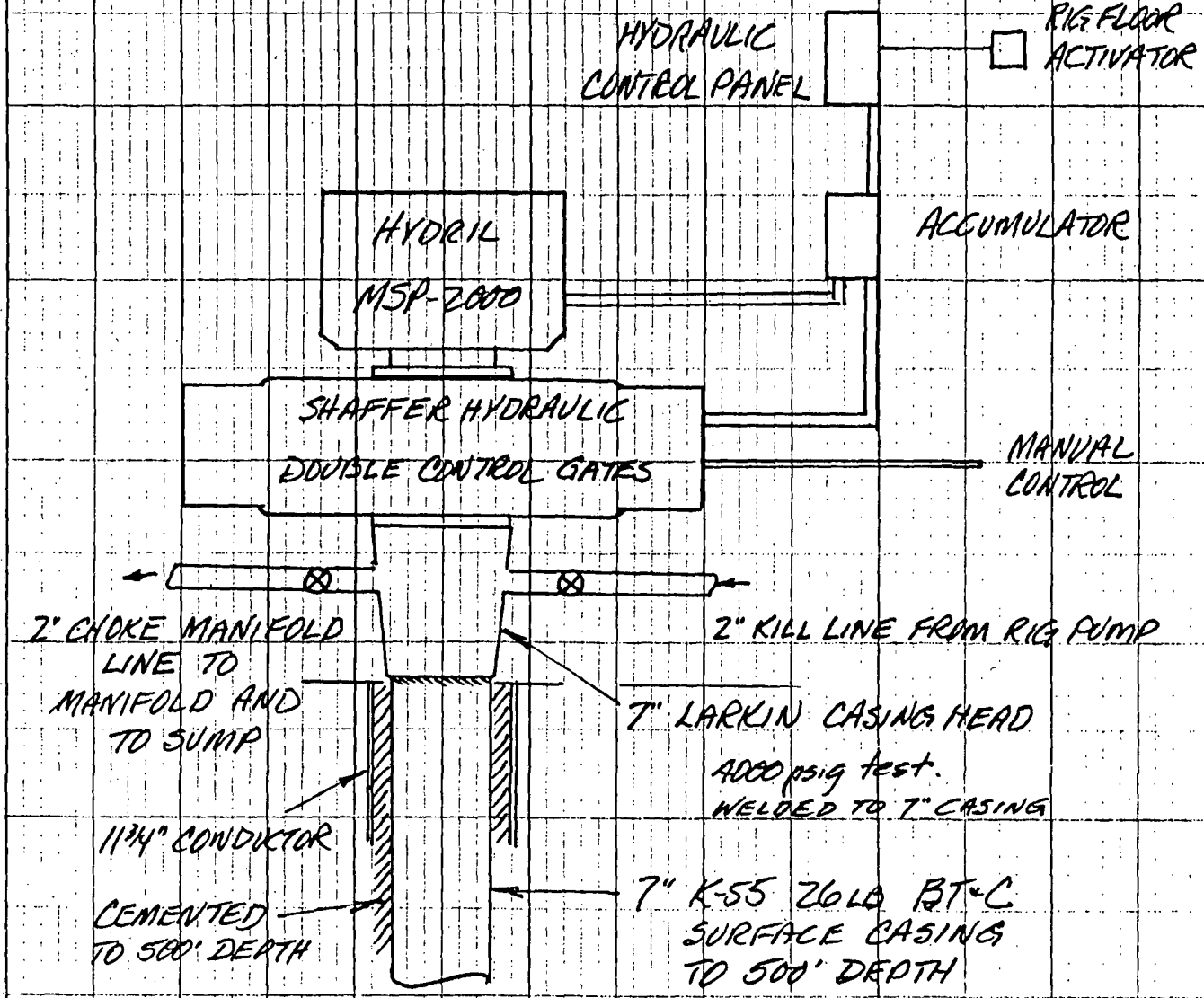
9. Run 2.875" OD J-55 tubing (solid string-water filled) to total depth and hang tubing in casing head if required for DOE high precision temperature log. Put 3" gate and lubricator connection on tubing or casing head. Release rig, fence the sump, clean and post the drillsite. Chain and lock the 3" and side port gates in the closed position. See Figure 2.

