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Geothermal Programs

**Idaho
Operations
Office**

INEL/Snake River Geothermal Drilling and Testing Plan - INEL - 1 Well

Butte County, Idaho

L.G. Miller
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EG&G
DOE-ID
DOE-ID

December 1978

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INEL/SNAKE RIVER PLAIN GEOTHERMAL DRILLING
AND TESTING PLAN

INEL-1 WELL
Butte County, Idaho

L. G. Miller,
EG&G Idaho, Inc.

and

J. L. Griffith, S. M. Prestwich
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1. INTRODUCTION

1.1 Background

Geologists have described the Snake River Plain (SRP) in terms of the tectonic plate theory. They see the plain as an area where two plates have been separating with the present spreading apex near Yellowstone National Park. This theory has been in part responsible for predictions that extensive geothermal resources are located beneath the plain; if the tectonic theory is correct, the earth's cool crust would be pulled thin beneath the plain, leaving very hot rock relatively near the surface. As yet, however no exploratory holes have been drilled beneath the thick deposits of basalt that cover the plain. The theory and the resources are unconfirmed.

As the population of the northwest region grows, and as the price of heating fuel climbs, the region must plan for future sources of energy. The existence of geothermal resources must be verified. At the Idaho National Engineering Laboratory (INEL), as well as in private homes and businesses throughout the Snake River Plain, geothermal heating could replace the use of oil and natural gas. If researchers can find resources hotter than about 150°C (and there is every indication that they will), then the geothermal energy can also be used to produce electricity.

The INEL must convert from oil to an alternate fuel within the next five years. The heat load required by the Idaho Chemical Processing Plant (ICPP) is currently being evaluated by Allied Chemical, and by subcontractors such as Facilities System Engineering Corp. The evaluations indicate that a coal-fired plant to supply this heat load would require a capital investment of about \$24 million.^(a) In addition, the INEL would have to compete with other consumers for available coal supplies, and need to develop the ability to handle coal.

If geothermal resources can be tapped for this use, production wells near ICPP could supply the facility's requirements. Six wells could supply most of the space heating and process heat needed by the remainder of the INEL. Six or more wells could be drilled and the heating systems could be converted for a cost of less than \$24 million and the system would cost much less to operate than most conventional systems.

Until the first hole is drilled, however, we can only speculate about the geothermal potential under the SRP. This proposal describes the plan for drilling a 7,500 ft (2300-meter) exploratory hole.

^(a)Based on latest projections of \$1000/KW, including scrubbers, for on-line power plants in 1983.

the hole would be drilled on the INEL, so that it could be immediately utilized by one of the government facilities. The plan details the hole design, describes the drilling program, proposes a testing program, and estimates costs. It is proposed that the exploratory hole be drilled as a joint venture by DOE, the USGS, and the State of Idaho. It is proposed that the drilling would begin late in January, 1979. The well drilling, coring, logging and hydrologic testing would be funded mainly by DOE. Some funding was necessary in FY-78 fiscal year to purchase materials and construct sites. Drilling and testing time is estimated to be 120 days, though problems would increase the required time.

1.2 Program Objectives

The proposed drilling and testing program has been designed to meet the following objectives:

1. To verify the existence of a geothermal resource, and determine its characteristics, and estimate its ability to produce geothermal fluids;
2. To generate a lithologic log and define the thicknesses of aquifers, the permeability of the subsurface rocks, and the mineral content of the water in the various zones. This information is also important to the continuing waste-storage and waste-monitoring activities at the INEL.

To meet these objectives, the drilling and testing program has built-in flexibility; planners have anticipated the many problems crews can encounter while drilling volcanics.

To better ensure the achievement of the above goals, certain parameters have been selected:

1. The drill-rig selection will allow the hole to be drilled to 10,000', if necessary, and allow crews to run and cement casing to 5,000'. This parameter will allow flexibility should lithology, temperature, or geothermal fluid flow indicate a need for further drilling;
2. The intermediate casing string (the casing from ground level to about 3,500 ft (1100 m) will be 13-3/8 in (34 cm). By starting with the large-diameter casing at the surface, more uncontrollable-loss-circulation zones can be cased out while ending up with a bottom diameter sufficient for producing geothermal fluid;
3. Each liner will be hung from the previous casing string, using a fluted hanger that will allow remedial cementing from the top if the initial cement job fails;

4. Drill-stem hydrologic tests will be conducted periodically, as requested by the USGS, to provide permeability and water-chemistry data.

1.3 Program Description

The INEL-1 exploratory hole will be located on the eastern Snake River Plain in southeastern Idaho (see Figures 1, 2, and 3). The hole will be located near the Idaho Chemical Processing Plant, so that if the hole produces geothermal fluid the fluid can be used at the ICPP and other INEL facilities. The geological and hydrological data from this area will also benefit the INEL's Waste Management Program. The actual location of the 7,500 ft (2,300 m) hole was selected after considerable surface geophysical testing and coring and logging tests at two core holes located 14 m (23 km) south and 17 m (27 km) north of the ICPP. DOE-ID, EG&G, and the USGS together selected the final location. At the request of DOE-ID, Fenix and Scisson (F&S), an operating contractor of DOE/NV will provide the technical direction and supervision for drilling INEL-1. EG&G Idaho, Inc., will provide various support services and administer all drilling service subcontracts except the contract for the drilling rig which will be a DOE-ID prime contract.

A rat-hole driller will be subcontracted for drilling, running, and cementing the 30 in. (76 cm) conductor pipe to a depth of 40 ft (12 m). The drilling of the exploratory hole will require the services of a drilling contractor with a rig capable of drilling and casing as proposed. Appendix C shows a schedule of major activities. First, using conventional drilling methods, crews will drill a 26 in. (66 cm) hole to 1500 ft (460 m). A 20 in. (50 cm) casing will then be run to total depth and cemented to the surface. Next, a 17-1/2 in. (44 cm) intermediate hole will be drilled below the 20 in. (50 cm) casing to approximately 3500 ft (1100 m). Thirteen and three eights in. (34 cm) (OD) casing will then be run to total depth and cemented to the surface. Below the 13-3/8 in. (34 cm) casing shoe, a 12-1/4 in. (31 cm) hole will be drilled to approximately 5000 ft (1500 m). A 9-5/8 in. (25 cm) (OD) casing liner will be run; it will be hung from 200 ft (60 m) above the 13-3/8 in. (34 cm) shoe to total depth, and it will be cemented from total depth to the casing hanger. An 8-3/4 in. (22 cm) hole will be drilled below this liner, to the total depth of approximately 7500 ft (2300 m).

Fig. 1 Location of the INEL

IDAHO'S GEOTHERMAL ENERGY

IDENTIFIED HOT SPRINGS

Fig. 2 Detail of eastern Snake River Plain

Fig. 3 Area where INEL-1 will be located

2. GENERAL SITE ACTIVITIES

2.1 Site Preparation

The drilling will take place on a drill pad 500 ft by 500 ft (150 meters square) (see Figure 4). EG&G will subcontract and provide necessary site preparation as follows:

1. Level and compact the drill pad and surface with run-of-bank gravel.
2. Excavate the mud-reserve pit and stabilize slopes.
3. Construct a concrete-lined cellar 8 x 10 x 10 ft (2.4 x 3.0 x 3.0 meters).
4. Drill, run, and cement a 30 in. (76 centimeter) conductor pipe to 40 ft (12 meters).
5. Provide an access road.
6. Provide for site and access-road maintenance.

2.2 Trailers

One combination living and office trailer will be available on site for EG&G and DOE/ID personnel. An additional trailer, living and office, will be provided by EG&G to accommodate the F&S drilling supervisor and DOE/NV personnel. Trailers will be connected to a common septic tank and drain field. Additional trailers are anticipated to be provided by mud logging and drilling contractors for their personnel.

2.3 Communications

EG&G will provide a minimum of four telephone lines at the drill site. Two lines will be located in the EG&G trailer, one will be installed in the F&S drilling supervisor's trailer and one will be installed in the drilling contractors trailer. A radio base station tied into one of the INEL nets will be provided in the F&S trailer.

2.4 Power

EG&G will provide the site and the drilling subcontractor with power from existing INEL sources. Distribution and connection of power to site trailers, pumps, and other facilities will be provided by EG&G as required. Four daylight sensitive flood lamps will also be supplied.

NOTE: Some dimensions and equipment locations may be different depending upon the drill rig requirements.

TYPICAL SITE LAYOUT

Fig. 4 Drill-site layout for INEL-1

2.5 Site Cleanup and Restoration

When the drilling is complete, the drilling contractor will remove the drill rig and all rig-associated materials. EG&G will dispose of drilling fluids, backfill and mud reserve pit, and dress and restore the pad. If the hole is unsuccessful as a geothermal source, it will be prepared as indicated in Appendix E. The site will be prepared to meet the needs of future testing and logging. If the hole is a successful geothermal fluid source, the site will be prepared as indicated in Appendix F.

2.6 Drilling Water

EG&G will provide drilling water.

2.7 Potable Water

EG&G will provide potable drinking water to all trailers.

2.8 Vehicles

EG&G will provide vehicles for the drilling supervisor. Vehicles will be made available to NV operations personnel when required.

2.9 General Operational and Logistics Support

EG&G will provide the following general logistics support:

1. Crafts personnel (except for drilling and associated work) from INEL craft shops.
2. Clerical staff.
3. Office supplies.

2.10 Reproduction Machine

EG&G will deliver a copier to the EG&G office trailer.

2.11 Trailer, Site, and Road Maintenance

Trailer, site, and road maintenance will be provided by EG&G, INEL craft shop personnel.

3. OCCUPATIONAL HEALTH AND SAFETY

3.1 General

All drilling operations and other site activities will be conducted in accordance with the Occupational Safety and Health Act of 1970 (OSHA), including record-keeping and reporting responsibilities. EG&G Idaho will see that all service contractors observe the OSHA Standards of Safety.

The subcontractor will take all reasonable precautions in the performance of the work under this subcontract to protect the safety and health of employees and of members of the public, and will comply with all safety and health regulations and requirements (including reporting requirements) of DOE and the contractor. In the event that the subcontractor fails to comply with said regulations or requirements of DOE and the contractor, the contractor may, without prejudice to any other legal or contractual rights of DOE and the contractor, issue an order stopping all or any part of the work; thereafter, a start order for resumption of work may be issued at the discretion of the contractor. The subcontractor will make no claim for extension of time or for compensation or damages by reason of or in connection with such work stoppage.

The Occupational Safety and Health Act (OSHA) record-keeping requirements require each employer to maintain certain records at the establishment ("establishment" is defined as the location where personnel report to work). It also provides that the prime contractor, as employer, shall have the responsibility for preparing and maintaining the OSHA Log 100 or 200 for all his and his subcontractor's reportable experience, and for submitting prescribed quarterly reports and attachments in duplicate.

Therefore, the subcontractor will prepare consolidated Form DOE-102A and Form DOE-102B according to instructions, and will furnish the forms with appropriate attachments to EG&G, in duplicate, not later than the seventh of the month following the end of each calendar quarter. Form DOE-101, or ID-13 prepared for each injury or illness recorded on OSHA Log Form 100 (pursuant to 29 CFR 1904), and Form DOE-283, for property damage or loss in excess of \$1,000.00, if applicable, will be submitted to EG&G quarterly, in duplicate, as attachments to Form DOE-102A and Form DOE-102B.

All participating organizations are also responsible for protecting the health and safety of their own personnel, and for conducting all activities in accordance with procedures that ensure:

1. That employees have a safe and healthful environment.
2. That hazards to the public and to personnel or other participants are controlled and minimized.

