

PUNA GEOTHERMAL VENTURE

A Hawaii Partnership

October 31, 1991

Mr. William Paty
Chairman
State Department of Land and Natural
Resources
P.O. Box 621
Honolulu, Hawaii 96801

Dear Mr. Paty:

Re: Puna Geothermal Venture (PGV) Plan of Operations

Thank you for your letter dated October 4, 1991, restating the intent of the Geothermal Management Plan, Element I, "Changes in PGV's Drilling Procedures and Supervision."

The attached response addresses all the points raised in your letter using the same numerical system found in your October 4, 1991 letter. PGV feels this response fulfills the Element I requirement of the Geothermal Management Plan.

In addition to addressing the Geothermal Management Plan, PGV requests this submittal also be considered as a formal amendment to the PGV Plan of Operations.

On October 24, 1991, PGV submitted a proposed amendment to the Plan of Operations that included a (1) drilling sequence and schedule; and (2) geologic modeling of the PGV geothermal resource which includes the requested injection strategy.

PGV anticipates the submittal of the following applications or documentation to your office:

1. Revised noise plan.
2. Revision to the October 2, 1991, amendment to the Plan of Operations. The revision will address and incorporate the recommendations found in Element I of the Geothermal Management Plan.
3. Testing program for KS-8 well.

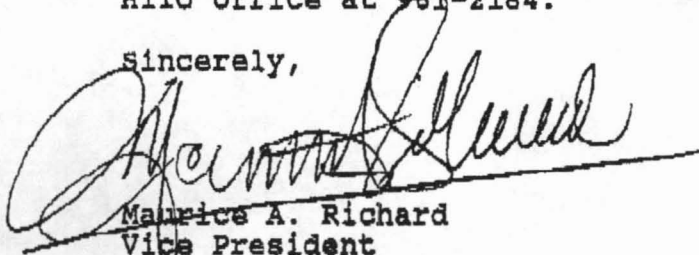
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4. Injection program and casing integrity program for KS-1A well.
5. Well modification and testing procedures for KS-3 well.
6. Drilling program and testing program for KS-4 well.

If there are any questions, please feel free to contact me in the Hilo office at 951-2184.

Sincerely,



Maurice A. Richard
Vice President
Funa Geothermal Venture

Attachment

cc:

B. Anderson, DOH
M. Tagamori, DLNR

PUNA GEOTHERMAL VENTURE
RESPONSE TO GEOTHERMAL MANAGEMENT PLAN
ELEMENT I

1. The driller will be the supervisor on the rig floor during all drilling operations. The contractor's supervisor will be on the floor during all crew changes to ensure continuity of floor supervision. During critical operations, the contractor's and/or operator's supervisor will also be on the rig floor. The driller has available direct communications with both the contractor's and the operator's supervisors. The driller will have additional supervision anytime he needs it or sees a condition that may require more attention.

PGV will have two drilling supervisors assigned working an equal time schedule. The drilling contractor will provide an additional mechanic/electrician to relieve the rig supervisors from some of the duties they have been responsible for. The contractors rig supervisors also work an equal time schedule and do not work more than three days in a row. These changes will allow the supervisors to provide closer supervision.

The IADC Tour Sheet will be signed daily by the three drillers on shift, the contractor's supervisor and the operator's supervisor. Copies of the tour sheets will be sent to the Department of Land and Natural Resources (DLNR). DLNR representatives are free to check the rig floor at any time by informing the contractor's and operator's supervisor that they are going to the floor.

2. Periodic blowout prevention drills will be conducted and noted in the IADC tour reports. All personnel will receive training in BOPE operations. DLNR field personnel will be informed of the dates and times of this training and may participate in the training. Training shall consist of providing copies of the University of Texas Petroleum Extension Service, Blowout Prevention Manual. The manual will be discussed during safety meetings with the operator's supervisor. Tests will be given to all personnel to ensure that the material is understood.
3. All tool pushers, drillers, and derrickmen will be trained in the use of monitoring equipment, and this training will be noted in the IADC tour reports. DLNR field personnel will be informed of the dates and times of this training and may participate in the training. Training shall consist of informal classes in the use of the Drillers Assistant Monitoring System by TECTON GEOLOGIC personnel using the Operators Manual which will be distributed. The class will

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cover equipment specifications and operating instructions. Tests will be given to ensure that the material is understood. The class will be given periodically as part of pre-spud operations.