WLD/RJB/ma

Attachments - Supplemental Information and 5 Figures

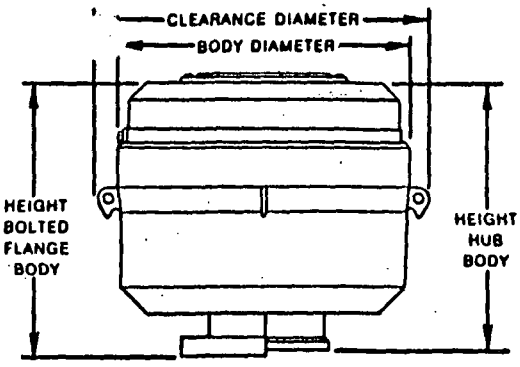
CLACKAMAS 5000' THERMAL GRADIENT HOLE

BOPE & SURFACE CONTROLS: DRILLING-CORING MODE



Diamond Shamrock
Thermal Power Company

FIGURE 1a



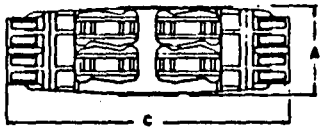
HYDRIL TYPE MSP-2000

ENGINEERING AND DIMENSIONAL DATA

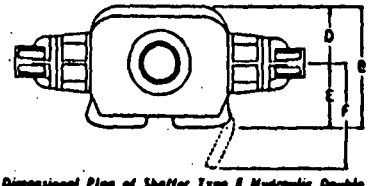
Connector Size and Pressure Rating (PSI)	Open Bore, In.	Approx. Weight, Pounds	Height Flange Body, In.	Height Hub Body, In.	Clearance Diam., In.	Body Diam., In.	U.S. Gallons for Full Piston Stroke	Piston Stroke Inches
6"-2000	7 1/16	1,850	25 1/4	...	29 1/4	25 1/2	2.85	4 1/2
8"-2000	8 1/16	2,450	30 1/4	...	32	27 1/2	4.57	5 1/2
10"-2000	11	3,520	31 1/4	...	37 1/2	32 1/2	7.43	8 1/2
20"-2000	21 1/4	14,900	52 1/2	51	58 1/2	31.05	11 1/2	

*MSP 2000 Blowout Preventers are furnished with 1" opening and closing ports. 1 1/2" or 1 1/4" are available on special request.

