GL01835

Blue Lake

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 well 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, specifically:

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

2.0 Scope

The Participant, Blue Lake Geothermal Company, will drill a 4000-foot hole in the Santiam Pass Area, SE1/4 SW1/4 Sec. 27, T13S, R8E(W.M.), Jefferson County, Oregon. The Participant will perform data collection both during and subsequent to drilling and will allow DOE access to the hole to collect data. The hole is designed to be rotary drilled in the upper section, with the bottom approximately 1000 feet to be cored.

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. 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 list of deliverables by task, 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. The plan will also designate an individual or individuals who will act as principal points of contact with DOE on behalf of the Participant.

B. 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 support, if necessary.

Deliverable: Approved Project Management Plan

4.2 Permitting and Environmental Reporting

A. 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 solution.

B. Prepare, submit and obtain approval of any documentation required by governmental regulatory agencies for the performance of this work. A copy of all documentation provided to any governmental agency and pertinent to this project shall be provided to DOE.

C. Prepare and obtain DOE approval of an Environmental Evaluation Report prior to performance of any ground disruptive activity. The Environmental Evaluation Report will be site-specific and in accordance with DOE Environmental Guidelines. The Environmental Evaluation Report will be identified in the Project Institutional Plan. If DOE determines that an Environmental Assessment is required, DOE will notify the Participant in writing. Upon such notification, the Participant will provide information as required by DOE for DOE's preparation of the Environmental Assessment.

Deliverables: Approved Project Institutional Plan, regulatory documentation and approved environmental document

4.3 Drilling

A. Prepare and obtain DOE approval of a Project Drilling Plan prior to drilling. The plan shall describe:

- o Surface and subsurface conditions anticipated to be encountered during drilling, including configuration of the resource.
- o Site access.
- o Site preparation.
- o Hole design including hole size, casing size, cementing, etc.
- o Rig and equipment specification.
- o Well containment during and after drilling.
- o Drilling fluids and disposal method.
- o Hole completion.
- o Plugging and abandonment.
- o Site restoration.
- o Anticipated hole problems, if any, and proposed solutions.
- o Health, safety and environmental considerations.
- o Site facilities, if any.
- o Drilling schedule including major activities and estimated duration.
- o On-site supervision to be used during drilling, including drilling supervisor(s) and geologist(s).

B. Prepare a drill site and drill a deep thermal gradient hole in accordance with the approved Project Drilling Plan. The Participant shall report on drilling status daily to the designated DOE representative, so that decisions concerning the drilling operation can be made in a timely manner.

Deliverable: Approved Project Drilling Plan

4.4 Data Collection

A. Prepare and obtain DOE approval of a Project Data Collection Plan prior to drilling. This plan will address data collection 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.

B. Collect the following data as a minimum in accordance with the approved Project Data Collection Plan. These data and samples shall be provided to DOE as soon as possible after collection.

Temperature. In the section of the hole to be rotary drilled, the in and out temperatures of the drilling fluids will be measured every ten feet. Maximum reading temperatures will be taken with each core run.

Rock Sampling. Cuttings will be collected every ten feet of rotary drilling. Continuous core will be taken in the bottom 1000 feet of the hole. The core will be logged, photographed and stored in core boxes on-site in a protected core garden. The Participant will take

a 50% split of the samples as desired and will give the balance of the core to DOE. DOE will provide procedures for identification and splitting of core and cuttings.

Drilling Records. Logs describing primary lithology and secondary mineral content and mud return temperatures will be kept during the tricone drilling and cored portion of the hole, copies of which will be provided to DOE. These logs will also include information on penetration rates, lost circulation amounts, times and depths and/or the location of water entries.

Fluid sampling. If artesian flow is encountered during drilling, representative samples of any formation fluid produced from the hole will be collected. A two-liter sample of the drilling fluids in use prior to sampling will be taken. Sampling procedures and analyses will be performed in accordance with the approved Project Data Collection Plan.

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, boiling, 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.

Hydraulic head. At the start of daily drilling, or whenever the drilling operation will allow, measurements of the hydraulic head or depth to fluid surface in the hole will be made. If the well has artesian flow, artesian flow rates will be measured and wellhead pressure will be measured when the well is shut-in.

Geophysical well logging. Openhole temperature, caliper, resistivity, sonic and self-potential logs will be run in the interval(s) between the surface pipe and total depth. A temperature tool capable of 0.01°F precision in measurement will be used to measure the geothermal gradient. One set of field prints will be sent to DOE as soon as possible.

Deliverables: Approved Data Collection Plan, Data & Samples

4.5 Hole Completion and Maintenance

A. Upon satisfactory completion of openhole geophysical logging and sampling, the well will be completed for observation. DOE and the Participant shall review and discuss the data; a mutual agreement must be reached prior to releasing the rig. After allowing sufficient time for thermal equilibration to occur, a temperature log will be run from which a geothermal gradient will be derived.

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

C. The hole and site facilities shall be maintained for at least one field season after hole completion in accordance with the approved Project Drilling Plan. The hole and site

facilities shall be made available to DOE during this period for DOE's scientific use. The Participant may also collect data from the well during this period at its own expense and on a non-interference basis.

Deliverable: Completed Hole Configuration Schematic

4.6 Abandonment

The hole will be plugged and abondoned in accordance with applicable regulations and the approved Project Drilling Plan within the 12 months subsequent to the end of the DOE access period. If for any reason the hole is not plugged and abandoned by the end of the period, the hole becomes the legal and financial responsibility solely of the Participant.

4.7 Site Restoration

The site will be cleared, the pits filled and the site restored in accordance with applicable state regulation and as outlined in the approved Project Drilling Plan. If the Participant elects not to abandon the well or restore the site, it assumes sole legal and financial responsibility for the hole and site.

5.0 Reports, Data and Other Deliverables

A. The Project Drilling Plan as required by Subtask 4.3.A.
B. The Project Data Collection Plan as required by Subtask 4.4.A.
C. The Project Management Plan as required by Subtask 4.1.A.
D. The Project Institutional Plan as required by Subtask 4.2.A.
E. All data collected by the Participant under Task 4.4.
F. Regulatory documentation and approved environmental document under Subtasks 4.2.B and 4.2.C.
G. Completed hole completion schematic as required by Subtask 4.5.B.
H. Project status and management reports as identified on DOE Form CR-537, Reporting Requirements Checklist.