4. All supervisory drilling personnel will be trained to understand the implications of changes in subsurface conditions, such as pit level changes, pump pressure changes and rate of penetration indicated by the monitoring equipment. This training will be noted in the IADC tour reports. DLNR field personnel will be informed of the dates and times of this training and may participate in the training. Training shall be included in the TECTON GEOLOGICAL Class on monitoring equipment operations. The significance of the surface changes on subsurface conditions will be discussed. The possible subsurface causes of the surface changes and their significance in the drilling operations will be pointed out.

PGV will provide a Well Control School tailored to geothermal drilling conditions for all supervisory personnel. This school will be similar to the Well Control Course for MMS Certification and will include:

1. Pressure/Pressure Gradient, 2. Well Kicks, 3. Shut-In Procedures, 4. Circulating Out-Kicks, 5. Equipment, 6. Well Design, 7. Special Operations, 8. Common Mistakes in Well Control, and 9. Organizing and Directing Well Control.

5. PGV has establish reporting criteria for subsurface conditions (attached) and will instruct all drilling personnel to communicate significant changes in subsurface conditions to supervisors. Examples of some of these conditions are: 1. Trip Gas/Bottoms-Up Vapor, 2. Mud Pit Level Changes, 3. Flow Line Temperature Changes, 4. Rate of Penetration Changes, 5. Pump Pressure Changes, 6. Gas Detection, 7. Mud Property Changes, 8. Formation Changes, and 9. Bottom Hole Temperature Changes. When changes in subsurface conditions will significantly affect the drilling procedure or casing program, the DLNR field representative will be informed by the operator's supervisor.

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6. PGV will henceforth take a conservative, flexible approach to casing the well above 2,000 feet. Drilling and casing programs will be submitted for approval on a well by well basis. Any changes will be made and approved as set forth in point 10.
7. When drilling below 500 feet without BOPE, PGV will:
 - a. Run maximum reading thermometers at each stand drilled looking for increases in thermal gradient.
 - b. Take a representative water sample and have it analyzed as soon as possible to determine salinity and conductivity.
 - c. Catch 10 foot samples and analyze them for hydrothermal alteration when there are returns to surface. We will attempt to maintain returns whenever possible.
 - d. Monitor circulating fluid returns for abnormal increase in salinity, conductivity, or chloride content.
 - e. If it appears that a geothermal zone is to be encountered, secure DLNR approval, run casing, cement, and rig up BOPE.
8. PGV will:
 - a. Install a large relief valve from the 13-5/8-inch BOPE stack.
 - b. Install a low-pressure burst plate in the flow relief line (to divert the flow).
 - c. Include an additional double-gate preventer in the 13-5/8-inch BOPE stack with variable pipe rams.
 - d. Install a muffler on the large diverter line,
 - e. Equip mud pumps with the maximum appropriate sized pump liners.
 - f. Provide an adequate cool water supply on site to control the well.
 - g. Provide a larger, more efficient mud cooler. The more efficient mud cooler will provide up to 50% more cooling when the mud flowline temperature is in the 125°F to 150°F range. PGV may use two coolers if PGV encounters mud temperatures that indicate the need for two coolers.

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- h. Drilling personnel and supervisors will be provided with monitors of drilling functions and conditions. The monitors will include an alarm system. The monitoring system will include the following functions: 1. Hydrogen sulfide levels, 2. Pump pressure, 3. Rotary table torque, 4. Rate of penetration, 5. Weight on bit, and 6. Pit volume.
9. PGV acknowledges that the Department of Land and Natural Resources is now the lead State regulatory agency with regard to oversight and control of both production and injection wells. Plans and modifications for the drilling of all currently permitted and any future proposed geothermal wells will be revised in accordance with these plan amendments, and will be directed to the Department of Land and Natural Resources for approval before any operations take place.
10. The following mechanism is proposed whereby PGV may propose and the Department of Land and Natural Resources may approve, on-site modifications to casing programs or drilling operations.
- PGV supervisors will discuss on-site modifications to casing or drilling operations with the DLNR field representative. After these discussions, the DLNR field representative will contact his supervisor and provide a detailed explanation of the proposed changes. After discussions with his supervisor, the DLNR field representative and/or his immediate supervisor shall have the authority to provide PGV with a verbal approval immediately for any modifications. PGV will submit a written sundry notice of the approved changes as soon as possible.
11. PGV has provided DLNR with Appendix B (Revised) as a generic development well drilling program. It is acknowledged, however, that specific revised casing programs will be provided for each well, for those already permitted and for those proposed to be drilled, based on total knowledge accumulated on all the wells.