DIMENSIONAL AND ENGINEERING DATA ON SHAFFER TYPE E HYDRAULIC DOUBLE CONTROL GATES



Dimensional Elevation of Shaffer Type E Hydraulic Double Control Gate



Dimensional Plan of Shaffer Type E Hydraulic Double Control Gate

TYPE E DOUBLE

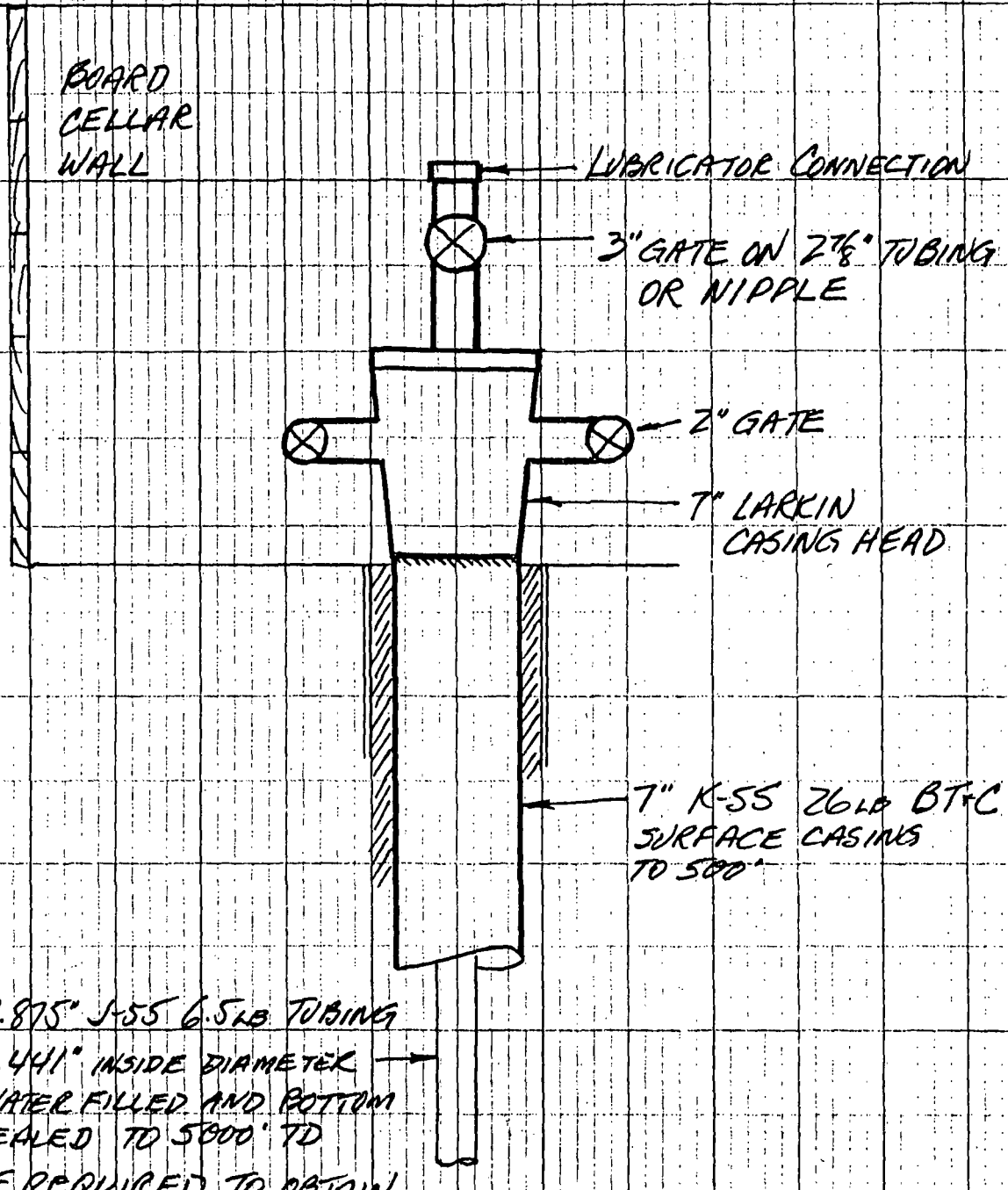
Size	Max. Service Pressure Rating, PSI	Test Pressure, PSI	Vertical Bore	Approx. Weight, Lbs.	Ram Size	A Height	B Width	C Length	B Center to Rear	E Center to Front	F Doors Open to Change Rams	Closing Ratio	Opening Ratio	U.S. Gals. Fluid to Close Rams	U.S. Gals. Fluid to Open Rams
6"	3,000	6,000	7 1/16"	4,915	C.S.O. thru 5 9/16" O.D.	25"	27 1/2"	73 1/2"	13"	14 1/2"	24 1/2"	6 to 1	2.57 to 1	2.75	2.3
6"	5,000	10,000	7 1/16"	5,735	C.S.O. thru 5 9/16" O.D.	26 1/2"	31 1/2"	74 1/2"	14"	17 1/2"	25 1/2"	6 to 1	2.57 to 1	2.75	2.3
8"	3,000	6,000	9"	5,525	C.S.O. thru 7" O.D.	25 1/2"	30 1/2"	75"	13 1/2"	16 1/2"	26 1/2"	6 to 1	1.89 to 1	2.75	2.3
8"	5,000	10,000	9"	6,705	C.S.O. thru 7" O.D.	27 1/2"	34"	79"	15 1/2"	18 1/2"	27 1/2"	6 to 1	1.89 to 1	2.75	2.3
10"	3,000	6,000	11"	6,965	C.S.O. thru 8 1/2" O.D.	27 1/2"	34 1/2"	80 1/2"	15 1/2"	18 1/2"	29 1/2"	6 to 1	1.51 to 1	3.25	2.7
10"	5,000	10,000	11"	9,465	C.S.O. thru 9 1/2" O.D.	30 1/2"	36 1/2"	85 1/2"	17 1/2"	21"	31 1/2"	6 to 1	1.35 to 1	3.25	2.7
12"	3,000	6,000	13 5/8"	10,105	C.S.O. thru 10 1/2" O.D.	30"	40 1/2"	94 1/2"	18 1/2"	22"	36 1/2"	6 to 1	1.14 to 1	3.55	2.9
14"	5,000	10,000	13 5/8"	12,248	C.S.O. thru 10 1/2" O.D.	34"	42 1/2"	94 1/2"	19 1/2"	23 1/2"	37 1/2"	6 to 1	1.14 to 1	3.55	2.9
16"	2,000	3,000	16"	8,300	C.S.O. thru 13 1/2" O.D.	27 1/2"	37 1/2"	98 1/2"	17 1/2"	20 1/2"	34 1/2"	6 to 1	1.06 to 1	3.65	3.0

Diamond Shamrock
Thermal Power Company

FIGURE 16

CLACKAMAS 5000' THERMAL GRADIENT HOLE

SURFACE COMPLETION: DOE 12-MONTH ACCESS PERIOD



• IF REQUIRED TO OBTAIN DOE HIGH PRECISION TEMPERATURE LOG

FIGURE 2

Diamond Shamrock
Thermal Power Company

THERMAL POWER COMPANY
Santa Rosa Office

Supplemental Information for Geothermal Drilling Permit
Clackamas 5000-Foot Thermal Gradient Hole

Formation Evaluation

This thermal gradient hole will be diamond cored (HQ size or 2.5" core diameter) from 500 feet to 5000 feet total depth. An 80% core recovery or better is anticipated. The geophysical wireline logs to be run from surface to total depth include hole caliper resistivity, self-potential, sonic velocity, density, natural gamma ray and temperature. A borehole deviation survey will be run at total depth to record the actual course of this intended vertical hole.

Drilling Hazards

The risk of blowout, consequent to drilling without returns, is the only significant drilling hazard posed for this thermal gradient hole. However, the prospective geothermal zone, if present and at high temperature, is confidently expected to be deeper than 3000 feet. The BOPE stack, consisting of a double control gate and Hydril, anchored to 500 feet of cemented 7" surface casing, will be in place, tested and periodically retested, ready for immediate activation at both the rig floor and at the control panel distant from the head of the borehole. Additionally, both a choke manifold line and a kill line will be connected to the casing head side ports while all drilling and coring operations proceed below 500 feet.