Blue Lake
Santiam Pass

PART B - TECHNICAL APPROACH TO THE PROJECT

(a) Drilling

1. Surface and Subsurface Conditions Anticipated

The surface at the proposed Blue Lake drill site is a clearing on a relatively flat bench about 150 feet above the valley. The surface formation is cinder and fragments of bedrock from the Blue Lake eruption. This will form a good working surface, but the sumps will probably have to be lined to contain the drilling fluids.

The thickness of this explosion debris is unknown at the proposed drill site, but it is probable that 20 feet of conductor pipe will reach through it to bedrock.

Solid lava flows are exposed in the Blue Lake crater, but the deeper formations are unknown in this area. It is assumed that they will be the usual variety of lavas, tuffs, and cinders commonly found in the Cascades, but Blue Lake is near the Deschutes Basin and it is conceivable that the sediments may extend under the volcanics at this point. If sediments are encountered, the drilling may be easier than is now anticipated. In either case, sediments or volcanics, relatively solid bedrock is anticipated for about the first 3,000 feet. Below 3,000 feet the hole is expected to encounter fracturing associated with the probable fault mapped between Blue Lake and Round Lake. It is anticipated that this fractured section will be drilled with H wireline core tools, and reduced if necessary.

2. Site Access

Blue Lake Resort property is accessible by paved road from Highway 22 through the Santiam Pass. Roads on the property are graded in the Blue Lake explosion debris which is good road metal. The drill site is on an old logging road which may require minor grading. Snow plowing would probably be needed if the well were drilled during wintertime. Access to the Resort is maintained the year round.

Photo 4 - Looking east along old logging road to the Blue Lake well site. The road is graded in Blue Lake Cinder.

Photo 5 - Looking northeast at the Blue Lake drill site. Site preparation and reclaimation will be very easy in this flat area of cinder.

3. Site Preparation

The site preparation will consist of digging sumps and a shallow water well. No leveling or clearing is anticipated. As previously discussed, the sumps will probably require lining. The site lay-out is shown on Figure 1.

The water well will be drilled with air at one edge of the sump. If sufficient water is not found at relatively shallow depths, this will become the deep drill hole and water will be hauled. If shallow water is found as expected, it will be developed as a temporary well for the duration of the project, and the rig moved to the other side of the sump for the drilling of the deep well.

4. Hole Design

a. Conductor Casing

A 16" hole will be drilled through the loose Blue Lake explosion debris to a firm formation and lined with 12 inch conductor casing. This will probably be to a depth of 20 feet.

b. Surface Casing

Mud and/or air drilling would then proceed with an 11 7/8" bit to 400 feet. 400 feet of threaded 8 5/8" surface casing would be set and cemented to the surface. A Blow-Out Preventer (BOP) will be attached to the surface casing and tested to at least 500 psi. Advance notice will be given to the proper regulatory personnel with the Oregon Department of Geology and Mineral Industries to witness both the cementing and the pressure testing of the surface casing.

c. Core/Production Casing

With the surface casing in place and the BOP tested, the drilling would then proceed with a 7 7/8" mud rotary bit to an estimated depth of 3,000 feet. This section of the hole would be cased with 4 1/2" threaded casing. This would serve as the casing for the H wireline core drilling and would become the production casing if a resource were found in the lower open portion of the well.

The option is also open for switching to core drilling any place between 400 feet and the 3,000 foot objective depth. If highly fractured rock is encountered, a core hole would be much less likely to bridge than the larger size drilled with a rotary bit.

d. Open Hole

With the 4 1/2" casing in place, the drilling would proceed with H wireline core which leaves a 3 25/32" hole size. Further reductions to N (2 63/64" hole size) and to B (2 23/64" hole size) could be done if necessary. Unless conditions dictate otherwise, the cored portion of the hole would be left open for the production of hot water.

5. Anticipated hole problems and solutions

a. Artesian flow

The collar of the proposed drill hole at an elevation of 3,600 feet is about 1,200 feet lower than much of the Santiam Pass. Given this potential for high static heads plus possible thermal drive, the well is likely to have artesian flow. Artesian flow would be desirable for collecting water samples, and for a production well. However, if the pressures become too great to contain with drilling mud, it will be necessary to cement, set additional casing, or even discontinue drilling. Decisions as to which to do will have to be made on a case by case basis, depending upon depths, planned hole size reductions, and the conditions in the hole. Usually it is preferable to cement and continue to drill ahead with the same size bit. However, each portion of the hole has been planned to be of sufficient size to permit at least one intermediate reduction if additional casing is necessary.

b. Fractured formations

The proposed well is near an explosion crater and designed to intercept a probable fault zone. The fault probably has had recent activity because of its assumed connection with the Holocene volcano one mile to the north. The fractured formations in the hanging wall of this fault may tend to cave into the 7 7/8" hole. The "built in" solution to this problem is to switch to core drilling. The core hole will be 3 25/32" in diameter, and thus less likely to cave or bridge. In addition, a much smaller volume of drilling fluid is needed for core drilling than for rotary mud techniques, and thus the tendency for hole erosion is greatly reduced.

c. Other problems

The proposed well is being drilled in virgin territory where the deepest test to date is only to 400 feet. It will encounter formations which are unexposed and unknown in the immediate area. In such wildcat drilling, surprise problems are likely to occur. To cope with these anticipated surprises, there will be an experienced driller at the controls of the rig, backed up by an experienced geologist and an experienced drilling engineer.

6. Drilling fluids and disposal

The drilling fluids will be bio-degradable lubricants for air drilling and non-polluting jells and clays for mud drilling. These fluids would be disposed of in the sump at the drill site.

If heavy muds are used which require special handling, they will be disposed of in a manner approved by the Oregon Department of Geology and Mineral Industries.

7. Hole completion

The proposed well will be completed as a production well if a suitable geothermal resource is found for direct use heating at the Blue Lake Resort and near-by Camp Davidson. It is anticipated that the well will have an artesian

flow, in which case it will be capped, with a small valve in the cap to bleed off gases, and a 2" valve on the blooie line for production. Further development of a geothermal heating system, including well maintenance and a pump if needed, will be the responsibility of the Blue Lake Lodge.

If the well has a high temperature artesian flow, as expected, all of the down hole monitoring should be completed before flow testing begins. Thus, there will be a seven to ten day period that the drill rig will remain on the hole to assist down hole logging and permit temperatures to stabilize after the drilling ceases.

If there is no artesian flow, or only a small flow that is manageable without special equipment, the temperature monitoring period will be for at least one month. The well would, of course, be available for other scientific tests during this period.