3. That the accidental damage or loss of equipment, materials, and property is minimized.
4. That its employees, particularly the employees designated to work on this subcontract, are covered by Idaho Workman's Compensation provisions, and further agrees that upon request of the contractor, the subcontractor will furnish evidence satisfactory to the contractor of such coverage. The subcontractor further agrees that if the contractor should legally incur any costs whatsoever under the Idaho Workman's Compensation Laws by reason of the subcontractor's employees' injury or death while engaged in the subcontract work, the subcontractor will indemnify and hold harmless the contractor for such costs which the contractor may legally be required to pay to the employees of the subcontractor.

3.2 Site Access

Because of nuclear security and radiation hazards at INEL, access to the drill site will be controlled by the DOE security force. All contractor, subcontractor, and service-company personnel will obtain clearances and badges as required by DOE security regulations.

3.3 Fire Protection

Hand-operated fire extinguishers will be provided for the drill rig and other surface equipment. Extinguishers suitable for the control for Class A, B, and C fires will be available as appropriate. Full-time, manned, fire-fighting equipment will be available within six miles of the drill site. It can be summoned by dialing the telephone number 6-2211.

3.4 Industrial Hygiene

Portable water-and-chemical or standard toilets will be provided by the drilling contractor at all areas where personnel are stationed on a full-time basis. The chemical toilets will be serviced on a regular basis. Solid wastes will be disposed of in accordance with legal regulations, in a manner that will avoid creating a health hazard, insect or rodent habitat, or polluting the environment.

3.5 First-Aid

First-aid kits will be available at all times in the EG&G office trailer. A registered nurse will be available full time at the Central Facilities area about six miles away. The nurse can be contacted by dialing telephone number 6-2356. Ambulance service will be available at the same location; it can be summoned by dialing telephone number 6-2211. All accidents and injuries shall be reported immediately to the EG&G drill-site manager, field operations manager or his alternate.

They will in turn notify the proper people, in accordance with reporting requirements. WCC telephone 6-1515 must be notified of any injury that required off-site medical treatment.

3.6 Drilling Safety and Health Requirements

Following is a list of the most significant items pertaining to safety and health in this drilling operation. Those items marked with an asterisk (*) will apply only if air drilling is attempted:

1. All engines will be equipped with vapor and/or explosion-resistant or explosion-proof ignition systems.
2. All rig lighting will be vapor and/or explosion proof. The wellheads, blowout preventers (BOPs), and cellar will be illuminated with floodlights located as far away as possible while maintaining proper illumination.
3. The rig pumps will be connected to the stand pipe and wellhead at all times, with the pits or tanks filled with appropriate mud or water. The fluid will be sufficient to fill the well bore and it will be ready for immediate use at any time.
4. The tool joints and the kelly drive bushing will be kept well doped.
5. The passageways from the rig floor will be sufficient to provide emergency escape for all personnel. These passageways will be kept open and clear at all times.
6. A sufficient amount of fire-protection equipment will be on hand.
- *7. Signs will be posted at each approach to the location, 60 meters from the rig, warning that air drilling is in progress. The signs will be illuminated during night drilling activities.
8. Automotive equipment will be parked at a designated, safe distance from rig.
9. The BOPs will be checked for condition and for proper pressure rating, height, and bore. No rusted, pitted, dented, or bent ring gasket will be used. Blind rams will be cycled every trip, and pipe rams every tour. Sealing elements will be inspected for heat damage or abrasion after every trip.
10. All valves on the choke manifold will be full-opening, steel-flanged valves. They will be checked before installation for working condition, and checked periodically for operating condition.

11. The choke manifold will be constructed so that the chokes can be changed without shutting in the flow.
12. Water nozzles may be installed, so that cooling water can be sprayed on the BOP stack to control temperatures and to help preserve the rubber elements in the event that circulating temperatures become excessive.
13. The hydraulic BOPs will be equipped with two control stations- one near the driller's position and the other at a safe distance from well - with all lines and connections made of high-pressure steel or approved piping.
14. The BOP accumulator will be located a safe distance from the well. It will be large enough to close off all of the hydraulically operated equipment when the pumps are off, and have a minimum of 7,000 kilopascals (1,000 psi) remaining in the accumulator.
15. All BOPs and lines with fluid pressure will be checked before drilling, and any leaks will be corrected.
16. Floats will be used in the drilling string, and they will be checked each trip.
- *17. The air compressors will be inspected and equipped with all normal safety features.
18. Crew members will receive instruction in the use of BOPs, choke controls, etc. Drills will be held at least once a week to ensure all crew members are familiar with their assigned duties in a well-control situation.
19. Provisions will be made for derrick men to escape by using a wire line and a non-spark buggy.
20. When toxic materials are used, authorized personnel only will handle the materials and safety equipment will be specified.
- *21. Crews will be instructed in proper operation of all valves in the air-supply system in case of emergency.
- *22. One crew member will be designated to shut off the valve on the air-supply system in case of emergency.
- *23. Personnel are to stay clear of the discharge from the blooie line, due to the hazards of dust, steam, and hot water.
- *24. Care must be exercised in collecting samples, due to associated hazards.

- *25. Welding is not to be permitted on the rig during air drilling operations. If welding is required, circulation must be stopped and lines purged with water. Welding on casing lines and materials subject to high pressures will be performed by certified welders.
- 26. Drill-rig personnel will be instructed in the proper use of all DOE-supplied respiratory-protection devices. The instruction will be given by the EG&G Safety Division Training Section.
- 27. Hard hats and safety shoes will be worn by all personnel within the immediate rig vicinity. Safety glasses will be worn by all personnel on the drilling platform. Ear protection will be used to assure safety commensurate with measured noise levels.
- 28. Good housekeeping practices are essential to a safe operation and must be followed at all times.
- 29. The well-drilling contractor must have an emergency action plan for this particular job. It will be designed to cope with actual or potential conditions which adversely affect or threaten the health and safety of his employees or the general public, or damage public or private property. The written plan will outline the responsibilities and document the provisions necessary to implement actions. The plan must appropriately match and supplement the overall INEL emergency-action plan.

4. DRILLING OPERATIONS

4.1 General

The site will be prepared as outlined in Section 2 prior to moving in the drilling rig (Figure 4). Included in site preparation will be the construction of a 8 x 10 x 10 ft (2.4 x 3.0 x 3.0 meter) deep cellar (see Figure 5). A 30 in. (76 centimeter) conductor will be set at a depth of 40 ft (12 meters). The drilling rig will be set on the drill site, properly centered over the conductor hole, and leveled prior to spudding. Certification that the proper inspections have been made within 30 days just prior to mobilization shall be furnished to the Contracting Officer. All drill pipe and drill collars will be visually inspected on location before they are picked up and used in the drilling operation. No drill pipe which does not meet API Grade No. 2 (Grade E or better) will be used in the drilling operation. Figures 6 and 7 show the BOP stack arrangements used during drilling operations above 3500 ft (1100 meters) and below 3500 ft (1100 meters) respectively.

4.2 Formations

Drilling operations are likely to encounter the following formations at the indicated depths:

<u>Formation</u>	<u>Depth</u>
Basalt	0 to 6000 <u>+</u> ft (0 to 1800 m)
Rhyolite & Tertiary Sediments	6000 - 7000 <u>+</u> ft (1800 to 2100 m)
Basement (?)	7000 ft - ? (2100 to ?m)

Figure 8, based on a USGS seismic profile, provides supplementary information.

4.3 Surface Hole

A 26 in. (66 centimeter) hole will be drilled to 1500 ft (460 meters) with conventional drilling methods. There are four minimum requirements:

1. 8 in. drill collars, 80,000 lb
2. Two pumps: one 1,000 HP input pump and one 700 HP input pump.
3. Rotary table (27-1/2 in) sized to pass 26 in. (66 centimeter) bits.
4. Casing load, 133 M lb (63,000 kilograms); setback load, 89 M lb (40,000 kilograms).

Fig. 5 Concrete cellar construction detail

Fig. 6 -BOP FOR DRILLING BELOW THE 20-INCH CASING SHOE

Fig. 7 - BOP FOR DRILLING BELOW THE 13-3/8" CASING SHOE

Fig. 8 USGS Bouguer gravity profile

This hole will be drilled with gel and lime, to ensure enough viscosity to clean the hole during the drilling operation. Upon completion of the drilling, 20 in. (50 centimeter) surface casing will be run to TD and cemented to surface (through the drill pipe in a continuous operation). The 20" casing is designed as follows, 500 ft 20 in., H40 64-lb/ft, 8-Rd ST&C, and 1000 ft K55, 133 lb/ft 8 Rd, ST&C.

4.4 Intermediate Hole

A 17-1/2 in. (44-centimeter) hole will be drilled below the 20 in. (50 centimeter) casing, to a depth of 3,500 ft (1,100 meters). There are three minimum requirements:

1. 8 in. drill collars, 80,000 lb
2. Two pumps with combined output of 1200 gpm (76 l/sec) at 2200 psi (10,000 kilopascals)
3. Casing load, 235 M lb (107,000 kilograms); setback load, 138 M lb (63,00 kilograms)

A 17-1/2 in. (44 centimeter) hole will be drilled with a low-solids, nondispersed-gel, chemical-mud system. In the event circulation loss is encountered and cannot be controlled with the addition of lost circulation materials, the hole will be dry-drilled with water. If hole conditions at 1500 ft indicate drilling with water would be more suitable than mud water will be used as the drilling fluid.

The 13-3/8 in. (34 centimeter) casing will be run and cemented to the surface in a single stage. In the event circulation loss will not allow a single-stage cement job, a DV tool will be utilized for a two-stage cement job.

The 13-3/8 inch casing is designed to include thermal stresses for a temperature change of 250°F. 13-3/8 inch OD, P110, 72-lb/ft, 8-RD ST&C, casing drifted for 12-1/4 inch bits will be required.

4.5 Main Hole

A 12-1/4 in. (31 centimeter) hole will be drilled from the 13-3/8 in. (34 centimeter) casing shoe to approximately 5000 ± ft (1500 meters). The drilling fluid will be water. There are three minimum requirements:

1. 8 in. drill collars, 60,000 lb and 25-joints of 5-inch "Hevi-Water" drill pipe
2. Pump output 600 gpm (38 liters per second) at 2000 psi (14,000 kilopascals)

3. Liner load (including D.P.) 281 M lb (127,000 kilograms); setback load, 123 M lb

This hole will be of the conventional geothermal/geopressured design. Zones of interest will be tested as outlined in Section 5 of the plan.

A 9-5/8 in. (25 centimeter) casing liner will be run and cemented from total depth up to 200 ft (60 meters), above the 13-3/8 in. (34 centimeter) casing shoe. Drilling will continue below this liner, with 8-3/4 in. (22 centimeter) bits, to approximately 7500 ± ft (300 meters). It will be necessary to change out drill collars and possibly drill pipe in the 8-3/4 in. (22 centimeter) hole. [Maximum drill-pipe size in 8-3/4 in (22 centimeters) hole will be 5 in. (13 centimeters).].

The 9-5/8" OD casing liner is designed to include thermal stresses for a differential temperature change of 250°F. 9-5/8" OD special drifted 40-lb./ft., S95 LT&C casing will be required.

4.6 Well Equipment

The following equipment will be used as noted:

1. Thirty in. (76 centimeter) conductor pipe will be furnished by the operator, set with a dry-hole digger, and cemented with ready-mix cement prior to moving on the drilling rig.
2. Twenty in. (50 centimeter) (OD) casing will be furnished by the operator and set to 1500 ft (460 meters) in a 26 in (66 centimeter) hole.
3. Thirteen and three-eighths in. (34 centimeter) (OD) casing will be furnished by the operator and set to 3500 ft (1100 meters) in a 17-1/2 in. (44 centimeter) hole.
4. Nine and five-eighths in. (25 centimeter) liner will be furnished by the operator and set to 5,000 ft (1500 meters) in a 12-1/4 in (31 centimeter) hole. Section 4.5 describes casing and drill pipe requirements to set this liner.
5. Figure 9 is a schematic diagram of the wellhead equipment to be installed upon completion of a geothermal resource well. Installation will be supervised by WKM engineer. The 12-inch by 20-inch W-K-M expansion spool will tie the 20-inch surface casing to the 13-3/8-inch casing as shown in the Drawings, Figures 7 and 9.