Drilling Equipment

A truck-mounted rig, with diamond coring depth capacity not less than 7000 feet, will be utilized on this borehole. A mast hoisting capacity of 75,000 pounds or more would be backed by a diesel engine of 130 HP. Duplex mud pumps of approximately 230 gpm capacity would be included.

Geothermal Fluid Sampling

A short term flow test will be conducted at total depth (5000'), and possibly at intermediate depth, for the collection of uncontaminated fluid samples. Surface flow measurements will be taken in the process. The choke manifold line connected to a two-inch side port on the casing head will be used to flow geothermal fluid from the borehole to a large portable steel tank (e.g. Baker Tank). The drilling sump will be used for back-up containment. At completion, the fluids in the tank and sump will be chemically analyzed. If no hazardous constitutents are present, the fluids will be sprayed along existing logging roads as directed by the U. S. Forest Service. If hazardous constitutents are indicated, a joint recommendation on disposal will be formulated by the Oregon Department of Environmental Quality and Thermal Power Company. Disposition of the fluids will be coordinated with the Forest Service, if appropriate.

Abandonment

Abandonment, if elected by the Operator as an integral part of the DOE Project, would be accomplished in September, 1987. Following removal of the tubing string from the borehole, 50-foot cement plugs would be placed across the shoe of the 4-1/2" casing, across the top of the lap between the 4-1/2" and 7" casings and from 10-foot depth to the surface. The casing head would be cut off, the board cellar removed and the cellar hole filled to ground level. The sump would be filled to ground level and the drillsite restored to a natural state as existed before drilling. Abandonment may occur at a much later date, as allowed under the terms of the existing Federal lease under the drillsite, and in such other manner as approved by the BLM.

Location

The drillsite for the proposed thermal gradient hole is located approximately 2200 feet north and 1500 feet west of the southeast corner of projected Section 28, T8S, R8E, Willamette Meridian as shown in Figure 3. Section corners are not present on this unsurveyed land. Drillsite elevation is approximately 3900 feet above sea level, as read from the Breitenbush Hot Springs 15 minute topographic map (1961). The drillsite location is within clear cut parcel 30 of the Mount Hood National Forest. Surface and bottomhole locations of the intended vertical 5000-foot borehole should be similar.

Geological, Geophysical, Hydrological Conditions

The drillsite is situated in the High Cascades portion of the Cascade Range ten miles north of the major Quaternary stratovolcano, Mt. Jefferson. This 5000-foot hole would evaluate the Clackamas geothermal prospect which lies in the northern portion of the heat flow anomaly which exceeds 100 milliwatts per meter square (Black et al, 1983). The drillsite lies in the Olallie Lake Plateau which consists of the relatively uneroded composite cones of Olallie Butte, Sisi Butte and Pinhead Butte. None of the rocks in this area exhibit reversed magnetism indicating that they are at least younger than the last magnetic reversal: 690,000 years ago. Petrochemical data for this area suggests that this region may be a growing stratovolcano. A contemporary magmatic intrusion, postulated under Olallie Butte, is taken to be the heat source for the Clackamas geothermal project.

The borehole will penetrate a sequence of volcanic rocks which are expected to contain cold water flows to depths of 3000 or 4000 feet. Below this, prospective geothermal fluids may be contained in the Miocene-Oligocene pyroclastic volcanic rocks of the Breitenbush Formation. Three principal fault directions have either been mapped or inferred (linear analysis) as offsetting these volcanic rocks. North-south trending normal faults define the Western Cascade/High Cascade boundary and control the alignment of the major volcanic cones and a conjugate set of shear faults, trending approximately N60^{o}W and N50^{o}E result from the present day north-south compression. The northwest trending faults are clearly the dominant failure plane direction and they assist thermal waters, originating at depth under the High Cascades, to migrate westward and updip to Austin and Breitenbush Hot Springs. The Clackamas 5000-foot Thermal Gradient Hole is situated at a fault intersection northwest of Olallie Butte. Maximum bottom hole temperatures of 550^{o}F are considered possible as shown in Figure 4. The reservoir, if intersected, may be of the two-phase liquid dominated type. If such a system is found, the produced fluid will have a high-steam quality. Salinities are expected to be moderate.