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12. The first confidential report will be made available to DLNR before December 31, 1991, and shall contain a comparison and analysis of differences between PGV's earlier conceptual geologic model. The model will be updated to DLNR when it is significantly modified.

Further, PGV will ensure that the Plan of Operations Appendix "B", Development Well Drilling Program, conforms to the recommendations of the Independent Technical Investigation, Element I. This will be done by including the following changes in Appendix "B":

- A) Page 2 - Blowout Prevention Equipment (20-inch BOPE)
17-1/2-inch hole (Figure 5A, 5B, and 5C)

Blowout prevention equipment to drill a 17-1/2-inch hole should consist of a minimum of a 21-1/4-inch - 2M annular preventer and diverter system as per Figure 5A. This configuration would be used for cases where the 20-inch shoe is set shallow in unconsolidated formation. When the shoe is set deeper in more competent formation a double-gate preventer, choke line and kill line will be added as per Figure 5B. The diverter line will be eliminated when the casing shoe is set into very competent formation at a depth which will provide control any pressure encountered, as shown in Figure 5C. The determination of which BOPE configuration to use will be dependent on the formation and casing depth and made with the approval of DLNR. Test BOPE per ...

- B) Page 3 - Blowout Prevention Equipment
(9-5/8-inch BOPE) 8-1/2-inch hole (Figure 7)

(Line 5) box with a valve on the side outlet (and a single-gate preventer as required by conditions), a rotating head ...

(Line 7) 24 hours prior to testing. Install blooie line and muffler. Install hydrogen sulfide ...

(Add to above paragraph) Provisions will be made to abate any well flow from the choke line or the blooie line.

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DRILLING REPORTING CRITERIA

- a. The Drilling Supervisor shall report to the PGV Drilling Engineer or his designated relief on the day to day operations.
- b. As closely as possible, the Drilling supervisor will follow the drilling program for a particular well as provided by the Drilling Engineer. There will be changes in the drilling program as the well progresses and these changes must be discussed with the Drilling Engineer before action is taken.
- c. Approximate casing setting depth will be set in the Drilling Program with assistance from the Geologist. These depths should be used absent other information. A mud program will be outlined in the Drilling Program and this program should be followed as closely as possible. The Drilling Supervisor shall have ample latitude to change the mud program as dictated by actual drilling conditions.
- d. Historical drilling data have been developed regarding the PUNA GEOTHERMAL PROJECT and this data should be used to advantage in drilling wells within the project.
- e. In and out mud temperatures and maximum recording temperatures will be logged on the IADC tour sheet.
- f. When drilling below the 13 3/8-inch casing shoe, special precautions must be taken when encountering any lost circulation zones or drilling brakes.
- g. If a drilling break is encountered when drilling, the Kelly should be picked up and bottoms up should be circulated around. The PGV Drilling Supervisor should be immediately notified along with the contractor's supervisor. A temperature survey should be run whenever a drilling break is encountered. An interpretation of the survey should be made by the Drilling Engineer before drilling further. It is important not to drill ahead with excessive temperature in the mud returns.

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- h. The driller should also note in the IADC Tour report of any gains or losses in mud pit volume. Any significant mud loss should be reported to the PGV and the contractors supervisors. If any continuous or significant mud volume gain is encountered, the driller should pick up the kelly and check for flow and notify the supervisors. If flow is observed, the well will be shut in immediately.
- i. Based on past experience in the PUNA GEOTHERMAL PROJECT, it is imperative that constant supervision of the well be accomplished once drilling is undertaken below the 13-3/8-inch casing shoe.
- j. PGV Supervisors will be in charge of all activities on location. PGV Supervisors will report to the PGV Drilling Engineer.
- k. Drilling Supervisors will spend sufficient time together at the rig during change out to exchange information on the current activities. Drilling Supervisors will be on the floor, on the pump truck, in the wireline unit, etc., for all critical operations.
- l. The Drilling Engineer will be responsible for engineering programs with input from the Drilling Supervisors. The Drilling Engineer will also advise and assist the Drilling Supervisors.
- m. Contractor's supervisors will report to the Drilling Supervisor on location. They will also be on the floor during all crew changes.
- n. Drillers and crews will work eight hour shifts. Reporting procedures for crews will be the responsibility of the drilling contractor. Drillers will log all rig operations on the IADC daily tour sheet, including the depths of all work performed. Rig crews will assist service company personnel as directed by the contractor's supervisor.