Fig. 9 Schematic diagram of wellhead equipment to be installed on completed well

4.7 Equipment and Services

4.7.1 Blowout Preventor and Control Manifold. A rotating head, 20 in. (50 centimeter) spherical BOP, and 20 in. (50 centimeter) double-gate BOP will be used for control while drilling the 17-1/2 in. (44 centimeter) surface hole (Figure 6). Upon setting the 13-3/8 in. (34 centimeter) intermediate pipe, a 12 in. (30 centimeter), 3000 lb (20,000 kilopasca) BOP stack consisting of rotating head, spherical annular preventor, two double-gate BOPs, flow spool with drilling spool and a master valve and expansion spool will be installed. Figure 7 is a schematic of this control equipment. Outlets from the BOP stack will be double-valved at the stack and at the control manifold. All valves will be 4 in. (10 centimeter), full-opening 3000 lb working pressure. The choke manifold (Figure 10) will consist of 3 in. double-valved outlets on each side of a cross, with two adjustable chokes for control.

4.7.2 Float and Guide Equipment. The surface casing and intermediate casing will use a conventional float collar and guide shoe with a baffle adapter, which will accept an inter string seal assembly for cementing through drill pipe. This equipment will require manual fill up while running casing.

Float Equipment for the liner will be furnished by the liner-hanger supplier and will consist of a guide shoe, float collar, and latching collar.

4.7.3 Centralizers. Fifty and 20 and 13-3/8 in (34 cm) casing will be centralized with bow-spring centralizers on the shoe joint and second and third collars. Additionally one centralizer will be run on the top of the string inside previous casing string. Bar centralizers will be run on the shoe joint and two additional joints of the 9-5/8 in. (25 cm) liner.

4.8 Support Services

4.8.1 Down-Hole Equipment. The following sizes will be needed for this test hole: 26, 17-1/2, 12-1/4, and 8-3/4 in. (66, 44, 31 and 22 cm) standard bits, conventional to the drilling industry, will be used. These bits will be provided by the supply companies that service the drilling industry. The bits will be provided through standard RFQ procedures.

It will be necessary to incorporate reamers and stabilizers in the drill string near the bit to maintain proper hole size and to control deviation. These reamers and stabilizers will be provided through standard RFQ procedures, by the supply companies that serve the drilling industry. The drilling supervisor at the drill site will determine the selection of the tools to be used and their placement in the drill string.

- 13 sets of 2"-900 lb. Flange Bolts and Nuts
- 2 sets of 2"-1500 lb. Flange Bolts and Nuts
- 4 R-57 Ring Gaskets
- 13 R-31 Ring Gaskets
- 2 R-24 Ring Gaskets
- 3 2"-3000 lb. x 2" Threaded Flanges
- 1 2" Hi-Pressure Bull Plug W/1/2" Side Opening
- 1 5000 lb. Gauge
- 1 2"-3000 lb. Ball Choke
- 1 1/2" Needle Valve

Fig. 10 - Choke Manifold Assembly

A 6-3/4 in. (17 cm) (OD) core barrel with a 4 in. (10 cm) inter barrel 30 ft (9 m) in length will be used for all coring on the project. Core bits 7-7/8 in OD by 4 in ID (20 cm OD by 10 cm ID will be provided by the supply companies that serve the drilling industry. The core barrel and service man will be included in the quotation.

Tools and services for drill-stem testing as outlined in the drilling procedure will be provided by service companies through RFQ procedures. Additional services associated with the drilling and testing operation outlined herein will be provided by service or supply companies which serve the drilling industry, either through RFQ procedure or by purchase order.

4.8.2 Drilling Fluids. The drilling fluid used for the surface hole, for depths of from 12 to 460 m (40 to 1500 ft) will consist of gel water and lime. This will provide viscosity to carry drill cuttings and suspend solids when not circulating. It will be necessary to maintain a high-viscosity fluid in this large-diameter hole - 26 in. (66 cm), because of a low annular velocity during the drilling operation.

The drilling fluid to be used for the intermediate hole, at depths of from 1500 to 3500 ft (460 to 1200 m) will be a low-solids, nondispersed system using gel, bentonite extenders, and caustic soda. Additional materials for flocculating drilling solids will be used. This fluid is designed to provide good drill-solids carrying capacity while having fluid properties that allow maximum rates of penetration. In the event of extreme lost circulation which cannot be controlled with lost-circulation material, the hole should be dry-drilled with water. Should water be used as a drilling fluid for this hole interval, high viscosity sweeps will be considered for hole cleaning.

Water will be used for drilling the hole at depths of from 3500 to 7500 ft (1100 to 2300 m). The hole may be drilled with water circulated through the reserve pit, if the hole will stand-up, and if sufficient water is available and ambient temperatures permit. Corrosion inhibitors and high-viscosity sweeps will be used as necessary for hole cleaning and pipe protection.

As an alternate plan if extreme hole troubles are encountered, it may be considered that a low solids non-dispersed mud be circulated thru the steel mud pit system. Mud specifications should be approximately as follows:

Viscosity - 35 to 40 - sec/qt

Weight - 9.0-lb/gal or less if possible

PV - 10 to 12

YP - 3 to 6

Wtr. Loss - 20-cc or less

The above low solids non-dispersed mud should handle temperatures up to 300°F. Above 300°F, a mud using a surfactant with a lignite should be stable up to approximately 450°F.

4.8.3 Mud Logger and Detection Equipment. A mud-logging unit will be used from conductor-hole depths to total depth. The mud logger will prepare three sets of samples, washed and dried, along with a sample description log. A mud logging unit will contain hydrocarbon detectors and a calorimeter for hydrocarbon analysis.

At 1500 ft (460 m) the mud logger will install hydrogen sulfide detectors in the flow line and under the floor, along with H₂S alarm systems. These detectors should have a sensitivity in the range of 0 to 20 parts per million, with alarm setting at 5 parts per million to provide maximum safety for working personnel at the drill site.

Additional detection equipment will also be used. Pit volume totalizers and a flow-line sensor will be installed at 1500 ft (460 m) and will remain in operation to total depth. This equipment will have readout gauges at the drillers console and recording gauges in the doghouse. This equipment will be sensitive enough to detect a minimum of 5% flow-line-rate change, or a 5-barrel pit-level change. An alarm system independent of the H₂S alarm will be an integral part of this system.

4.8.4 Cement and Cementing Services. The following cement program incorporates many of the cement techniques in geothermal cementing defined in a recent DOE funded study. See Table 1, Cementing Program.

Prior to cementing a string of casing at any of the designated intervals, cement tests should be run with the cements to be used and the waters with which they will be mixed. Laboratory tests matching bottom-hole temperatures and pressures should be simulated.

In the event that during the cementing operation the cementing-design requirements have not been met, alternative cementing procedures will be required. If improper fill-up occurs and the top of the cement is near surface, remedial cementing through the casing head down the annulus should be considered. If fillup and formations prohibit the "top job" method then squeeze cementing in the 20 and 13-3/8 in. (50 and 34 cm) casing strings should be performed through perforations below a sliding-sleeve, drillable cement retainer. Squeeze cementing on the 9-5/8 in. (25 cm) liner may require squeezing on top of or inside the liner. These specific conditions can only be determined after detailed information concerning the failure is evaluated.

4.9 Casing Program

The casing program is summarized with the following information.

TABLE I

CEMENTING PROGRAM

1. 30 inch conductor will be set at + 40 feet and cemented to the bottom of an 8 foot deep concrete cellar.
2. 20 inch 500' H-40 94 lb/ft ST&C and 1,000', 133 lb/ft, K-55, ST&C, 8-RD.THD casing will be set at + 1,500 feet.

Casing Equipment:

A 20 inch tag-in float collar, one joint above the cement jet-float shoe with one centralizer on each of the bottom two joints and then one every third collar to the surface. High temperature thread dope will be used on all pipe joints. Tack weld three one inch beads both top and bottom of each collar on the bottom three joints.

Cement Slurry:

Any API class (low cost) cement may be used at a depth of 1,500 feet if temperatures are not above normal. Cement, 1:1 Perlite by volume, 40% fine silica flour, 3% gel. Friction reducer and retarder to be determined by hole temperature. Approximately 100% water by weight. Approximate weight 13 lbs/gal. Cement volume will be determined from caliper logs. Theoretical volume without hole enlargement and with 50% excess will require approximately 3,440 cubic feet of cement. Flocele will be added as determined by loss of returns while drilling.

3. 13-3/8 inch, 72 lb/ft, P-110 (drifted for 12-1/4 inch bits) ST&C 8-RD.THD casing will be set at + 3,500 feet.

Casing Equipment:

A float collar one joint above the cement guide shoe with one centralizer on each of the bottom two joints and then one every third collar to the surface. High temperature thread dope will be used on all pipe joints. Braze tack with low temperature metal three places top and bottom each collar on bottom three joints.

Cement Slurry:

API class "B" (low cost) cement may be used at a depth of 3,500 feet if temperatures are not above normal. If higher than normal, use API class "G" cement. Slurry mix for either Class "B" or Class "C". 1:1 Perlite by volume, 40% fine silica flour, 3% gel. Friction reducer and retarder to be determined by hole temperature. Approximately 100% water by weight. Approximate weight: 13 lbs/gal.

Cement volume will be determined from caliper logs. Theoretical volume without hole enlargement and with 50% excess will require approximately 4,235 cubic feet. Fresh water shall be used with all cement. Water or a hydrazine preflush (maximum 400 ppm) shall precede each stage of cement.

4. 1700 feet of 9-5/8 inch, 40 #/ft, S-95 LT&C THD liner shall be run to + 5,000 feet and conventionally cemented with a mechanical liner hanger. The liner will be circulated with a volume of cement adequate to bring the top of the cement 200 feet above the top of the liner. A hydrazine preflush should (maximum 400 ppm) precede the cement. After bumping the plug, test the liner with 1,500 psi. Pick up out of liner and bleed differential pressure through plug head and rig choke manifold. Pull drill pipe out of hole. Cement will be drilled out to top of liner and liner top tested with 1,500 psi. The liner top will be squeezed using a retrievable squeeze packer if a hydraulic seal is not obtained through conventional circulation.

Cement Slurry:

API class "G" or "H" 1:1 Perlite by volume, 40% silica flour, 3% gel. Friction reducer and retarder to be determined by hole temperature. Approximately 100% water by weight. Approximate weight 13 lb/gal. Estimated volume allowing for 50% excess is 877 cubic feet.