8. Plugging and abandonment

If the well does not have a sufficient geothermal resource to justify completion for direct use production, it will be plugged and abandoned in conformance with the laws of the State of Oregon. Plugs will be set as prescribed in the State of Oregon to prevent the intermixing of aquifers.

The shallow water well would also be plugged and abandoned, or become the responsibility of the landowner if he wishes to use it.

9. Site restoration

Site restoration will consist of filling the sump and grading the site back to its nearly level original contours. Given the gravel-like nature of the Blue Lake explosion debris which is the surface formation, this will be a simple and inexpensive task.

It is probable that the owners of the Blue Lake Lodge will wish to have the entire geothermal distribution system buried, including a man-hole cover over the well. This, however, will be their decision and done at their expense. The

work proposed under this SCAP is to be limited to the general cleanup and leveling of the drill pad.

10. Rig and equipment specifications

The drilling rig to be used is a modified Portadrill TLS top drive rotary 1977 Model TLS on 5070 paystar, rig SER #382, derrick rated @ 90,000#, (self standing. open-view) top head lift cylinders rated @ 78,000# lift, drawworks rated @ 60,000#, rotary tophead (0-150 RPM, Noster gear hi torque), core head (Acker 8 speeds 0-1800 RPM). The equipment includes a portable pit system, storage van, dog house and service trucks.

11. Well containment during and after drilling

The proposed drilling site is located at a relatively low elevation in relation to the surrounding terrain. Static pressures in excess of atmospheric pressure can be encountered at some point after the surface casing has been set. Pressure control equipment will be in place and artesian flows will be suppressed by drill fluid weight.

Upon completion of the drilling of the well, well will be prepared for testing with core drilling pipe in place. The drilling rig will remain on the well for up to 7 days for the completion of the testing.

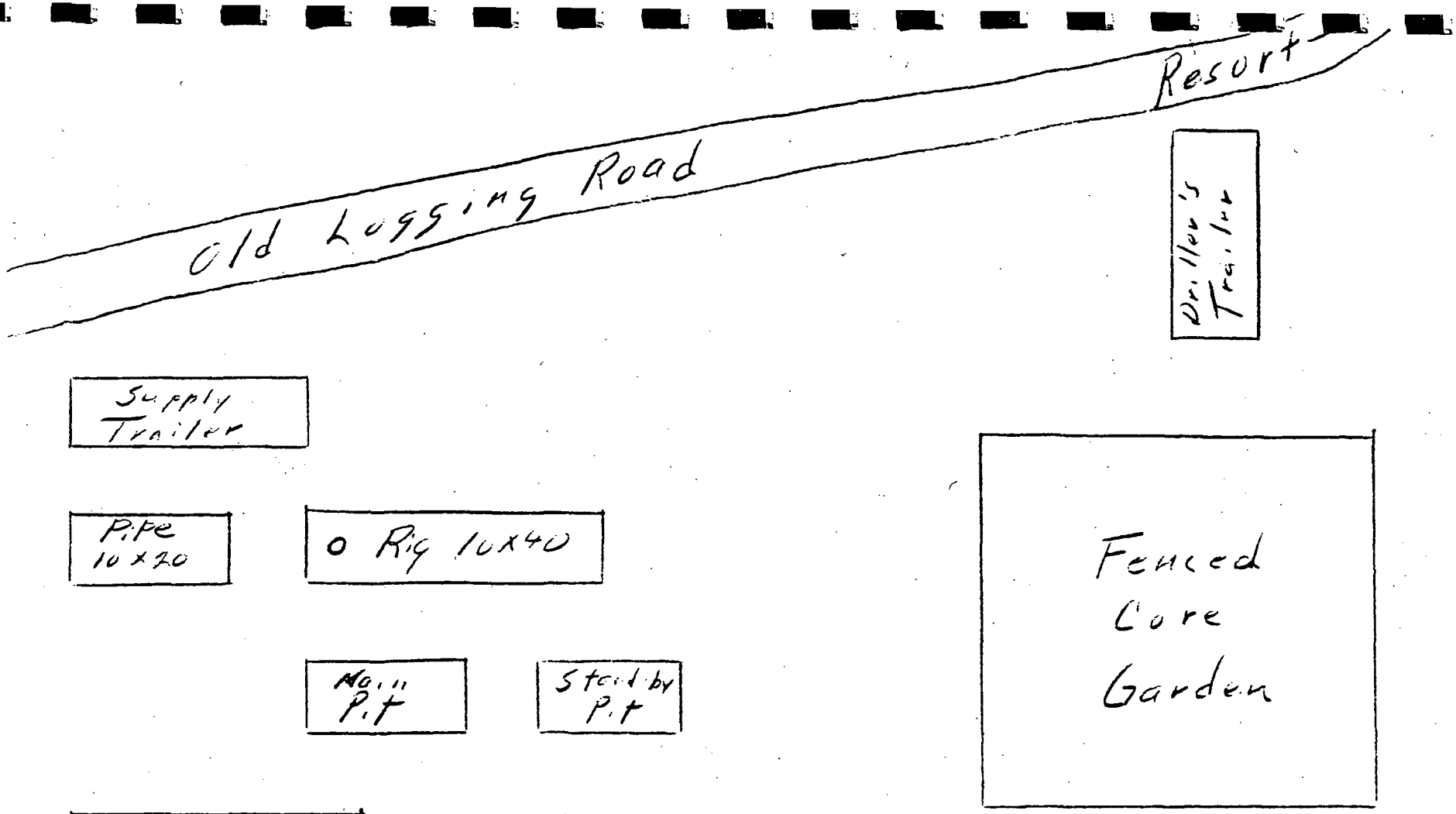
If the well is converted to a production well after testing, the drilling pipe or casing will be cemented in place to a point where cement has covered a sufficient zone of competent formation (as approved by the State of Oregon). Production will be established on perforation in the desired zones or from the uncased core hole.

12. Site facilities

The site facilities are shown in Figure 1.

13. Health, safety, and environmental considerations

The drilling contractor, Jannsen Drilling Company, will be directly responsible for the health and safety of the drilling crew. All personnel, including visitors, will be required to wear hard-hats when on the drilling pad. H_2S monitoring will start at 400 feet when drilling below the surface casing.



Sketch Map of Blue Lake Drill Site
Location T13S/R6E/Sec 7 NE
Jefferson County, Oregon
Appx. Scale 1" = 40'
Figure 1

During periods of forest fire danger, standard practices and precautions for operating within the Deschutes National Forest will be observed.