CLACKAMAS 5000' THERMAL GRADIENT HOLE

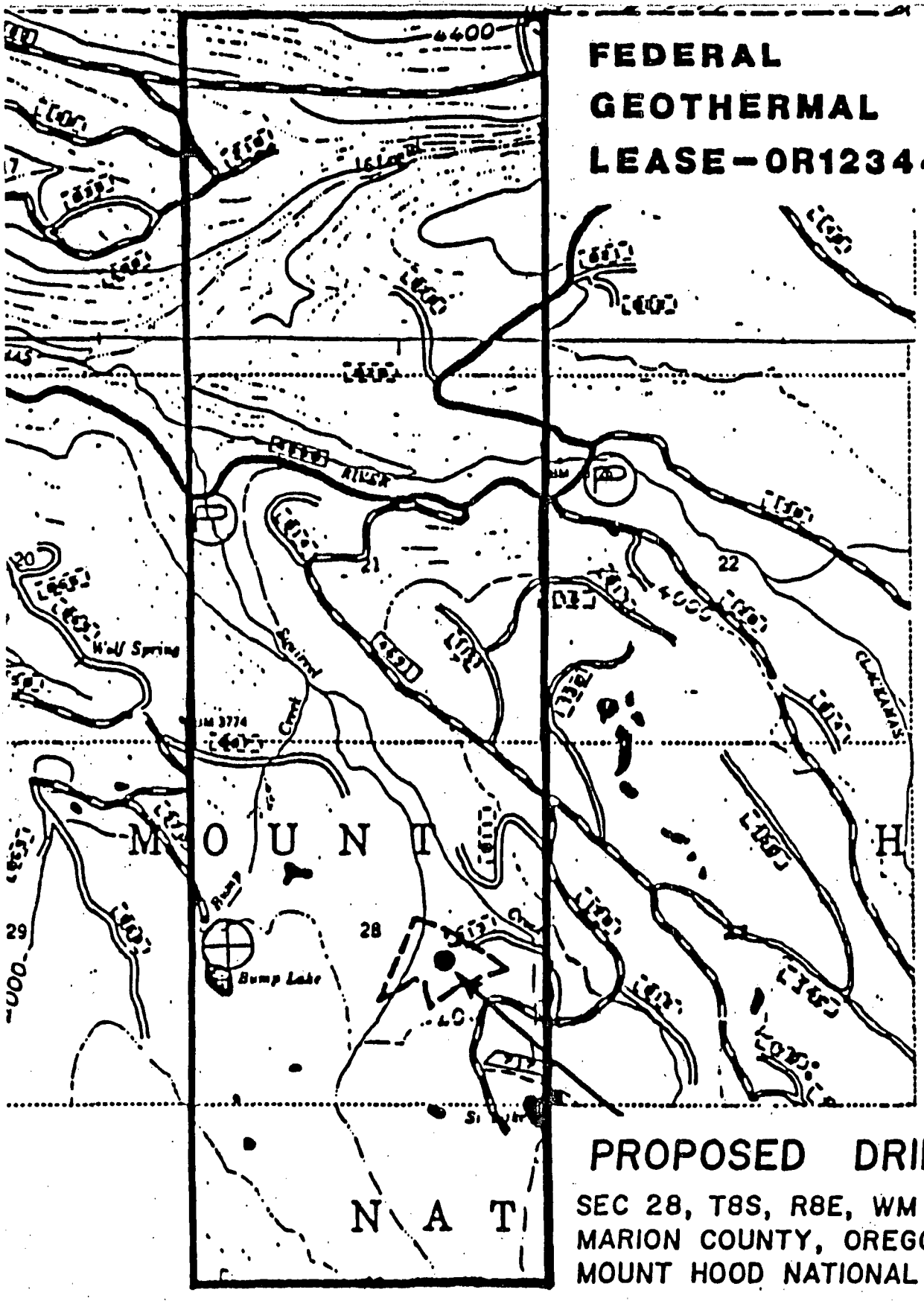


FIGURE 3

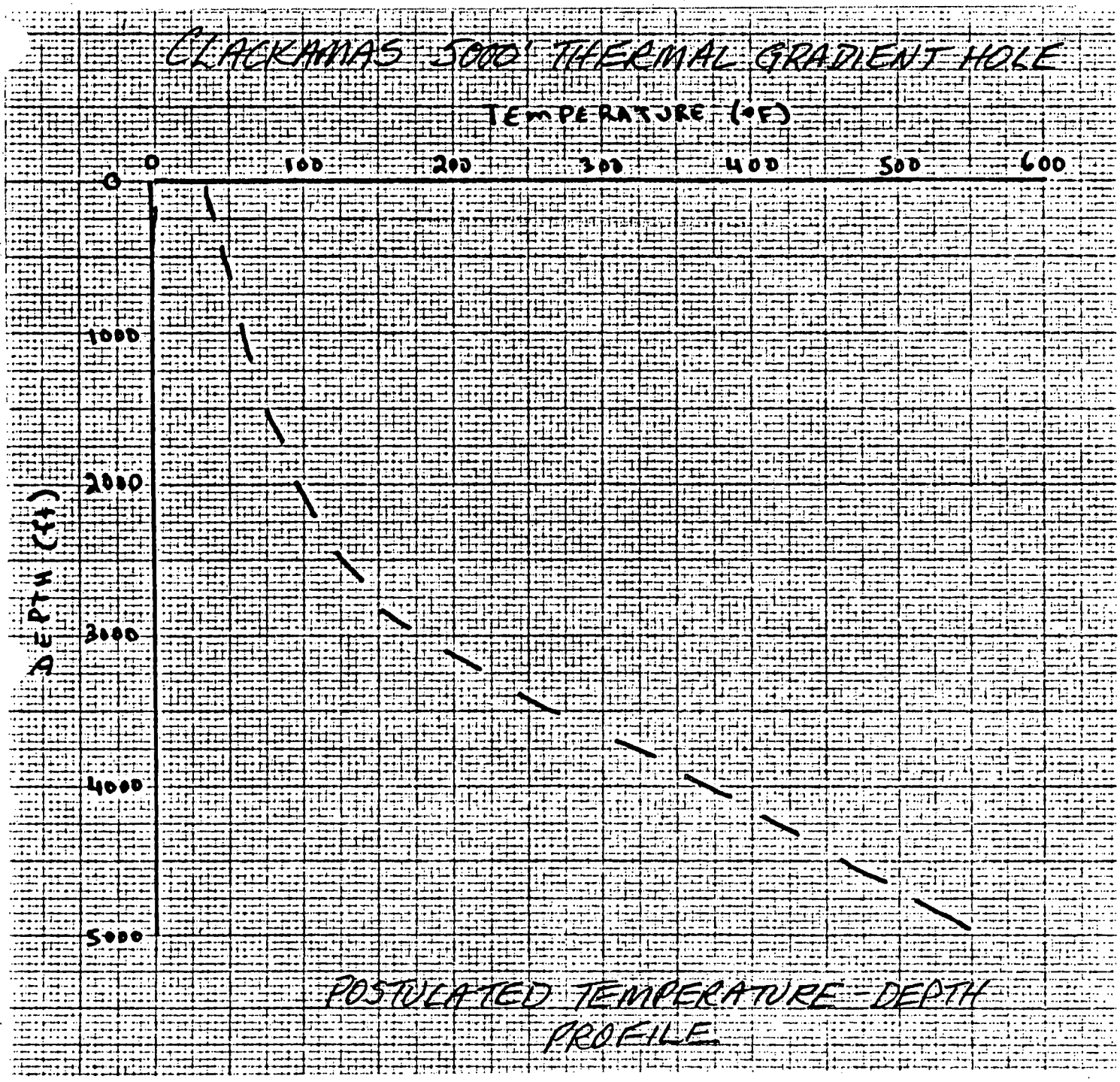


FIGURE 4

Diamond Shamrock
Thermal Power Company

VICTOR ATIYEH
GOVERNOR

Department of Geology and Mineral Industries
ADMINISTRATIVE OFFICE
1005 STATE OFFICE BLDG., PORTLAND, OREGON 97201 PHONE (503) 229-5580

January 10, 1986

RECEIVED
JAN 13 1986
TPC - Santa Rosa

W.L. D'Olier
Vice President
Geothermal Exploration
Thermal Power Company
3333 Mendocino Avenue, Suite 120
Santa Rosa, CA 95401

Dear Mr. D'Olier:

Enclosed is Thermal Power Company's Permit 124 effective January 9, 1986 for the drilling of CTGH-1, Marion County. The January 1984 stipulations approved by the State Geologist are conditions of this permit.

Please call us approximately six hours before the surface casing pressure test is to be made as we will want to inspect the blow-out prevention equipment.

In reference to specifications listed in the Plan of Exploration and supporting materials, the "double control gate" of the BOP must consist of pipe and blind rams. In addition, the choke manifold must have a gauge and two valves, and there must be a drill string safety valve on the rig floor. Finally, the plugging program should list plug lengths as 100 ft. for shoe and lap plugs. Please notify us who the field supervisor will be and how to reach him when you move in.

If we can be of assistance, please let us know.

Sincerely,