Fig. 11 Well casing design

<u>Size Hole</u>	<u>Size Csg.</u>	<u>Setting Depth</u>	<u>Cementing</u>	<u>Remarks</u>
(36 in.) 91 cm	(30 in.) 76 cm	(40 ft) 12 m (below GL)	Ready Mix	Set with dry digger hole
(26 in.) 66 cm	(20 in.) 50 cm	(1500 ft) 460 m	Circ to surface	See Sec. 4.3
(17-12 in.) 44 cm	(13-3/8 in.) 34 cm	(3500 ft) 1100 m	Cmt to surface	See Sec. 4.4
(12-1/4 in.) 31 cm	(9-5/8 in.) 25 cm	(5000 ft) 1500 m	TBD	See Sec. 4.5
(8-3/4 in.) 22 cm	-	(7,500 ft) 2300 m	-	See Fig. 11

4.10 Mud Program

The following information summarizes the mud program for drilling the INEL-1 well:

<u>Interval</u>	<u>Type</u>	<u>Weight</u>	<u>Viscosity</u>	<u>Fluid Loss</u>
(40-1500 ft) 12-460 m	Gel Lime	8.5/.7	50/60	NC
(1500-3500 ft) 460-1100 m	LSND	8.5/8.7	32/34	NC
(3500-7500 ft) 1100-2300 m	Water	3.4	28	NC
3500-7500 ft	LSND	9.0 or less	34/40	20 CC or less

Alternate*

NOTES:

1. In the event circulation is lost in the intermediate hole between 1500 and 3500 ft (460 and 1100 m) lost-circulation material should be used for control. If lost-circulation material does not adequately control the system, the hole should be dry-drilled with water.
2. High viscosity sweeps should be conducted prior to running the 20 and 13-3/8 in. (50 and 34 cm) casing strings.

4.11 Hydraulics

Hydraulics will be required as shown:

<u>Hole Size</u>	<u>Pump No.</u>	<u>(GPM) Output</u>	<u>AV-DP</u>	<u>AV-DC</u>	<u>Viscosity</u>	<u>Density</u>	<u>PV</u>	<u>YP</u>
(26 in.) 66 cm	1 & 2	(1700 gpm) 126 l/s	75	85	55/75	8.5/8.7	15	20
(17-1/2 in.) 44 cm	1 & 2	(1200 gpm) 76 l/s	105	143	32/34	8.5/8.7	8	12
(12-1/4 in.) 31 cm	1	(600 gpm) 38 l/s	118	213	Water			
(8-3/4 in.) 22 cm	1	(330 gpm) 21 l/s	144	216	Water *35/40	9.0 or less	10/ 12	3/6

4.12 Samples and Deviation Surveys

The well site geologist may alter the sample interval, but the present plan is to sample as shown:

<u>Interval</u>	<u>ft/Sample</u>	<u>Survey Interval</u>	<u>Maximum Deviation</u>	<u>Max. Deviation Between Survey</u>
(0-1500 ft) 0-460 cm	(30 ft) 9 m	(100 ft) 30 m	1°	1°
(1500-3500 ft) 460-1100 m	(10 ft) 3 m	(200 ft) 60 m	4°	1°
(3500-7500 ft) 1100-2300 m	(10 ft) 3 m	(200 ft) 60 m	10°	1°

The depth and frequency of the surveys will be as indicated or as specified by well-site supervisor. Two survey instruments will be on hand at all times, and they will be alternated when obtaining surveys. A monel collar and directional instrument may be required to run directional survey after reading on T.D.

4.13 Stabilization

The stabilization procedure is outlined below:

1. Surface, 26 in. (66 cm) hole:

below conductor run 80,000 lb of 8 in. DC with NRS on top of first and second DC.

2. Intermediate, 17-1/2 in. (44 cm) hole: below conductor run 80,000 lb of 8 in. DC with NRS on top of first.
3. Main, 12-1/4 in. (31 cm) hole: run double short DC hookup. Bit, 6 pt, IBS, 8 in. SDC, 3 Pt, Shock Sub, IBS, 60,000 lb of 8 in. DC.
4. Barefoot, 8-3/4 in. (22 cm) hole: run double short DC hookup. Bit, 6 Pt, IBS, 6-3/4 in. (17 cm) SDC, 3 Pt, Shock Sub, IBS, 60,000 lb of 6-3/4 in. (15 cm) DC.

4.14 Coring, Logging, and Testing

From 1500 ft (460 m) to total depth, eleven 30 ft (9 m) cores will be attempted. Their depths will be specified during the drilling by the USGS and EG&G personnel.

The following logs will be run in the intermediate, main, and barefoot holes:

<u>Type</u>	<u>Logger</u>
Caliper	Commercial
Compensated Density w/Caliper	Commercial
Compensated Neutron w/GR	Commercial
Focused DIL	Commercial
BHC Acoustic Log	Commercial
Temperature Log	Commercial
Sonic Log	USGS
Magnetic Log	USGS

When the above logs are run on the intermediate and main holes, the logs should be taped. A computerized evaluation (synergic evaluation) will be prepared from the taped log data.

Two nuclear cement top locator logs will be required during each casing and cementing job. One as a baseline log after running casing and prior to cementing and one as cement top locator after cementing.

4.15 Testing Program

The following testing program is proposed to meet initial requirements of the upper aquifer by USGS and the geothermal resource by EG&G Idaho, Inc. Test plans will be finalized prior to drilling.

4.15.1 Below 1500 ft (460 m) in the 17-1/2 in. (44 cm) hole, a conventional drill-stem test will be run at regular intervals of 750 ft (230 m). If significant sample information indicates that additional drill-stem tests should be run for resource evaluation, the extra tests will be run.

The drill-stem tests will utilize inflatable packers; the test procedure is as follows:

Initial Flow Period	1 to 10 minutes
Initial Shut-In Period	30 to 60 minutes
Final Flow Period	60 to 240 minutes
Final Shut-In Period	60 to 120 minutes

4.15.4 Samples and Analysis. All fluid samples will be available to the USGS and the DOE for their independent analysis. Pressure-versus-time and temperature-versus-time charts will be recorded during the test procedure, to aid in the evaluation of each resource-interval test.

4.16 Rig Requirements and Specifications

4.16.1 Hoisting Requirements. The derrick substructure and draw works will require a minimum of 380,000 lb (170,000 kg) hoist capacity, with a setback load of 250,000 lb (110,000 kg). This will allow a minimum of 100,000 lb (50,000 kg) overpull during the maximum hoisting operation.

The maximum hoisting operation will be running a 25 cm 13-3/8 in. casing at 3500 ft. Substructure clearance will be adequate to accept BOP stack Fig. 6 and 7.

4.16.2 High-Pressure Pumps. Minimum requirements are one 1000 horsepower (700 kw) pump and one 700 horsepower pumps. It will be necessary to utilize both pumps on the 26 and 17-1/2 in. (66 and 44 cm) hole. The 12-1/4 and 8-3/4 in. (31 and 22 cm) holes will require one pump, and will need one pump for standby purposes.

4.16.3 Low-Pressure Pumps and Circulating System. Minimum requirements are three centrifugal pumps. Three pumps will be necessary to allow drilling-fluid additives to be properly mixed and to operate drill-solids removal equipment.

4.16.4 Surface Support Equipment. A desander and desilter capable of handling a minimum of 600 gpm (38 liters per second) will be required as will a high-speed, double-screen shaker. The surface pits will be properly designed, to allow compartmental bypassing. They will have a volume of 1000 bbls.

4.16.5 Drill Pipe and Drill Collars. For all drilling operations from the surface to the setting of the liner, the drilling contractor will provide 80,000 lb of drill-collar weight in air whose minimum OD will be 8 in. All drill collars will have the same connection and will be inspected on location prior to being picked up and run in the hole. For drilling below the 9-5/8 in. (25 cm) liner, the drilling contractor will provide 60,000 lb of 6-3/4 in. (17 cm) OD drill-collar weight in air.

The drilling contractor will provide 4-1/2 in., 16.6 lb or 5 in., 19.5 lb (1 cm, 24.7 kg per meter or 13 cm, 29.0 kg per meter) drill pipe for this operation. All drill pipe will be inspected on location prior to being picked up and run in the hole. Minimum specifications acceptable will be grade 2. Inspection will include both tube and end areas. Only one type of tool joint will be allowed on each size drill pipe. Hard banding will be smooth and contoured. Tensile strength will be such that 50,000 kg (100,000 lb) of pull will be left in the drill pipe string under any normal operation. Collapsed strength will be that required for well killing, squeeze cementing, or any other operation.

If the 9-5/8 in. (25 cm) liner is run to about 5000 ft (1500 m) it will be necessary for the drilling contractor to provide a minimum of 3300 ft of 4-1/2 in 16.6 lb Grade G, or 3300 ft of 5 in 19.5 lb Grade G drill pipe.

4.16.6 Traveling and Auxiliary Equipment. The contractor will check the crown block, traveling blocks, draw-works brakes, auxiliary brakes, swivel, hook, kelly, kelly cock, and handling tools for wear and capacity before the equipment are put to use. Elevators, spiders, slips, bails, and handling tools are to be magnafluxed at contractor's expense before they are used. Minimum rating of all traveling equipment and crown block will be 400,000 lb.

4.16.7 Control Equipment. For drilling the 26 in. (66 cm) hole, to 1500 ft (460 m), BOP equipment will not be used. At 1500 ft (460 m) a 20 in. (50 cm) rotating head, a 20 in. (50 cm), 2000 psig (20,000 kilopascal) working-pressure spherical annular preventer, and a 20 in. (50 cm) single gate will be installed on the 20 in. (50 cm) casing flange. Figure 6 is a schematic diagram of this control equipment.

At 3500 ft (1100 m) the operator will provide a 20 x 12 in. (50 x 30 cm) 3000 psig (20,000 kilopascal) working-pressure expansion spool and a 12 in. (30 cm), 3000 psig (20,000 kilopascal) master valve. This equipment will be installed in the cellar below ground level. Above the master valve the drilling contractor will provide a 12 in. (30 cm) 3000 psig (20,000 kilopascal) working-pressure double gate. A 12 in. (30 cm) triple-outlet drilling spool, and a 12 in. (30 cm), 3000 psig (20,000 kilopascal) working-pressure spherical annular preventor. The operator will provide a 12 in. (30 cm), 1500 psig (10,000 kilopascals) working-pressure rotating head above this spherical preventor. Figure 7 is a schematic diagram of this control equipment.

This control equipment should be rated to handle pressure as indicated, temperatures to 200°C and sour and corrosive fluids.

A 8 in. (20 cm) geothermal flowline will be installed on one outlet of the drilling spool for geothermal testing. This equipment will be provided by the operator.

4.16.8 Instrumentation and Auxiliary Equipment. The following recording instruments are to be furnished by the drilling contractor:

1. Six-pen recorder to record footage, weight on derrick, rotary torque, standpipe pressure, and pump strokes on both pumps.
2. Torque gauges on the drillers console to read rotary torque and drill-collar makeup.
3. A weight indicator at the driller's console and on the dead line.
4. An independent wire-line unit with sufficient wire line and lubricator for surface connections for operation to total depth.
5. An automatic driller.
6. Accumulator unit to operate BOPs 1-1/2 cycles, with a remote-control station on the drilling floor.
7. A standard 7 degree deviation instrument.
8. Kelly spinner with forward and reverse.

4.16.9 Rig Inspection. Two inspections will be conducted. The first inspection will be conducted prior to bid award, by a DOE/ID or his representative, to verify that the rig meets bid specifications and that the rig is in a satisfactory operating condition. The second inspection will be conducted by EG&G Safety Division engineers when the rig is over the hole and ready for operation. The drilling supervisor will verify that the same equipment originally inspected has been mobilized.

The Safety Division will issue the inspection form shown in Figure 12. Other periodic safety inspections will also be conducted, and they will use the same inspection form. Safety Division will be given advanced notice for all inspections.

SAFETY INSPECTION ON ROTARY RIGS

SAFETY IS NO ACCIDENT!