The drilling will proceed on a 24-hour per day basis, with work breaks to coincide with normal breaks in the drilling program. Sounds of the drilling will be muffled by surrounding timber and noise at night will be kept at a minimum. The site is about 1500 feet from the cabins and campgrounds, and it is doubtful that the rig noises will be noticed over the sounds of Highway 22 which is only about 800 feet away.

Sanitary facilities are available at the Blue Lake Resort.

14. Drilling schedule

The duration of the major drilling activities is as follows:

Activity	Days
Site preparation, dig sumps	3
Drill shallow water well	3
Rig up, Drill 16" hole to 20' and set conductor casing	2
Drill 11 7/8" hole to 400'	4
Set and cement 8" surface casing	1
Vacation	2
Mount and pressure test BOP	1
Drill 7 7/8" hole to 3,000'	23
Set 3,000' of 4 1/2" casing	2
Vacation	4
Core drill to 4,000'	20
Vacation	4
Rig assisted logging	3
Flush, flow test and complete hole	2
Site rehabilitation	1

15. Other information

a. Use of resource

The Blue Lake Resort, Camp Davidson, Camp Tamarack and the Alpine Cafe are within 1/2 mile of the proposed well. These facilities are currently spending about $50,000 per year for electric and bottled gas heating needs which could be replaced by hot water from the well. It is quite possible that the proposed well will produce a sufficient geothermal resource to meet this need.

b. Funding and responsibility

If the well finds an adequate geothermal resource for direct use, it will be turned over to the Blue Lake Resort after a reasonable period of data gathering. The responsibility for the well and the use of the resource would belong to the resort, and the funding is not part of this proposal to DOE.

(b) Data Collection

1. Types of data

The data collection will be strongly oriented to provide hard data on the geology of the area and to physically test the intermediate depth geothermal resource, if present. The critical bottom 1,000 feet or more of the hole will be core drilled to give the first look at Taylor's hypothetical "Plio-Cascades" formations. (Taylor, 1981) Continuous core will provide directly measurable data on the lithology and structure of these formations. These data will be logged in great detail. Water samples, temperature measurements and flow testing will give viable data on the intermediate depth geothermal resource, as well as clues to what may be expected at greater depths.

Since even the most sophisticated geophysical logging cannot match the quality of data achieved by core drilling, and since the core hole may be too small to accept most electric logging tools, the only geophysical logging proposed is temperature measurements.

The in and out volume and temperature of the drilling fluids will be monitored, along with penetration rates.

2. Depths

The core drilling will start at or above 3,000 feet. Maximum reading thermometer temperatures will be taken with each core run. The drilling fluids will be monitored over the entire depth of the well. The water sampling will primarily be from the core drilled portion of the hole. If heavy artesian flows are available during drilling of the upper part of the well, they will also be sampled. However, in most cases as a matter of practical drilling, these flows will be suppressed with heavy muds so that penetration can proceed. Temperature gradient logging will cover the entire hole.

3. Timing

The timing of the data collection will, in most cases, be directly related to the current depth of the well, and controlled by the drilling progress.

When the total depth is reached, the drilling company will take a 4 day vacation while temperatures stabilize. There will be no charge for this rig time. The crew would then return and be paid stand-by time while the temperature logging is done. The hole, as well as the assistance of the drilling crew, would be available to other scientific groups to gather any data they may wish during this period. The rig would be kept on site up to three days for such studies. Any additional time would be at the expense of the organization gathering data.

4. Methods

The drill core would be logged and photographed at the site. For

this purpose it would be placed on corrugated fiberglass in a protected "core garden". The proposer would then take a 50% split of any samples he wished to analyze and the balance of the core would be given to DOE.

The in and out temperatures of the drilling fluid will be monitored and cuttings collected for each ten feet of rotary drilling. The driller will continuously monitor and record the flow rates and penetration rates. Down-hole maximum reading thermometer temperatures will be taken by placing the thermometer in a short length of 1/2" pipe capped on both ends and taped to the wireline immediately above the overshot each time it is lowered to place the innertube in the corebarrel.

Water samples will be collected by flowing the well either with its own artesian pressure or by air lifting. DOE will be responsible for furnishing the collection bottles and for preparing chemical analyses of the samples. A copy of the analyses will be furnished to the participant.

5. Additional well logs

A detailed lithologic log will be made of the cuttings and the core by a specialist trained in volcanic stratigraphy and hydrothermal alteration.

6. Core

At least the bottom 1,000 feet of the hole is planned to be core-drilled. The core drilling will start at or above 3,000 feet.

7. Downhole water samples/artesian flows

It is anticipated that water samples will be collected at the collar of the hole from artesian flows or by air lifting. Downhole samples will be taken if necessary.

8. Pressure measurements

If the well has an artesian flow, the shut-in pressure will be measured. No downhole pressure measurements are planned.

9. Reservoir engineering data

Aresian flow rates or the static water level would be measured and recorded, but no other reservoir engineering data gathering is planned from this single core hole.

(c) Hole Completion and Maintenance

It is planned to complete the hole as a production well for hot water if a suitable resource is found. The well and further development would then be the responsibility of the Blue Lake Geothermal Company.

However, when the total depth is reached the well will temporarily be completed for observation. The observation period for data gathering will be for a minimum of one month to permit full stabilization of the temperature. These observations will be through the 4 1/2 inch casing to 3,000 feet, and the open 3 25/32" H core drill hole from 3,000 to 4,000. (These planned depths may have to be altered in the actual drilling.)

As previously discussed, high pressures may require suppression with drilling mud. If this condition exists when the total depth is reached, the drill rig will be kept on site for at least one week for temperature measurements through the wireline drill rods. The well would then be flushed and flow tested, but further downhole geophysics may not be possible without a work-over rig.

(d) Abandonment

If the well fails to find a useable resource, it will be plugged and abandoned in compliance with the laws and regulations of the State of Oregon. (Appendix A)

3. Work schedule

The drilling of the Blue Lake well is expected to take about three months. A tentative schedule is outlined below, but the actual schedule will vary with the drilling conditions encountered. It is hoped that the project can be started in early September to take advantage of the usually good fall weather in the Cascades. However, the site is at a low enough elevation to be operated at any time of the year, although snow plowing may be needed if it is started late in the year.