Dennis L. Olmstead
Petroleum Engineer

DLO:ak

Enclosure

ORIGINAL to OR-CL-PL-02
cc to: DOlier
Borden

APPENDIX II

RECEIVED-P-SD

API: 36-047-90002

Form 9-1957

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY, CONSERVATION DIVISION

DEC 9 1985

DEPT. OF GEOLOGY

Form Approved
Budget Bureau No. _____

GEOTHERMAL DRILLING PERMIT

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

Clackamas 5000' Thermal Gradient Hole (CTGH)

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

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

c. WELL STATUS: Proposed

2. NAME OF LESSEE/OPERATOR: Thermal Power Company

3. ADDRESS OF LESSEE/OPERATOR: 3333 Mendocino Avenue, Suite 120, Santa Rosa, California 95401

4. LOCATION OF WELL
At surface: Approximately 2200' N and 1500' W of SE Corner of Sec. 28
At proposed prod. zone: Same as Surface Location

5. LEASE SERIAL NO.: OR 12344

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

7. UNIT AGREEMENT NAME: N/A

8. WELL NO.: CTGH-1

9. PERMIT NO.: _____

10. FIELD OR AREA: Squirrel Creek

11. SEC., T., R., B. & M.: Sec. 28 T8S R8E Willamette Meridian

12. COUNTY: Marion

13. STATE: Oregon

14. APPROX. STARTING DATE: 1 June 1986

15. DISTANCE FROM PROPOSED LOCATION TO NEAREST PROPERTY OR LEASE LINE: 1500' W of East Line of Sec. 28

16. DISTANCE FROM PROPOSED LOCATION TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR ON THIS LEASE: No previous well drilled or applied for on this lease.