ROTARY DRILLING RIG CHECK SHEET

Contract No. _____ District _____ Inspection Date _____

Operator _____ Toolpusher _____

Location: Lease _____ Well No. _____ County _____ State _____

(✓) IF OK	(—) Not applicable	(X) If Correction Needed
I. MUD PUMP AREA ☐ a. Shear relief valve covered ☐ b. Relief line secured ☐ c. Vibrator hose snubbed at end ☐ d. New mud stacked safely ☐ e. Eye wash facility at hopper ☐ f. General housekeeping good	VII. TONGS ☐ a. Snubbing lines condition good ☐ b. Jerk lines condition good ☐ c. Three clamps on all snub and jerk lines, properly used ☐ d. Dies sharp — tongs bite & keepers installed ☐ e. Handle safety pin in place/no bolts & nuts used ☐ f. Tong body & jaws in good condition ☐ g. Tong counter weights safe and snubbed to prevent fall	XIII. PERSONAL PROTECTIVE EQUIPMENT ☐ a. Proper clothing being worn ☐ b. Hard hats on crew (approved) ☐ c. Hard hats used by visitors ☐ d. Hearing protection being used ☐ e. Safety goggles (approved) ☐ f. Face shield for grinder ☐ g. Safety toed shoes used ☐ h. Spare safety belt
II. SUBSTRUCTURE AND DERRICK ☐ a. All assembly pins in place ☐ b. Assembly pins secured with keepers ☐ c. Lower and upper substructures properly bolted together ☐ d. Rotary beams and all braces are in good condition ☐ e. Drilling line installed properly on anchor and keyed to keep from jumping off tie down ☐ f. Derrick properly guyed if applicable	VIII. CATHEAD, DRUM, & AIR HOIST ☐ a. Smooth and guarded both sides ☐ b. Condition of automatic cathead ☐ c. Catline not worn or kinked ☐ d. Catline tied back safely ☐ e. Spinning chain and headache post regularly ☐ f. Crown safety cut-out checked ☐ g. Air hoist line in good condition ☐ h. Air hoist properly spooled with line guide	XIV. TOOLPUSHER'S QUARTERS ☐ a. Clean ☐ b. Fire extinguisher present ☐ c. First aid kit present ☐ d. General condition
III. BLOWOUT PREVENTORS ☐ a. Properly installed and tested ☐ b. Hydraulic controls accessible ☐ c. Gauges in working order ☐ d. Hydraulic lines protected ☐ e. Wheels and stems in place ☐ f. Preventor work boards safe and secured ☐ g. Choke manifold — stand and line secured ☐ h. General housekeeping good	IX. FLOORS, STAIRS, & HANDRAILS ☐ a. Stair step treads non-skid ☐ b. Stairs level, secured and clear ☐ c. Rails on stairs, rig floor, and mud tanks ☐ d. Rig floor free of holes or covered ☐ e. Rotary floor and racking area in good condition ☐ f. Floors free of grease and tripping hazards ☐ g. Non skid material used around rotary ☐ h. V-door provided with gate type handrails and closed	XV. MISCELLANEOUS ☐ a. Generator skid door props properly pinned ☐ b. Hammer and wrenches free of defects ☐ c. Grinder properly guarded and rest positioned ☐ d. Ladders on location in good condition ☐ e. Kelly cock wrench and safety valve accessible ☐ f. Tools in place ☐ g. Location condition ☐ h. Bulletin board orderly ☐ i. Oil leaks cleaned up ☐ j. Boiler in good condition ☐ k. Comparison of general rig condition with other rigs <div style="margin-left: 20px;"> ☐ Below average ☐ Average ☐ Above average </div>
IV. PIPE RACK AREA ☐ a. Ends properly choked ☐ b. Layers of pipe properly choked ☐ c. Pipe racks level ☐ d. Pipe tubs in good condition ☐ e. Catwalk deck in good condition & level with racks ☐ f. V-door chute in good condition ☒ g. Derrick stand in good condition and ladder provided ☐ h. General housekeeping good	X. EQUIPMENT GUARDS ☐ a. All engine belts guarded ☐ b. All rotating shafts and couplings properly guarded ☐ c. Rotary drive chain guarded ☐ d. Mud pump drive belts guarded ☐ e. Shale shaker guards in place	XVI. SAFETY ☐ a. Are drillers holding weekly safety meetings and sending in reports ☐ b. Are accidents being discussed ☐ c. O.S.H.A. poster unobstructed ☐ d. O.S.H.A. file up to date ☐ e. O.S.H.A. doctor, hospital, police sign
V. DERRICK BOARD AREA ☐ a. Emergency exit line ☐ b. Geronimo in place ☐ c. Tools secured ☐ d. Pipe hooks or fingers snubbed and condition good ☐ e. Standpipe secured ☐ f. Mudhose snubbed both ends ☐ g. Derrick climber installed ☐ h. Safety belt and lines present	XI. DOG HOUSES ☐ a. At least two doors opening out ☐ b. Driller's doghouse clean ☐ c. Crew change house clean ☐ d. Supply storage house clean ☐ e. Outhouse clean and sanitary ☐ f. Stoves properly installed ☐ g. First aid kit in driller's doghouse	Inspected By _____ Discussed With _____ Title _____
VI. LIGHTING & WIRING ☐ a. Wires up off the ground and properly secured ☐ b. All wires properly spliced ☐ c. All lights properly protected ☐ d. Receptacles and plugs in good condition ☐ e. Derrick lighting approved ☐ f. Electric tools grounded ☐ g. Generator skid and toolpusher trailer properly grounded ☐ h. Water hose for washing kept away from generator skid	XII. SAFETY EQUIPMENT & WARNING SIGNS ☐ a. Fire extinguishers charged, tagged and visible ☐ b. Gasoline in explosive proof can and kept off rig floor ☐ c. Warning signs on fuel tanks ☐ d. All vessels labeled as to contents ☐ e. High voltage signs used ☐ f. No smoking signs used ☐ g. Hard hat sign ☐ h. Signs clean	See Attached Explanation of Recommendations

Fig. 12 Safety check sheet for rotary drilling

5. PERMITS

This hole is located on public land withdrawn from public use by the Department of Energy. If DOE decides any permits are necessary, they will obtain the permits in a timely manner.

6. ENVIRONMENTAL ASSESSMENT

ENVIRONMENTAL ASSESSMENT
INEL EXPLORATORY WELL
Butte County, Idaho

by

S. G. Spencer &
J. F. Sullivan

November 1978

1. INTRODUCTION

This report assesses the environmental impact of drilling a 3000-m exploratory well at the Idaho National Engineering Laboratory in eastern Idaho. The well will be drilled to assess the geothermal potential under the Snake River Plain.

1.1 Site Location

The INEL-1 well will be located in the NE'14, Sec. 1, T3N R29E(BM) in Butte County, Idaho (Figure 1). The Universal Transverse Mercator coordinates for this location are 4,830,000 m.N and 344,000 m.E. The well will be located on land designated as part of the Department Energy's Idaho National Engineering Laboratory (INEL). The Test Reactor Area (TRA), the Chemical Processing Plant (CPP) are just south of the well site.

1.2 Activity Objectives

The proposed drilling and testing has been designed to meet the following objectives:

1. To verify the existence of a geothermal resource, determine its characteristics, and estimate its ability to produce geothermal fluids;
2. To generate a lithologic log and define the thickness of the aquifers, the permeability of the subsurface rocks, and the mineral content of the water in the various zones. This information is also important to the continuing waste-storage and waste-monitoring activities at the INEL.

1.3 Participants

The proposed drilling will be funded primarily by the U.S. Department of Energy (DOE). The Idaho Operations Office of DOE will be responsible for implementation of the drilling plan. The U.S. Geological Survey and EG&G Idaho, will have technical input to the drilling, will perform logging and well testing, and will be responsible for data interpretation.

1.4 Relationship to the National Geothermal Development Program

The goal of the DOE Geothermal Energy Development Program is to both perform and stimulate research development and demonstration which will lead to major utilization of geothermal resources by industry. Drilling the INEL-1 well will enable researchers to determine if geothermal resources that can be developed for direct uses and power production underlie the Snake River Plain.

1.5 Schedule and Costs

Site preparation for the INEL-1 well will begin in mid-September 1978. Drilling will begin about October 1, 1978, and is scheduled to be completed by April 1, 1979. Site restoration and the final report should be completed by June 30, 1979 (see Figure 2).

The total estimated costs associated with the well drilling and testing are \$2,800,000.

2. DESCRIPTION OF THE PROPOSED ACTIVITY

Proposed activities include the drilling, completion and testing of a 3000-m exploratory well on the eastern Snake River Plain. The drilling will take place on a 150 m x 150 m drill pad, which will be levelled, compacted, surfaced with gravel. A 60 m x 60 m reserve pit will be excavated to contain drilling fluids. The exact depth of the pit (estimated to be 4.5 m) will be determined by subsurface conditions. In preparation for drilling, a 2.4 x 3 x 3 m concrete cellar will be constructed, a 76 cm conductor pipe will be set a 12 m, and "rat" and "mouse" holes will be drilled. Power and phone lines will be run into the site from existing lines approximately 300 m away. In addition to the drill rig, two living-office trailers, fuel storage tanks, mud pumps, generators, a water tank, and equipment storage facilities will be located on-site. A 150 m, 25 cm well will be drilled on the edge of the site to supply water for drilling. Portable sanitary facilities will be provided on-site during the drilling and initial testing.

The well will be constructed as follows (Figure 3):

1. A 66-cm hole will be drilled with mud to 460 m and 50 cm casing run and cemented to the surface;
2. A 44 cm hole will be drilled with mud* to 1100 m and 34 cm casing run and cemented to the surface;
3. A 31 cm hole will be drilled with water to approximately 1500 m. A 25 cm casing liner will run and cemented from total depth up to 1000 m.
4. A 22 cm hole will be drilled below the liner to approximately 2300 m.

* If circulation loss is encountered and cannot be controlled, the hole will be drilled in this section with water.

INEL-1 Well Construction

A rotating head and double-gate BOP will be used for control while drilling the surface hole. When the 34 cm intermediate pipe is set, a 20,000 kPa BOP stack will be installed.

From 460 m to total depth, eleven cones will be cut and analyzed by the USGS. The following logs will be run in the intermediate, main, and open-hole sections: caliper, compensated density, compensated neutron, DIL, acoustic, temperature, sonic, magnetic, and televiewer. Water samples will be collected from various intervals, as determined by EG&G and the USGS.

Drill stem tests will be run in every 230 m interval below 460 m. Temperature, pressure, flow, and water quality characteristics will be measured. Approximately 130,000 m³ of water will be produced during flow tests following completion of the well.

Upon completion of drilling, the drill rig and all associated materials will be removed from the drill site. The drilling fluids will be disposed of, the reserve pit backfilled, and the site dressed and restored. If the hole is to be used for logging and testing, a shelter will be placed over the hole. If the hole is successful, control valves and a production line will be installed. The wellhead will be housed in an insulated building for security and weather protection. Eventual use of the well will depend on the quantity and temperature of fluids produced from the well.

3. DESCRIPTION OF THE EXISTING ENVIRONMENT

The proposed well will be drilled at the Idaho National Engineering Laboratory (INEL), a limited-access government reservation. The INEL was established in 1949 as a place where various types of nuclear reactors could be built and tested. Today, INEL is one of the principal centers for developing nuclear energy.

3.1 Physiography

The INEL is located along the western edge of the eastern Snake River Plain, at the foot of the Lost River, Lemhi, and Bitterroot mountain ranges. The average elevation of the 23,000 ha included in the INEL is 1490 m above mean sea level. The center of the INEL site is approximately 43°40'N and 112°41'E. Arco, (population 1,244) 11 km to the west of INEL, is the largest nearby community. Large areas of land around INEL are either irrigated or are used for grazing. Nearly 65% of the land within the boundaries of INEL is used for cattle and sheep grazing.