Sept.	3-5	Site preparation, dig sumps
Sept.	6-8	Drill and complete shallow water well
Sept.	9-10	Rig-up and Drill 16" hole to 20 feet. Set 12" conductor casing
Sept.	11-14	Drill 11 7/8" hole to 400 feet
Sept.	15	Set and cement 400 feet of 8" surface cashing
Sept.	16-17	Vacation
Sept.	18	Mount and pressure test BOP
Sept. 18-Oct.	11	Drill 7 7/8" hole to 3,000 feet
Oct.	12-13	Set 3,000 feet of 4 1/2" casing
Oct.	14-17	Vacation (4 days for drill crew)
Oct. 18 to Nov.	6	Core drill to 4,000 feet, flow test and collect samples as needed.
Nov.	7-10	Vacation
Nov.	11-13	Rig on stand-by to assist with downhole logging
Nov.	14-15	Flush well and flow test.
Nov.	16	Site rehabilitation.

The schedule from Nov. 7 on assumes that the well will have artesian pressures which will require suppression with drilling mud for the final temperature logging. If this were not the case, the rig would be pulled and the final logging would be done after a 30 day stabilization period.

(c) Key Personnel

The key personnel listed earlier in connection with the Blue Lake Geothermal Company are John W. Hook, W. F. Covert and C. Girard Davidson. The resumes of these men are in Appendix B. In addition, the detailed geologic logging will be done by a student of Dr. Edward M. Taylor of Oregon State University.

(d) Institutional Considerations

1. Reports, plans, permits

The proposed well is on private land in Jefferson County, Oregon. Jefferson County has no geothermal rules or regulations. The reports, plans and permits for geothermal wells in Oregon are under the Department of Geology and Mineral Industries. (Water rights must be obtained from the Water Resources Board if the use is in excess of 5,000 gallons per day. This will be the responsibility of the resort if the well is developed for production, but not a concern of the project to drill the well.) The Department of Geology and Mineral Industries requirements are listed in the Laws and Administrative Rules Relating to Geothermal Exploration and Development in Oregon. Miscellaneous Paper No. 4, Part 2, Revised 1981 which are in Appendix A.

Department of Energy

Idaho Operations Office
550 Second Street
Idaho Falls, Idaho 83401

June 26, 1985

Blue Lake Geothermal Company
Park Washington Building, Suite 410
519 S.W. Park
Portland, OR 97205

ATTENTION: *John W. Hook*

SUBJECT: Solicitation No. DE-SC07-85ID12580

Dear Sir:

With regard to the proposal which you submitted in response to the subject solicitation, you are requested to provide additional information. Please respond to the following by July 5, 1985. You should contact me on (208)526-1229 if you have any questions.

Sincerely,

Elizabeth M. Hyster
Contract Specialist
R&D Contracts Branch
Contracts Management Division

cc: S. M. Prestwich

BLUE LAKE

- What rationale was used to determine at what depth the switch would be made from rotary to core drilling? Please provide this rationale, including data and any input from others (e.g., Dr. Taylor).
- What accuracy will the temperature tool used to log the hole have?
- If the hole is unsuccessful from a development standpoint, does Blue Lake intend to complete the hole to meet DOE's objective for heat flow data?
- Who will Blue Lake use to perform an environmental evaluation of the proposed activities? If the selection has not been made, provide the criteria on which selection will be made.
- Will two on-site geologists be provided for 24-hour converage during drilling? If not justify why not. Clarify by name who the geologist(s) on-site will be. For individual(s) identified other than Hook, specifically the student, provide educational level and experience.
- Will the cored section of the hole be cased if hole stability problems are encountered and in order to provide good heat flow data?
- How does BLGC plan to deal with any environmental issues which could result from private landowners' concerns about the project to the state or county?
- Is access to the site available on public roads or does Blue Lake need to coordinate access with the Forest Service?
- Will the 4 1/2" casing be cemented and pressure tested?
- Do the State of Oregon regulations require pressure testing of the well head, casing and BOPE at 500 psi or 1000 psi for this hole?
- Will daily hydraulic head measurements be made during drilling when possible?
- Explain fully how anticipated lost circulation problems in the upper part of the hole will be handled.
- Will BLGC box the core samples and store them in a secure manner until the samples can be transferred to DOE? Explain the manner in which the samples will be secured. Identify the category in which the associated costs have been proposed.

- The proposal indicates that the access period for data gathering will be a minimum of one month. What is the maximum amount of time the hole will be available to DOE for additional data gathering?

- Provide the details of the proposed amount estimated for travel, including origins and destinations, number and duration of trips, estimated travel and per diem amounts by location.

- Are the individuals proposed as "Consultants" (Project Manager and Project Engineer) subcontracted or employees of the company? If employees, identify their annual salarly rates.

- Identify the total number of hours proposed for each, the Project Manager and the Project Engineer.

- Provide the basis for the proposed Material Overhead cost rate and for the proposed G&A cost rate using the following format for each.

	Prior FY Actual	Current FY Budget	Current FY Actual thru	Next FY Budget
Accounts: (List Accounts)				
Total Pool	_____	_____	_____	_____
Direct Cost Base: (Description)	_____	_____	_____	_____
Annual Rate	_____	_____	_____	_____

- Provide the details of the amount proposes for plug and abandon costs and for standby costs.

- Define the activities anticipated for site restoration.

BLUE LAKE GEOTHERMAL COMPANY
519 S.W. Park, Suite 410
Portland, OR 97205

December 19, 1985

Ms. Elisabeth M. Hyster-Bowhan
Contract Specialist
Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Dear Ms. Hyster-Bowhan:

In reference to your letter of November 22, 1985, we agree that the number one question to be resolved is that of openhole geophysical logging. We concur completely that gathering of scientific data about the geothermal potential of the Cascades is of paramount importance since we firmly believe that there are major geothermal fields to be found in the Cascades. We also believe that these can be discovered only by drilling. In fact, I made some of the original suggestions for this cooperative drilling program to Dr. Rod Thoms during the GRC field trip to Medicine Lake which preceded the 1983 Annual Meeting in Portland. The idea was further developed at that meeting by others from government and industry, and Mr. Davidson and I worked hard for its implementation.

This project, as originally conceived, was to explore the Cascades for geothermal energy. While recognizing the value of scientific data, we did not think this program was designed for "pure science". If we can demonstrate the validity of the Cascades as a major energy resource by making some discoveries as a result of drilling, there will be plenty of funding for the very necessary scientific studies from both government and industry. However, to date the Cascades have had more studies than drilling, and it is only the drilling which can prove the resource.

We object to the requirements concerning openhole geophysical logging for the following reasons:

1. We, and many other prominent geothermal explorationists, do not believe that openhole geophysics are worth the costs in volcanic terranes. There is no question as to its demonstrated value in petroleum exploration in stratigraphic formations. However, such "pancake" geology cannot be expected in the volcanic piles which form the Cascades. It would be "after the fact" data for the proposed well, and it would be of dubious value to subsequent exploration.