17. ACRES ASSIGNED (WELL SPACING): N/A

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

19. PROPOSED DEPTH: MEASURED: 5000 TRUE VERTICAL: 5000

20. ELEVATIONS: ESTIMATED XXX FINAL ( )
REFERENCE DATUM: GR (X) RKT ( ) DF ( ) KB ( ) RT ( ) CASINGHEAD FLANGE ( ) OTHER ( )

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

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	COUPLING (Collars & Threads)	GRADE	SETTING DEPTH Top	SETTING DEPTH Bottom	QUANTITY OF CEMENT
14-3/4"	11-3/4"	28 lbs.	N/A	1/4" Wall	0	30	25 cu. ft.
10" or 9-7/8"	7"	26 lbs.	Buttress	K-55	0	500	266 cu. ft.
6" or 5-5/8"	4-1/2"	11.6 lbs.	Long	K-55	450	4000	605 cu. ft.

22. PROPOSED WORK SUMMARY

Prepare 160' x 200' drillsite pad and lined sump adjacent to existing access road into clear cut parcel 30. Move in truck mounted rig. Drill 14-3/4" hole to 30' depth, run 11-3/4" conductor to bottom and cement to surface. Drill 10" hole to 500' depth; run 7" K-55 26 pound Buttress casing to bottom and cement to surface. Install casing head on 7" casing, then BOPE consisting of a double control gate and Hydril. Test BOPE per BLM regulations. Diamond core with HQ heads to 5000'. Run geophysical borehole log suite to 5000'. Open HQ hole with 6" bit to 4000' or other selected depth; run 4-1/2" K-55 11.6 pound LT&C casing to 4000', cement solid from shoe to lap in 7" casing at 450'-500' depth. Briefly flow well to obtain expected geothermal fluid samples. Hang 2-7/8" J-55 tubing string to 5000'; fill same with water. Release rig; leave CTGH-1 shut-in awaiting DOE high precision temperature log.

This will be a vertical borehole; no directional drilling/coring practices will be applied. However, borehole directional surveys will be run with the geophysical logging suite.

This deep thermal gradient hole would be drilled under a Cooperative Agreement between Thermal Power Company and the U. S. Department of Energy as part of the DOE program to 1) gather data to characterize the deep hydrothermal resource of the Cascades volcanic region and 2) transfer this data to the public in order to stimulate further development of hydrothermal resources.

(Use additional space on reverse side of form)

23.

SIGNED W. L. D'Olier TITLE Vice President, Geothermal Exploration DATE 14 November 1985

(This space for Federal use)

APPROVED BY Dennis L Olmstead TITLE Petroleum Engineer (DOGAMI) DATE _____

CONDITIONS OF APPROVAL, IF ANY: NOTE: This permit is valid only if land use approval is obtained from the county or city in which the drilling takes place, and provided these authorities make a determinatic of compliance with statewide goals. Issuance of this permit is not a finding of compliance with the Statewide Planning Goals or the acknowledged comprehensive plan. Permit expires 180 days fr date of issue.

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

(See instructions on reverse side)

January 1984

STIPULATIONS WHICH APPLY TO GEOTHERMAL DRILLING PERMITS

1. The operator of a geothermal well must keep a daily record of work, collect drill samples, and maintain a log of rock formations penetrated.
2. If redrilling, deepening, altering of casing, testing or plugging is planned, notice must be given to the Department on Form 5, "Miscellaneous Notices and Reports on Geothermal Wells." Approval or disapproval can be given by phone but work approved in this way must still be proposed in writing by the operator.
3. Well summary (Form 8), well history, representative drill samples and copies of borehole surveys must be submitted to the Department within 60 days after completion, abandonment, or suspension. These records will be kept confidential for a four-year period from date of completion, abandonment, or suspension.
4. In the event of an emergency or blow-out, a Department representative should be contacted as soon as possible:

Dennis L. Olmstead - Petroleum Engineer	(503) 229-5580 office (503) 231-3835 home
William L. King - Petroleum Geologist	(503) 229-5580 office (503) 644-9331 home
Donald A. Hull - State Geologist	(503) 229-5580 office (503) 281-4895 home
John D. Beaulieu - Deputy State Geologist	(503) 229-5580 office (503) 234-6323 home

5. Permission must be obtained from the State Department of Environmental Quality (DEQ) for any extraordinary offsite disposal of drilling mud or wastes or any other emergency that could affect adjoining properties.
6. No fluid shall be discharged unless a permit has been issued by the State DEQ.
7. Notice is to be given to the State Geologist or his representative:
   a. Prior to construction of drill site and sump.
   b. Prior to BOP tests after running casing strings.
   c. Prior to performing work to complete or abandon a well.
   d. Prior to pulling casing strings.
   e. Prior to deviating a well from the vertical.
   f. In the event of fire, spill of fluids, or serious accident.
8. Unless the surface owner wants the drilling pad to be left, the site is to be restored to as near original condition as is practical, including revegetation using native species. Recommended seed mixture can be obtained by calling the Department of Fish and Wildlife at (503) 229-5679.
9. This permit does not include land-use approval. A separate approval should be obtained from the county or city in which the drilling takes place.
10. The State Geologist or his representative may enter the site at any time to make inspections and/or witness work done.
11. Release of the bond will be granted following proper plugging of the hole, restoration of the drill site, and filing of the required records.