3.2 Geology

The Snake River Plain is geologically young, as are the surrounding mountains. The Snake River Plain is believed to be a large graben with throw on the bounding faults estimated at 3 to 10 km. The graben has been partially filled with interbedded Cenozoic volcanics and lacustrine and alluvial sediments to a depth of at least 1000 m. Geophysical surveys indicate that a major structural or lithologic break exists at approximately 2,100 m. A thin layer of predominantly loessial sediments overlies an irregular lava surface in much of the area. Near the well site, the depth of this soil is approximately 1.5 m. Surface lava exposed in many areas was formed in the Quaternary period, with much of it being formed in the recent epoch of that

period. Lava flows from the Craters of the Moon National Monument, which is west of INEL, have been dated as 2,100 years old. Lava flows from the Cedar Butte south of INEL occurred in historic times (quite possibly within the last 1,000 years).

3.3 Seismology

No severely destructive earthquakes have affected the eastern Snake River Plain since towns were established in the early 1860 decade. Of the recorded earthquakes that have been felt, none has been of sufficient intensity to cause more than minor damage to buildings.

The Hebgen Lake earthquake of August 1959 focused attention on the seismic potential of the intermountain region and may explain why the Uniform Building Code (UBC) was revised in 1970. This changed parts of Idaho, Montana, and Utah from Seismic Risk Zone 2 to Zone 3. Since 1970, several studies have been published, which, together with other information, give more insight into the tectonic patterns, seismic activity, and seismic risks in the region.

The Intermountain Seismic Zone near Yellowstone National Park is the most active area in the region. A second area, which is less active, is located about 160 km north and west of the INEL, in east-central Idaho; it may be a separate tectonic element or it may be a branch of the Intermountain Seismic Zone. These two seismic zones are characterized as being in tectonically-active basin and range-type mountains, show evidence of geologically-recent faulting, and are the location of seismic activity from the lowest detectable limit up through potentially-destructive events. The magnitude and incidence of seismic events falls off from these known centers toward the Snake River Plain.

The Snake River Plain is characterized by the absence of the seismic events (including microseisms) or known faults, younger than the mid-to-lower Pleistocene basalts. Thus the Snake River Plain itself can be considered to be presently aseismic. One would

not expect faults or earthquakes to occur on the plain. the probability of faulting and the magnitude of possible seismic events increases from the mountains adjacent to the plain toward the active seismic zones described above.

3.4 Climatology

The climate of the region is characterized as a "cool desert." During the summer, days are warm, while nights are cool. Winters are cold and dry. The maximum average temperature which occurs in late July and is 18.3°C. During January, the minimum average temperature is -8°C. The annual average temperature is 5.6°C. Precipitation at the INEL averages 22 cm per year, peaking principally in May and June, with minor peaks occurring in December and January. Over a third of the annual precipitation occurs in the spring. The surrounding mountains strongly influence the INEL climate, with prevailing westerly winds on the Snake River Plain channeled into daytime southwesterly winds. Nighttime winds are generally out of the northeast, due to the influence of the Beaverhead Mountains. Climatologic data have been collected for the INEL since 1949 by the National Oceanic and Atmospheric Administration.

3.5 Air Quality

The only sources of air pollution on or near the INEL are windblown dust and minor releases of radioactive wastes (primarily krypton and xenon). Particulate levels at Atomic City south of INEL averaged 30 $\mu\text{g}/\text{m}^3$ in 1978.

3.6 Hydrology

3.6.1 Ground Water. The principal ground water feature is the Snake River Plain Aquifer, which underlies the entire Snake River

Plain. The altitude of the regional water table at the INEL ranges from about 1,400 m above sea level in the north to about 1,350 m near the southwest. The average water table gradient is about 1 m/km to the south-southwest. Within the INEL boundaries, the depth below the land surface to the regional water table ranges from 61 m in the northeast to 275 m in the southwest. From July 1962 to July 1972, the net changes of ground-water levels ranged from zero to a 5 m rise. In the northern part of the INEL, the water levels remained relatively constant, exhibiting only a slight rise.

The most significant natural recharge to the aquifer within the INEL is from the Big Lost River. A small amount of recharge occurs from infiltration of precipitation directly on the INEL and in some years of high runoff, Birch Creek water flows onto the INEL and seeps underground. The Big Lost River drains into a closed basin terminating at the northern end of the INEL. Perched ground water occurs under the Big Lost River and in other areas where there are significant seepage losses.

The concentration of dissolved solids in ground water at the INEL, not affected by IENL waste disposal, ranges from 140 to 540 mg/l. Most of the ground water has dissolved solids of 180 to 225 mg/l.

3.6.2 Surface Water. Surface water at the INEL consists mainly of streams draining from intermountain valleys Northwest of the INEL. The major streams, the Big Lost River, Little Lost River, and Birch Creek, terminate in the Birch Creek playa in the north-central INEL (Figure 3). The Big Lost River is the most important of the three, discharging an average of 2.6×10^4 ha-m/yr below Mackay Dam northwest of INEL. Upon entering the Snake River Plain, the Big Lost River continually loses water by infiltration, disappearing completely into the playas in the northcentral INEL. The 100-year flood on the river below Arco is $120 \text{ m}^3/\text{sec}$.

Big Lost River System

3.7 Biological Environment

Vegetation and animal life on the INEL is typical of the northern part of the Great Basin area. No known endangered species permanently inhabit the INEL.

3.7.1 Flora. Vegetation is dominated by sagebrush (Artemisia tridentata), with the most frequent understory species being bottlebrush squirrel tail (Sitanion hystrix), rhizomatous wheatgrasses (Agropyron species), winterfat (Eurotia lenata), and bluebunch wheatgrass (Agropyron spicatum). Lanceleaf rabbitbrush (Crysothamnus viscidiflorus) is also a common ground covering. The INEL has only a few trees located principally along the Big Lost River. The well site is located in an area dominated by Artemisia tridentata and Agropyron dasystachyum.

3.7.2 Fauna. A sizable population of pronghorn antelope (Antilocapra americana) exists at the INEL, as well as populations of coyote (Canis letrans) and bobcat (Lynx rufus). Populations of these last two predatory species are somewhat cyclic in nature, following the cyclic patterns of blacktail jackrabbit (Lepus californica), cottontail (Sylvilagus nuttalli), and pigmy rabbits (S. Idahoensis).

The small mammal density on the INEL is among the highest on the North American continent. Those small mammals typically present include Ord's kangaroo rat (Dysodomys ordii), least chipmunk (Eutamias minimum), Northern grasshopper mouse (Onychomys leucogaster), Great Basin pocket mouse (Perognathus parvus), and deer mouse (Peromyscus maniculatus).

Reptiles and birds are also present. The reptile is represented by lizards, such as the small sagebrush lizard (Sceloporus graciosus) and a few snakes, such as the Western rattlesnake (Crotalus viridis). Resident populations, such as sage grouse and pheasants, are present. Several migratory species of birds, such as larks, doves, hawks, ducks, geese, and eagles, frequently pass over the

INEL. Aquatic life on the INEL is limited and is mainly dependent on the flow of the Big Lost River.

3.8 Cultural Factors

Population centers on the Snake River Plain are widely spaced and most of the plain around the INEL is uninhabited. Atomic City (population 28), located 21 km southeast INEL-1, is the closest populated area, while Arco (population 1,244) is 50 km to the west and is the largest nearby community. Idaho Falls is located 56 km to the east. Range grazing is allowed within the INEL and some irrigated farms are located between the southern INEL boundary and Blackfoot.

Artifacts recovered during archaeological surveys performed at the INEL indicate that man has been present in the area over along period of time ranging at least from the time of the mammoth hunters. An archaeological clearance survey of the land included in the INEL-1 well site yielded no artifacts.

4.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTIVITY

Impacts resulting from the drilling and testing of the INEL-1 well at INEL are expected to be minor. The most significant of these are noise, land disturbance, and potential contamination of water supplies.

Noise will be highest during drilling of the well. Readings taken near similar drill rigs yielded the following:

<u>Activity</u>	<u>Reading (dBA)</u>	<u>Distance (ni)</u>	<u>Calculated at 300 m (dBA)</u>
Drill Rig (idling)	68	6	34
Drill Rig (drilling)	96	6	62
Steam and Water Discharge	63	1.5	17

There are no permanent residents at INEL; therefore, drilling 24 hrs/day will not result in noise disturbance problems. The nearest working area to the drill site is 600 m to the south.

Approximately 22,500 m² (2.3 ha) of land will be cleared and graded for the drill site and an additional 0.7 ha will be graded and gravelled to provide access to the site. Soil excavated for the reserve pit will either be used to build up a berm around the pit or be stockpiled. Upon completion of drilling and initial testing, the disturbed area will be restored (see Section 5.) to meet requirements for future uses of that land. If the well is unsuccessful, all disturbed land will be contoured and seeded with native vegetation.

Protection of water supplies from potential contamination will be important during drilling and testing. The well will be constructed with double casing and cement to 460 m to eliminate the chance of fluids leaking from the well into the shallow groundwater system.

Cemented casing between 460 m and 5000 m with protect water supplies at those depths. Much of the water discharged to the reserve pit during drilling will be that used for drilling (i.e., that produced from the 150 m water supply well). Still mud tanks will be used to circulate mud while drilling the upper sections of the hole. The reserve pit will be unlined; mud and drill cuttings jetted to the reserve pit will decrease the seepage. A lined pit will be available on-site if the quality of fluids is poor enough that they cannot be discharged to the reserve pit.

Because hot water and/or high pressure fluids may be encountered during drilling, blowout preventer equipment will be used. This equipment will remain on the well until the permanent wellhead is installed upon completion of drilling. All equipment will be inspected to facilitate early detection of any deficiencies which would eventually lead to well failures.

Use of the reserve pit will prevent surface contamination. All fluids generated during drilling or initial testing of the well will be contained in the reserve pit and will not be discharged to existing water systems. Currently, plans call for 130,000 m³ of water to be produced from the well during flow tests. The actual amount of water produced and the disposal of that water will depend on its quality. If the quality of the water is similar to that of the shallow groundwater system (<600 mg/l), the water can be discharged directly to the reserve pit, where it will ultimately seep or evaporate. If the quality is such that permanent surface disposal is not allowable, (e.g., TDS > 600 mg/l), the length of the flow tests will be reduced and fluids will be injected in the well following each flow test.

Release of minute amounts of noxious gases (e.g., hydrogen sulfide) may accompany the production of fluids during testing. No data is available to indicate the presence or absence of such gases; however, if gases do occur in sufficient quantities to exceed regulated or recommended levels, emission control efforts will be made. Vehicle exhaust

emissions will constitute a source of air pollution. due to the limited number of vehicles, this source will not be detectable. Exhaust emissions from the drill rig will originate from two 500-hp engines.

The presence and movement of vehicles, equipment, and personnel will result in very minor disruption of normal activities. Access to the drill site will be limited to authorized personnel. State and federal safety regulations regarding well drilling and construction activities will be enforced.

Sensitive wildlife habitats, scenic areas, and natural areas will not be affected. If evidence of cultural resources is encountered during the site preparation or drilling, a state archaeologist will be consulted.

5. RECLAMATION AND RESTORATION

Upon completion of drilling and testing of the INEL-1 well, all equipment and structures will be removed from the drill site. Waste materials will be disposed of at an approved disposal site. The reserve pit will be backfilled at the completion of flow testing. If the well is unsuccessful, the well will be capped and covered with a shelter. The site area will be reduced to an area necessary to allow access to the well for logging. If the well is successful, a larger areas (approximately 0.1 ha) will be left to allow for wellhead maintenance and production activities. All disturbed lands not included in that area will be contoured and seeded with native grasses.

6. ALTERNATIVES

The choice not to drill the well is a feasible alternative; one that will result in no direct detrimental environmental impacts. However, there is a good chance that a significant geothermal resource underlies the Snake River Plain. If the drilling of the well confirms its existence, the geothermal resource could supply much of eastern Idaho's energy requirements. If no geothermal resource is encountered, a coal-fired or nuclear power plant will be constructed.