2. The additional time a hole would have to remain open while crews are called in from California and make the run, probably a day or two, would increase the risk of losing the well. Casing should be run as quickly as possible to reduce this risk.

3. Blue Lake's proposed program has options for as many as six reductions in the size of the well. Given the difficulties which have been encountered in previous drilling in the Cascades, we consider it prudent to keep as many options open as possible. A possible compromise might be considered in which we would start core drilling at the bottom of the surface casing and have open hole to the TD, reducing the open hole logging to one trip. However, this would seriously reduce our options for dealing with difficult portions of the well. We firmly believe that the importance of successfully completing the well far outweighs the value of the geophysics that may

be attained from it. To make as many as six runs, if we use all of our options for reduction in hole size, is simply too expensive.

4. Blue Lake Geothermal, when and if incorporated, will have limited financial resources. To avoid potential situations which would be beyond our means, we propose to handle all phases of the project on a "turn key" basis, and thus pay only the contracted amount. The risks of cost overruns will be on our contractors, not Blue Lake Geothermal, or DOE. Any compromise we negotiate concerning the openhole geophysics must have a dollar limitation on Blue Lake's obligation.

5. We are unaware of any geophysical tools capable of working in a high temperature environment which will fit in a small diameter core hole. We would be interested in knowing how this problem is being handled with the other proposers for the Cascades program. Who has such tools, and what are the costs?

While we oppose the use of openhole geophysics for the reasons stated, we are anxious to get on to the drilling. A reasonable compromise from our point of view would be to run openhole geophysics on only the lower most section of the well. If all goes as planned, this would be the bottom 1,000 feet which we plan to core. This will be the most important part of the hole and the geophysics could be correlated directly to core. But since we expect to handle the drilling on a turn key basis, a dollar limit would have to be placed on Blue Lake's share of the cost. If DOE or other groups studying the Cascades wished to do additional work, we would assist in every way we could as long as it did not put completion of the hole at risk.

In regard to your questions 2 and 3 concerning Documentation of Equity and Financial Responsibility, we will incorporate if we are awarded a contract. We do plan to use commitments from third parties, and these would be documented in writing. Financial arrangements for Blue Lake's share of the costs would also be documented. However, unless we can successfully resolve the problem of openhole geophysics, we see little point in further efforts toward incorporation and arranging the financing. Unless we can agree on an exploration plan, such efforts would be an exercise in futility.

I hope that we can discuss these matters in the near future to see if we can reach understandings which will further the very worthwhile objective of exploring the Cascades for geothermal energy.

Yours very truly,

John W. Hook
Partner

Comments by Bruce Sibbett

Diamond Shamrock
Thermal Power Co.

p. 15 Revised, Hole Design: point 4.

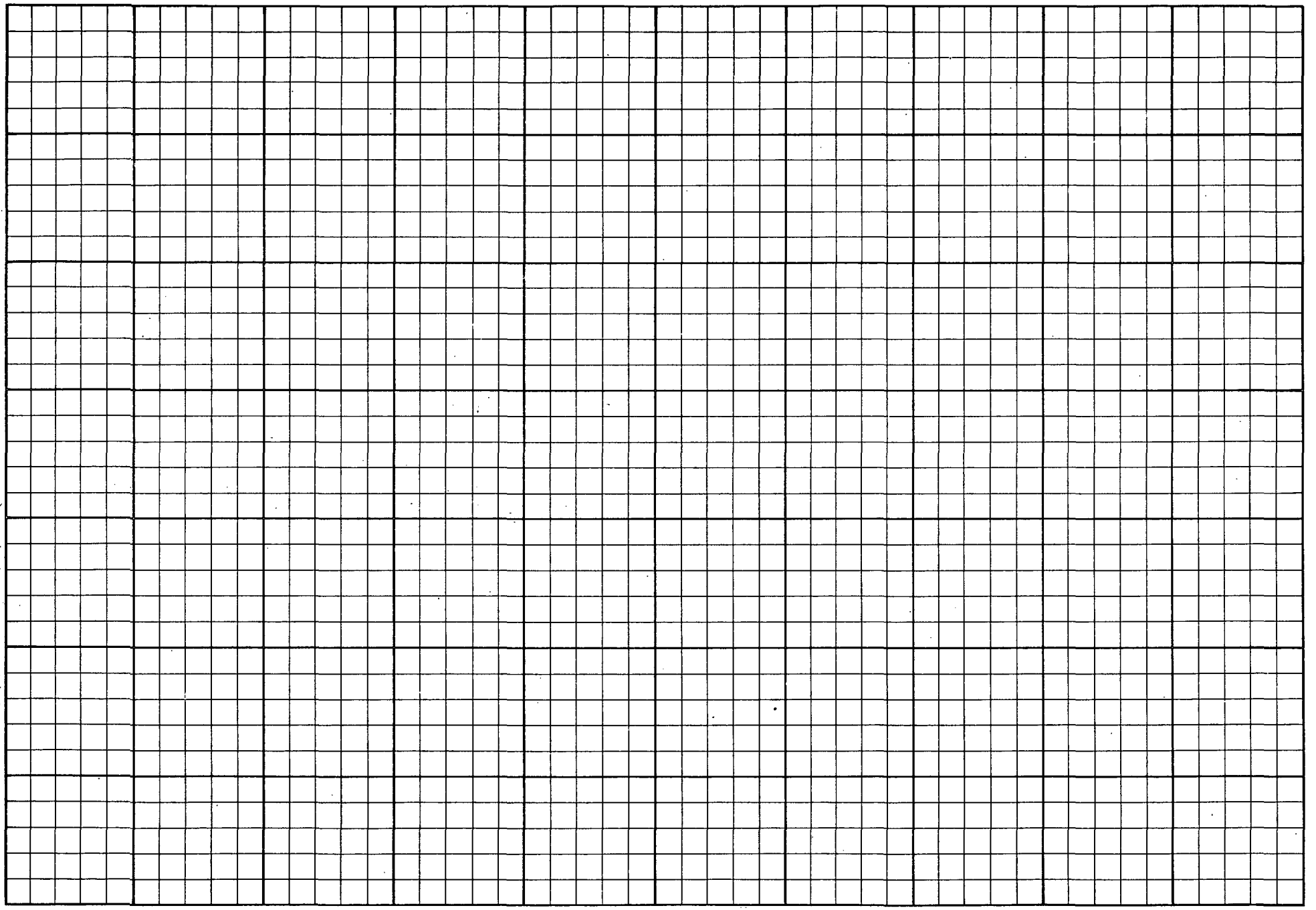
- 6-½" casing is probably O.D., I.D. would be almost exactly 6" depending on casing wall thickness. A 6" bit probably would not fit, however a 5¾" bit could be used. Drilling engineer should foresee this detail.