MARION COUNTY

DEPT. OF ENVIRONMENTAL SERVICES

CRAIG O. LUEDEMAN
Director
Planning 588-5038
Building Inspection 588-5147
Risk Management 588-5294

Senator Building • 220 High Street NE • Second Floor • Salem, Oregon 97301-3670

file
CTLH-1 Permit

December 26, 1985

Mr. William King
Petroleum Geologist
Department of Geology & Minerials Industries
910 State Office Building
Portland, Oregon 97201

Dear Mr. King:

Thank you for forwarding a copy of the application of Thermal Power Company to drill a geothermal test well in a portion of the Mt. Hood National Forest located in Marion County.

Because the site is federally owned land our Zoning Ordinance (Section 110.820 (a)) exempts this activity from the usual conditional use permit requirements. It stipulates however that the activity must be managed in a manner consistent with the intent of the County Comprehensive Plan and Zoning Ordinance and the Land Policy Management Act of 1976.

The issues we would address if the proposal were located on private land include: Fire hazard management, containment and disposal of drill spoils, removal of all equipment and structures, revegetation, erosion control at the site and along any new access, and prevention of public access to the site during and subsequent to drilling.

If, in issuing your permit, these factors are adequately addressed, we would have no objection to the issuance of the permit and it would comply with our ordinance requirements.

Thank you for the opportunity to comment.

Best Regards,

Russell Nebon

Russell Nebon
Chief Planner

RN/dh

APPENDIX III

Diamond Shamrock
Thermal Power Company

March 24, 1986

Water Rights Division
Water Resources Department
State of Oregon
3850 Portland Road N.W.
Salem, Oregon 97310

Application No. 68695
Permit No.

Attention: Mr. Wayne Overcash

Subject: Application for Permit to Appropriate Surface Water

Gentlemen:

Thermal Power Company is pleased that the Water Resources Commission will allow submission of an application to use water from the Upper Clackamas River as necessary for geothermal exploration.

Submitted herein is Thermal's Application for Permit to Appropriate Surface Water, as well as the $200 examination fee and (assuming approval) the $100 recording fee. The Water Permit is required to support the planned 5000-foot thermal gradient hole drilling and completion program. This hole is located in the Mt. Hood National Forest on the issued Federal geothermal lease OR 12344 in the NW 1/4, SE 1/4 of Section 28, T8S, R8E, Willamette Meridian, Marion County, Oregon.

The aforementioned activity will be conducted as part of the U.S. Department of Energy's Cascades Deep Thermal Gradient Drilling Program. The operation, estimated to begin on 1 June 1986 and be completed by 1 August 1986, will consist of rotary drilling the upper 500 feet and coring the lower 4500 feet of the borehole. In this process, water will be used as the principal component of the drilling fluid. The estimated water requirements are 4000 gallons per day. Under conditions of severe lost circulations, where no fluid returns occur, up to 25,000 gallons per day may be utilized.

Primary and Supplemental Diversion Points are designated in this permit application (see Application attached, Figure 1). The Primary Diversion Point is on Squirrel Creek above the drillsite location. Thermal estimates that this water diversion point will only be functional during the early part of the drilling/coring operation. Both the U. S. Forest Service, Clackamas Ranger District and the State of Oregon Fish and Wildlife Department have indicated that they have no concerns with the

Thermal Power Company
A subsidiary of Diamond Shamrock, 3333 Mendocino Avenue, Suite 120, Santa Rosa, California 95401
Phone 707 576-7022

intended Primary Diversion Point as long as there is water running in the creek. As indicated in the attached Plan of Exploration, all surface activity will be coordinated with the Clackamas Ranger District. The Supplemental Diversion Point has been suggested by the U. S. Forest Service as a tanker fill location.

We are hopeful that the Water Resources Department will issue this permit in early May to allow finalization of drilling/coring operation plans for the intended 1 June spud date. If there are any concerns developed with either the application or requested time frame, please contact the undersigned at 707/576-7232. Your early attention to this matter will be greatly appreciated.

Please acknowledge receipt of this application by signing the enclosed copy of this letter and returning it to us.

Sincerely yours,

J. L. Iovenitti
Senior Geologist

JLI/ma/JLI021

Acknowledged:

By: [signature]

Date: April 2, 1986

Application No. 68695
Permit No.