Another alternative is to locate the well elsewhere on the INEL. However, geophysical data and data from the test wells indicate that the proposed location offers the best chance of completing the objectives. Locating the well elsewhere would only increase the possibility of it being an unsuccessful well.

7. COMPLIANCE WITH REGULATIONS AND OTHER CONTROLS

The Federal Nonnuclear Energy Research and Development Act of 1974 authorized the Energy Research and Development Administration (now DOE) to establish and conduct a comprehensive national program for research, development, and use of all nonnuclear energy sources. The Act specifically directed DOE to incorporate the Geothermal Energy Research, Development, and Demonstration Act of 1974 into the national nonnuclear energy resources program. The activities proposed in this assessment are in support of these acts. The activities are administered through the Geothermal Energy Division of DOE and subject to any of the internal regulations and guidelines established by the division.

The holes are located on the INEL, which excluded from any county or local land use plans or control. DOE-ID Geothermal will coordinate review of the drilling specifications by the Idaho Department of Water Resources to ensure compliance with State regulations and policies.

7. INDUSTRIAL RELATIONS

Drill site and drilling work is determined, non-covered work and Service Contract Act applies.

8. PUBLIC INFORMATION

All site visits and inquiries will be coordinated through the DOE-ID office. All formal press releases made periodically during the program (e.g., start of drilling and termination of drilling) will be cleared through the DOE-ID office for public information.

9. PROGRAM MANAGEMENT

9.1 General

This section describes the responsibilities of the principal organizations and authorities participating in this drilling and testing program. Figure 13 shows schematically the project organization, including the interactions with the USGS and the State of Idaho. The principal organizations and individuals include:

1. Department of Energy, Division of Geothermal Energy,
Washington, D.C. Region II, Director (RD) - Dr. J. W. Salisbury
2. Department of Energy, Idaho Operations Office, Idaho Falls, Idaho
 - a) Idaho Operations Office General Manager (IOGM) -
Dr. C. E. Williams
 - b) Idaho Operations Program Manager (IOPM) - Dr. R. E. Wood
 - c) Idaho Operations Program Assistant Manager (IOPAM) -
Dr. C. R. Nichols
 - d) Idaho Operations Project Manager (IDPM) - Ms. S. M. Prestwich
 - e) Idaho Operations Reservoir Manager (IDRM) - Dr. L. L. Mink
3. U.S. Geological Survey, Geologic Division, Denver, Colorado
 - a) Geologic Division Geothermal Manager (GDGM) - Dr. Don Mabey
 - b) Hydrologic Division Waste Management Manager INEL (HDI) -
Mr. J. Barraclough
 - c) Hydrologic Division Geothermal (HDG) - Mr. E. G. Crosthwaite
(Boise, Idaho)
4. EG&G Idaho, Inc., Idaho Falls, Idaho
 - a) Director, Programs - Mr. L. F. Burdge
 - b) Geothermal Electric Division Manager (GEDM) -
Mr. J. H. Ramsthaller
 - c) Division Manager, Advanced Programs - Mr. R. R. Stiger
 - d) Project Manager - Dr. J. A. Bowman
 - e) Reservoir Engineer Manager - Mr. T. A. Allen
 - h. Environmental Engineering Manager - Ms. S. G. Spencer

Fig. 13 - Project Organization - Drilling Operations

5. State of Idaho, Idaho Department of Water Resources, Boise, Idaho
IDWR Assistant Manager - Mr. K. Dunn
6. Department of Energy, Nevada Operations Office, (DOE/NV) Las Vegas,
Nevada - Director Engineering and Energy Applications Division -
Mr James Cotter.
7. Fenix & Scisson (F&S) - Drilling Manager - Mr. Ken Ortego (Technical
Project Officer TPO)

9.2 Programmatic Responsibilities

9.2.1 DGE Region II Director (RD). The Region II director will be responsible for the overall programmatic aspects of the DGE's Region II resource exploration and assessment program. The RD and other headquarters staff will be informed of contract activities through informal and formal communications with the Idaho Operations Office (IDO). The RD will approve any proposed contract modifications which increase the level of funding or affect the project objectives (as stated in the Drilling and Testing Program Plan).

9.2.2 ID Project Manager (IDPM). All formal communication and directives between the Division of Geothermal Energy and the subcontractor will be directed through the IDPM.

The IDPM will be primarily responsible for project coordination between the subcontractor and DGE, and between the subcontractor and ID Administrative Services. He will assist the subcontractor by expediting and coordinating procurement approvals and other administrative tasks, as well as by being available to monitor all critical drilling and testing phases in the field. Whether at the well location or elsewhere, the IDPM will maintain close surveillance of the project and will be able to discuss comprehensively technical and administrative aspects of the project with the RD and IOPM.

The IDPM will be the principal subcontractor contact for the project. He will direct all aspects of the project in accordance with the Contract and this plan. All formal actions will go through the IDPM. During the field operation, no major change in the plan will be implemented without approval of the IDPM unless hole conditions or safety considerations require immediate action.

The IDPM will organize and chair a Project Review Committee consisting of the RD, and IOPM, and technical advisors. The committee will meet at times to be specified by the IDPM during the course of the program.

Specifically, the IDPM will be in continuous contact with the subcontractor and the operation. He will monitor the subcontractor's progress by reading reports, by telephoning, and if necessary by visiting.

The IDPM will assume responsibility for all press releases pertaining to the project. He will coordinate such releases with the ID Office of Public Affairs, the subcontractor, the DP, and the USGS.

Finally, the IDPM and the IOPM will together review all contractor reports before release. Notification of reports approved for release will be the responsibility of the IDPM.

9.2.3 Reservoir Manager (IDRM). The IDRM will coordinate all well testing activities as requested by USGS, Reservoir Engineer, etc.

Resource information will be provided to Idaho Department of Water Resources through the IDRM.

The IDRM will be responsible for environmental control and policy.

9.2.4 Geothermal Electric Division Manager (GEDM). The GEDM will designate other individuals (i.e., drilling project manager, reservoir engineer, and others as required) to facilitate communications or other technical and administrative functions.

The GEDM or his designee will also be responsible for preparing all project reports. The reports will be composites of work performed by all investigators directly related to the drilling and testing program.

All cost reporting for the project shall be the responsibility of the GEDM or his designee. This reporting shall include weekly costs during drilling and a comprehensive cost report at the conclusion of the drilling.

The GEDM shall provide reservoir engineering support as requested by the IDRM which shall include, but not be limited to, the production zone interval.

Environmental monitoring support will be provided by the GEDM as requested by the IDRM.

The GEDM will provide monitoring of safety and health, including emergency first-aid at the INEL facility and emergency action procedures.

9.2.5 DOE/NV

Provide a technical support contractor, F&S, to direct the drilling operations.

Direct and coordinate the F&S support activities.

9.2.6 F&S

Provide technical specifications, schedules and cost estimates for the drilling contract as well as other subcontracts for materials and services as may be mutually agreed to with DOE/ID.

Provide a Technical Project Officer (TPO) to assure compliance with the provisions of the ID prime drilling contract.

Provide technical direction for the drilling contractor as well as other subcontracts for materials and services as may be mutually agreed to with DOE/ID.

Provide ID with advice and consultation upon request.

Direct the drilling program in accordance with the approved drilling and testing plan. Obtain ID concurrence for any significant deviations from the plan.

Have line responsibility for safety and environmental control during drilling operations.

9.2.7 USGS. The USGS shall provide reservoir engineering support as requested by the IDRM which shall include, but not be limited to, the upper ground water aquifer investigation and onsite lithologic support.

10. FUNDING AND COST REPORTING

Costs incurred by the project will be reported to DOE-ID on a weekly basis by EG&G and will be included as part of the weekly program report. F&S will maintain a current status of drilling contractor costs and will report such costs through DOE-NV to DOE-ID on a weekly basis. DOE-NV will periodically furnish DOE-ID the status of F&S support costs. The parties recognize and agree that such costs are unofficial and are subject to change when official monthly costs are reported. Weekly costs will be reported in the form shown in Figure 14.

A comprehensive cost report will be prepared by EG&G for DOE-ID at the conclusion of the drilling.

WEEKLY COST REPORT

REPORT NO. _____

DATE: _____

WEEK ENDING: _____

<u>DESCRIPTION</u>	<u>ORIGINAL ESTIMATE</u>	<u>THIS WEEK</u>	<u>CUMULATIVE</u>	<u>TO COMPLETE</u>
PURCHASED ITEMS ⁽¹⁾				
SERVICES ⁽²⁾				
DRILLING ⁽³⁾				
SUPPORT ⁽⁴⁾				
OTHER ⁽⁵⁾				
TOTAL				

- (1) Purchased items include casing, wellhead, valves, bits, rental equipment, mud, and air drilling chemicals.
- (2) Services includes cementing, logging, H₂S and mud-pit monitoring, coring, transportation, and miscellaneous.
- (3) Drilling includes rotary rig, air compressors, fuel, mobilization, rig-up, demobilization, and contingency.
- (4) Costs include fees, overhead, transportation, consultant, etc.
- (5) OTHER includes EG&G, INEL support, etc.

Fig. 14 Weekly cost report

11. REPORTING

Reports and other documentation will be prepared by EG&G and provided to project participants as specified in this section.

11.1 Daily Drilling Report

This daily report will be prepared by the drilling contractor, using the form standard to the drilling industry and two copies will be provided, one to the F&S drilling supervisor and one to DOE-ID. A Daily Drilling Report (Figure 15) will be prepared by the F&S drilling supervisor. The following people will receive this report:

1. F&S Drilling Manager
2. Project Manager - EG&G
3. Geothermal Electric Division Manager (GEDM)
4. Advanced Programs Division Manager
5. USGS Hydrologic Division Geothermal (HDG) and ((HDI)
6. Idaho Geothermal Program Manager (IDPM)
7. Reservoir Engineer Manager - EG&G

11.2 Monthly Progress Reports

The Geothermal Electric and Advanced Program Divisions will prepare this report as part of the EG&G, Idaho, Geothermal Program Monthly Progress Report, and this report will be written in the same form. Standard distribution will be made to DOE-ID.

11.3 Drilling and Testing Completion Report

The Geothermal Electric and Advanced Programs Divisions will prepare this report. A Comprehensive Completion Report will be prepared at the end of the drilling program. This report will be provided to all individuals included in Subsections One through six of Program Management Section 9 and to all those on the standard distribution list for the Geothermal Program.