Blue Lake Well.

DOE should provide core boxes for protection and preservation of core. Laying the core on corrugated fiberglass exposed to the weather is very risky at best.

- Try to negotiate in that we gets only a skeleton core. This makes more sense than splitting

- Try to negotiate neg tape of logs, rather than logs themselves



BLUE LAKE GEOTHERMAL CO.
519 S. W. Park, Suite 410
Portland, Oregon 97205

July 5, 1985

Ms. Elizabeth M. Hyster, Contract Specialist
R&D Contracts Branch, Contracts Management Div.
Department of Energy
550 Second Street
Idaho Falls, Idaho 83401

Re: Solicitation No. DE-SC07-851D12580

Dear Ms. Hyster:

We are pleased that our proposal has been selected for further consideration. Please continue to address all correspondence to our Portland address. However, it would facilitate replies if you send a carbon to my Salem address:

John W. Hook
P. O. Box 3133
Salem, OR 97302

Our Portland telephone No. is (503) 223-3800, and my phone at Salem is (503) 371-3901.

In response to your letter of June 26, 1985, I have assigned numbers to the questions for quick reference, and that information is enclosed. We hope that you will find these answers complete, but if you have further questions, please let us know.

Sincerely,

BLUE LAKE GEOTHERMAL COMPANY

By John W. Hook
John W. Hook

Enclosure

cc: C. Girard Davidson
Wilford F. Covert

BLUE LAKE

1. What rationale was used to determine at what depth the switch would be made from rotary to core drilling? Please provide this rationale, including data and any input from others (e.g., Dr. Taylor).

1 and 12. The questions dealing with the rationale as to where to switch from rotary to core drilling and the problem of lost circulation are closely related and are treated together here.

First, there can be no question but that all of us prefer core over rotary cuttings. However, in the usual course of events, it is quicker and cheaper to make hole with rotary tools. The major exception to this is when problems of lost circulation or caving occur. As we discussed at the top of page 7 of our proposal, the bottom 1,000 feet of the hole is expected to intercept fractured formations associated with a fault zone. As we further discussed at the top of Page 12, core drilling is the best way to deal with fractured formations which may cause caving or lost circulation. If serious problems are encountered above 3,000 feet, we have the options of cementing, casing, or switching to core drilling. Thus we may elect to go to core drilling anywhere between the bottom of the surface casing (400 feet) and 3,000 feet. In any case, we plan to core from 3,000 feet to 4,000 feet. The drilling was bid on this basis.

2. What accuracy will the temperature tool used to log the hole have?

We plan to use a probe which reads to at least $0.1^{o}C$ increments. This will be calibrated by ice water/boiling water tests. It will be further checked and in the well by attaching a maximum reading thermometer.

3. If the hole is unsuccessful from a development standpoint, does Blue Lake intend to complete the hole to meet DOE's objective for heat flow data?

Yes. This question, we believe, is fully addressed on Page 19 of our proposal under (c) Hole Completion and Maintenance.

4. Who will Blue Lake use to perform an environmental evaluation of the proposed activities? If the selection has not been made, provide the criteria on which selection will be made.

The Blue Lake Drill site is on a tract of private land within the Deschutes National Forest. It is covered by the Geothermal Leasing Environmental Assessment Report, Sisters Ranger District, Deschutes National Forest. As discussed on

Page 25, and shown on the map on Page 26 of our proposal, the adjacent National Forest land has been leased for geothermal development with only the "Standard Stipulations" applying, except for a buffer zone around the lake. In view of this existing EAR, we did not propose any additional environmental evaluation.

5. Will two on-site geologists be provided for 24-hour coverage during drilling? If not justify why not. Clarify by name who the geologist(s) on-site will be. For individual(s) identified other than Hook, specifically the student, provide educational level and experience.

John W. Hook plans to live at the Blue Lake Resort on practically a full time basis. He will be relieved from time to time by Dr. Walter Youngquist. (Dr. Youngquist is a nationally known geothermal geologist and directed the DOE-EWEB Cascades Drilling Project in 1979 with Mr. Hook's assistance--we can have Dr. Youngquist send a resume if it is needed.) Mr. Hook or Dr. Youngquist will be available on a 24-hour basis to deal with drilling problems as they arise, and to meet scheduled data gathering activities. The routine sampling of the cuttings and lay-out of the core will be directed by the driller. With this type of arrangement, we have found that one on-site geologist is adequate for projects of this type.

We plan to use a student of Dr. Taylor's for special logging as described on Page 22 of our proposal. He will not be involved in the management of the drilling. Dr. Taylor will select the student and supervise this logging when plans have been confirmed. Personal data can then be made available.

6. Will the cored section of the hole be cased if hole stability problems are encountered and in order to provide good heat flow data?

The cored section of the hole will be cased with a slotted liner for hot water production if hole stability problems are encountered. While the rig is on site, the hole will be stabilized by the wire-line drill rods for the initial data gathering.

7. How does BLGC plan to deal with any environmental issues which could result from private landowners' concerns about the project to the state or county?

7. BLGC is working in cooperation with the private landowners to develop a geothermal resource for their use. They are sharing financially in this venture and have a say in the management of the project. The timing to start after Labor Day, is at their request for both financial and environmental reasons to coincide with their off-season.

8. Is access to the site available on public roads or does Blue Lake need to coordinate access with the Forest Service?

The access road from the paved public road to the drill site is entirely on private land owned by the Lovegrens, the Blue Lake Resort owners. The Forest Service also has the right to use this road to reach their land. The road will, of course, be kept clear for all valid users. No timber is scheduled for harvesting along this road during the project, so there is no need to coordinate access with Forestry. This road is normally closed to unauthorized vehicle use by both the Blue Lake people and Forestry.

9. Will the 4 1/2" casing be cemented and pressure tested?

The 4 1/2" casing will be set in jell for drilling the core hole. It will not be cemented or pressure tested. It may be desireable to cement it later if we complete the hole for hot water production, but this is not part of our proposal to DOE.

10. Do the State of Oregon regulations require pressure testing of the well head, casing and BOPE at 500 psi or 1000 psi for this hole?

The State of Oregon requires that the surface casing and B.O.P. be tested to 500 psi for a 4,000 foot well.

11. Will daily hydraulic head measurements be made during drilling when possible?

Yes.

12. Explain fully how anticipated lost circulation problems in the upper part of the hole will be handled.

Answered with Question 1.

13. Will BLGC box the core samples and store them in a secure manner until the samples can be transferred to DOE? Explain the manner in which the samples will be secured. Identify the category in which the associated costs have been proposed.

Under the section labeled 4. Methods starting on Page 17 of our proposal, it is explained that we plan to place the core on corrugated fiberglass in a protected core garden. We will log the core and have Dr. Taylor's student log the core. It will be available to DOE and other scientists at the site. We may take a limited number of samples for ourselves and Dr. Taylor, but this will probably be considerably less than the 50% permitted us by the SCAP. We do not plan to box our part of the core. If DOE wishes its half boxed, we would be pleased to do the boxing and labeling, but would expect DOE to furnish its own boxes.

14. The proposal indicates that the access period for data gathering will be a minimum of one month. What is the maximum amount of time the hole will be available to DOE for additional data gathering?

The one month minimum period discussed in Hole Completion and Maintenance was chosen because it is generally recognized in the industry that full temperature stabilization is reached within that time. We expect the observation time to be much longer. However, the expected completion date is mid-November, and if the well has discovered a useable resource, the Blue Lake Resort will wish to start using it as soon as they can get their heating system ready. This is likely to be considerably in excess of one month. Even if the well goes into production, we will wish to continue monitoring flow, temperature and water quality. It is likely that other geophysical measurements could be continued, if coordinated with the production needs. Temperature gradients are, of course, highly disturbed in flowing wells.

If the well fails to find a useable resource, it could remain available for observation for a year or more. With permission from the State of Oregon, it could remain available much longer, but BLGC would expect the requesting organization to accept responsibility for the well after the first year.

In brief BLGC wishes to cooperate fully with any scientific group which is studying the Cascades. However, our financial resources are limited, and other than the data gatheringoutlined in our proposal, these additional studies must be separately financed.

15. Provide the details of the proposed amount estimated for travel, including origins and destination, number and duration of trips, estimated travel and per diem amounts by location.

The estimate of $100 per day for Travel and Per Diem was a conservative estimate to cover $45 for a cabin at the Blue Lake Resort, $30 for food, and $25 average for transportation for each day spent in the field. The transportation will be quite variable, requiring trips to Portland, Salem and Bend which are round trips of 300, 200 and 80 miles respectively. Over the life of the project, the mileage is expected to average over 100 miles per day.

The above estimate was for the purpose of calculating the total amount to be paid to consultants for each stage of the project. On Pages 1 and 2 of Volume II of our proposal, the Consultants, like the driller, will be paid on a turn-key basis as each stage of the work is completed, regardless of his actual time and costs needed to perform his task.

16. Are the individuals proposed as "Consultants" (Project Manager and Project Engineer) subcontracted or employees of the company? If employees, identify their annual salary rates.

The Project Manager and the Project Engineer are to be subcontracted on a turn-key basis for each stage of the project.

17. Identify the total number of hours proposed for each, the Project Manager and the Project Engineer.

Because the Project Manager and the Project Engineer will be on call at all hours of the day or night, their estimated time has been computed at a daily rate of $500. The Project Manager will be at the site on practically a full time basis while drilling or data-gathering is in progress. The Project Engineer will visit the project for planning sessions while the work is in progress and be on call at all times to discuss drilling problems, and if necessary, make unscheduled

trips to the site. In all, it is anticipated that the Project Manager/Geologist will spend about 88 days on the project, and the Project Engineer will spend 16 days. These times and costs are summarized in the Task Budget on Page 8 of Volume II.

18. Provide the basis for the proposed Material Overhead cost rate and for the proposed G&A cost rate using the following format for each.

The Blue Lake Geothermal Company is a general partnership formed to coordinate efforts to drill a deep test at the Blue Lake explosion crater. As explained in Volume II of our proposal, we are prepared to incorporate the company if our proposal is accepted. However, at the moment it is a good-faith agreement between the Coverts, Davidsons and the Hooks who have similar arrangements on other geothermal prospects. As such, Blue Lake Geothermal has no past financial record.

If our proposal is approved, the corporation will be formed and assigned a 75% working interest in 13,600 acres of Federal government leases and lease applications, a $20,000 commitment in lodging fees, site preparation and restoration, and casing costs from the Blue Lake Resort, a yet to be determined amount of financial support from Camp Tamarack, and the sale of 1/6 interests in the project for $100,000 each, not to exceed three such sales.

At the present time we have enough commitment to do the project as proposed. If this proposal is acceptable, we will proceed to incorporate the company and set accounting procedures acceptable to DOE.

19. Provide the details of the amount proposed for plug and abandon costs and for stand-by costs.

The plug and abandon costs and the stand-by costs were verbal bids by the driller which were added as Items E and F to his bid (see Page 7 of Volume II). These additions were made and initialed by John W. Hook.

20. Define the activities anticipated for site restoration.

The activities anticipated for site restoration are described on Page 13 of Volume I:

"9. Site restoration

Site restoration will consist of filling the sump and grading the site back to its nearly level original contours. Given the gravel-like nature of the Blue Lake explosion debris which is the surface formation, this will be a simple and inexpensive task.

It is probable that the owners of the Blue Lake Lodge will wish to have the entire geothermal distribution system buried, including a man-hole cover over the well. This, however, will be their decision and done at their expense. The work proposed under this SCAP is to be limited to the general cleanup and leveling of the drill pad."

To further define this activity, this work will be done with a back-hoe by Gary Lovegren, son of the owner of the tract of land where the hole will actually be drilled, and a co-owner of the Blue Lake Resort. The spoil piles of Blue Lake cinder (the surface formation) which Gary will have placed to one side of the pits during site preparation will be used to refill the pits. Since the pits at this time will have been partially filled with waste cuttings from the well, there will be a surplus of cinder which will be graded over the relatively flat working area. The general clean-up of the area of the well will include taking down the fence around the "core garden" once the core has been removed. The wellhead will be left accessible for logging, testing and completion for production or P & A, as the case may be.

As will be noted in Photo 5 on Page 9a of Volume I, the site is practically clear of vegetation except for a few manzanitta bushes. No revegetation is planned. However, we will leave as much of the existing vegetation, especially the root-stock, as possible to aid the natural reproduction.

If a production well is developed, it will be done by the resort owners in a responsible manner in keeping with the high quality of their other facilities.