"EG&G GEOTHERMAL PROJECT"

Date _____

Operator _____ Lease & Well No. _____

Days _____ Depth _____ Fm _____ Ftge. & Hrs. Drld. _____ Ft./Hr. _____

Operations Present _____ Past 24 Hr. _____

Mud Wt. & Type _____ Vis _____ F.L. _____ pH _____

PV _____ YP _____ Gels _____ Sol. _____ Other _____

Deviation _____

Bit No. _____ Mfr. _____ Size _____ SN _____ Type _____

Jets _____ Bit Wt. _____ RPM _____ In _____ Out _____

Footage _____ Hrs. _____ Ft./Hr. _____ Bit Grade _____

Bit No. _____ Mfr. _____ Size _____ SN _____ Type _____

Jets _____ Bit Wt. _____ RPM _____ In _____ Out _____

Footage _____ Hrs. _____ Ft./Hr. _____ Bit Grade _____

Pump No. _____ SPP _____ Psi _____ GPM AV _____ fpm JV _____ FPS Bit HP _____

Pump No. _____ SPP _____ Psi _____ GPM AV _____ fpm JV _____ FPS Bit HP _____

Drill Collars _____ Size _____ Conn. _____ No. _____ Size _____ Conn. _____ Wt. in Mud _____

Stabilization _____ Jars _____

Cumm. Hrs. on DC _____ Cumm. Hrs. Drlg. _____ Half Strokes _____ Press. _____ Acc. Press. _____

TIME DISTRIBUTION	HR.	COST DATA		DATE LAST BOP CHECK	REMARKS:
		Day	Cumm		
Rig Up and Tear Down	_____				
Drill Actual	_____	Rig	_____	_____	
Reaming	_____	Supv.	_____	_____	
Coring	_____	Rental	_____	_____	
Condition Mud & Circulate	_____	Mud	_____	_____	
Trips	_____	Water	_____	_____	
Lubricate Rig	_____	Rits	_____	_____	
Repair Rig	_____	Mud Log	_____	_____	
Cut Off Drilling Line	_____	Geol.	_____	_____	
Deviation Survey	_____	Cmt.	_____	_____	
Wire Line Logs	_____	Fuel	_____	_____	
Run Casing & Cement	_____	Trk.	_____	_____	
Wait on Cement	_____	Supplies	_____	_____	
Nipple Up B.O.P.	_____	Labor	_____	_____	
Test B.O.P.	_____	Evaluation	_____	_____	
Drill Stem Test	_____	Completion	_____	_____	
Plug Back	_____	Stabilizers	_____	_____	
Squeeze Cement	_____	D. H. Rental	_____	_____	
Fishing	_____	Misc.	_____	_____	
Dir. Work	_____	Sub Total	_____	_____	
		Tang.	_____	_____	
Report By		Total	_____	_____	

Fig. 15 Daily drilling report

APPENDIX A

USGS HYDROLOGIC DATA REQUEST

1. Ltr from J. T. Barraclough (USGS) to D. R. Mabey (USGS), with the subject "Request for Hydrologic Information from the Proposed Deep Thermal Well at INEL."
2. Ltr from W. H. Robinson (USGS) to Dr. C. E. Williams (DOE), committing the USGS to help in the drilling program. Attached to the letter are three proposals, two for the deep hole and one for the three intermediate - depth core holes.

OBJECTIVES OF EXPLORATORY DEEP HOLE

I. Determination of the Principal Parameters of the Volcanic-Sediment Aquifer System

The Idaho National Engineering Laboratory is a model for those interested in reactor development and testing from all over the world. One of the prime prerequisites of a model study is knowledge of all phases of operation. This study then requires a thorough knowledge of the environment in which reactors are operated. Such information should be obtained before operations are begun if possible. However, at INEL a decision was made to proceed without this information and to obtain it later. It is even more important now as operations continue. Little is known about the deeper subsurface environment at the INEL. Few wells penetrate more than a few hundred feet below the water table of the Snake River Plain aquifer. One very important need is knowledge of direction, velocity, and volume of underflow beneath the INEL.

A. Geohydrologic Nature of System

It is proposed to make a continuous core of the 6,000 feet of the hole in order to obtain accurate and representative samples of all formations. Studies of lithologic, physical, chemical, and hydrologic properties would be made utilizing these cores. Numerous formation tests will be made to ascertain hydraulic head, effective porosity, formation pressure, permeability, and reservoir characteristics. Evaluating a composite of the results of all these tests together with caliper, gamma, gamma-gamma, sonic, multiple-point electric, flowmeter, neutron, and other logs will make it possible to evaluate the ground-water circulation and the transmissivity of the aquifer system. Furthermore, any changes in permeability with depth as well as changes in formation pressure should provide additional clues concerning vertical movement of fluids.

The location of the hole and its depth will determine the contribution to an understanding of the major tectonic features. Obviously, a deeper hole penetrating the full Paleozoic section into the basement rocks would contribute much more to knowledge of features such as a massive overthrust or overturning. A hole reaching into the sedimentary section below the basalts will provide data bearing on the origin of the Snake River Plain. Together with the geophysical data, it should provide a key to the magnitude of downfaulting and/or downwarping. Extrapolation of geophysical surface mapping will be most efficient if known contrasts of physical properties of the rocks beneath the Station can be used.

B. Thickness of Basalt Aquifer System

One of the primary purposes of the drilling is the determination of the total thickness of the basalt aquifer system. With proper

selection of the site the deep hole should penetrate the full basalt section which ranges from about 2,000 to about 7,000 feet. Proper logging and testing techniques together with the analysis of cores should make possible the extrapolation of geophysical data from this hole to mapping aerial and vertical distribution of basalt.

C. Hydrologic or Physical Boundaries

A single hole properly sampled, logged, and tested will provide a useful basis for the interpretation and extrapolation of results of gravity, resistivity, aeromagnetic, and seismic surveys. Methods can be used to extrapolate from known lithologic and physical characteristics of the test hole to other parts of the area covered by such surface geophysical surveys. These methods are feasible in the INEL area, because the various types of rock involved differ in magnetic susceptibility and density. Thus, once the key provided by the cores from a single exploratory hole becomes available, it should be possible to map the limits of the aquifer system.

II. Determination of Deep Source of Potable Water for Industrial or Domestic Use

The recommended sampling procedures together with a systematic geophysical well logging program should define the lower limit of potable water at the test well location, providing that limit lies within the proposed 6,000 feet. This would provide information concerning any constituents which limit its use for industrial or other purposes. All sampling would include observations of temperature, pressure, and formation characteristics in order to permit evaluation of changes occurring under ambient surface conditions. Coring should provide samples satisfactory for laboratory tests of adsorption and ion exchange.

III. Determination of Feasibility of Deep Disposal of Tritiated (Low-Level) Radioactive Waste

Drilling a deep exploratory hole into the materials underlying the basalt sequence and adequate testing, including formation fracturing methods, should provide a basis for evaluating the feasibility of deep bedrock storage of waste in liquid, slurry, or other form. Likewise, if geochemical and hydrologic testing should indicate that the lower part of the basalt terraine is hydraulically isolated, it may be possible to utilize permeable zones below useful aquifers for disposal of low-level liquid waste. Radio-isotope dating of selected water samples may indicate the practicality of deep disposal of low-level waste.

IV. Determination of the Depth of Migration of Chemical and Radioactive Waste

One of the primary geochemical goals was the determination of the depth of migration of wastes that have been discharged through various

various wells or ponds. Each of the formation tests would yield a water sample. Thus, a profile of complete radiochemical analyses from the hole should give a fairly reliable concept of the depth of migration. It is also important to determine the pattern of ground-water circulation in the deep test hole. Present knowledge indicates predominantly downward circulation in the vertical interval of the basalt aquifer system so far explored, although upward flow has been found. This is deemed important, because a well appears to be only a short circuit in the basalt system and probably simulates the interconnections believed to exist at depth. The determination of velocity and direction of flow are extremely important in the better understanding of the environment of disposal. Radioisotope dating of selected water samples should provide an index of velocity of movement to various depths.

V. Determination of the Need of Long-Term Monitoring

In terms of long-term monitoring, the value of a single deep hole will be in direct proportion to the adequacy of location and completion. For deep monitoring it may be feasible to use sub-basalt zones which will have intergranular permeability and more widespread fracture permeability than do the basaltic rocks. Hydrated tuffs--even though welded--possess appreciable intergranular permeability. Non-welded ash-flow tuffs have very high permeability. Most of the tuffs exposed in the vicinity of the INEL are moderately to firmly welded; however, some pumice or other pyroclastics, which have undergone little welding, are found. Absorption tests indicate that many of the tuffs of East and Big Southern Buttes have appreciable intergranular permeability. Very permeable pumice can be anticipated in the section in places beneath the Station.

Such intergranular permeability--even though only moderately effective under normal heads--will be vastly more effective under the high hydrostatic heads beneath the basalt section. Thus, a single hole which penetrates the tuffs--especially downgradient from disposal operations--will serve to monitor a large extent of the formation, because radial dispersion can be anticipated--instead of the circumvention of a given borehole which can occur in a predominantly tubular basalt aquifer system. A single properly completed hole could be used to monitor several aquifers. Great care would be necessary to keep the borehole effective in the most important monitoring function--that of ascertaining whether or not any waste passes to or beyond the bottom of the basalt aquifer system. Contamination during drilling by waste from the upper part of the system must be avoided.

Present wells downgradient from the INEL are too shallow to provide information on water at depth in the Snake River Plain aquifer. These wells are "skimming wells" and could not be expected to give advance warning of contamination moving at depth. Due consideration should be given to the need of the deep well to give advance warning of lateral

and vertical movement of radioactive contamination below 1,500 feet, even though the level of contamination of controlled discharge points is kept low.

VI. Heat-Flow Measurement for Geothermal Evaluations

Although geothermal exploration is not the main thrust of this exploratory hole, heat-flow measurements will be made when they don't conflict with the use of the hole for other geohydrologic tests. Such measurements would aid in the evaluation of the geothermal potential of a portion of the Snake River Plain.

VII. Value of Drilling Techniques in Transfer Value

The development of experience in drilling techniques in a highly permeable basalt terraine will obviously be of great value to any future deep drilling ventures on the Snake River Plain. It may also have transfer value to other similar aquifers. Obtaining the maximum amount of information by coring this exploratory hole will provide information for any future drilling. This knowledge can be transferred to parts of the Pacific Northwest, to other parts of the world, where basalt flows are known, and to other terraines having similar characteristics--such as cavernous or fractured dolomite or limestone. If future deep-well disposal of low-level wastes should be considered, this exploratory hole will provide information on the distribution, nature, and size of permeable openings, the adaptability of fracturing and sealing methods to rock and structure, formation fluids, lithologic and hydrologic characteristics controlling disposal, and a basis for planning adequate casing, sealing and construction of a well for disposal of low-level waste.

VIII. Promote Efficient Management of Waste

It is apparent that the decision on whether or not to continue and increase releases at present levels or reduce by treatment the amount of nuclides released is not a prime consideration in justification of the deep exploratory hole. This hole is needed first to understand adequately the complete environment of disposal. There is no alternative to this proposal. The deep exploratory hole became necessary when it was first decided to dispose waste to the environment at the INEL. Time will only accentuate the need. Due consideration should also be placed on the need of this information for planning or for management use in the event that low-level waste is to be disposed to or has reached this deep environment.

PROPOSED DEEP GEOHYDROLOGIC EXPLORATORY HOLE AT THE INEL

Broad Objective: To determine the geohydrologic nature of the Snake River Plain aquifer and of the rocks immediately beneath it at the INEL.

Program Aspects: The exploratory hole will provide the first direct evidence of the nature of the Snake River Plain aquifer at depth in the vicinity of the INEL. Information gained will be important in:

- (1) further studies of water supply, subsurface waste storage, and waste monitoring at the INEL,
- (2) studies of the water resource in the Snake River Plain by state and Federal agencies, and
- (3) studies of the deep structure and geothermal resource of the Snake River Plain by DOE, the Geological Survey, and other agencies.

Detailed Objectives:

To define the subsurface environment at the INEL by determining the thickness, stratigraphy, physico-chemical properties, and boundaries of the Snake River Basalt and of any underlying rocks penetrated.

To determine the geohydrologic nature of the rocks penetrated, including the water-bearing characteristics of the aquifer(s) and confining bed(s).

To determine the geophysical properties of the rocks penetrated, as an aid in studying their character and as a tool in the interpretation of surface-geophysical surveys at the INEL and elsewhere in the Snake River Plain.

General Specifications: A hole, anticipated to be of the order of 6,000 to 7,000 feet deep, drilled through the complete section of basalt and into the underlying sedimentary rocks or older volcanic rocks sufficiently to establish their hydrologic character and geophysical signatures.

Types of Data to be Collected:

- I. (Core Samples) -- lithology and mineralogy; physical, chemical, and hydrologic properties.
- II. (Downhole Tests) -- (a) borehole-geophysical logs for (1) correlation with core, (2) correlation with data from surface geophysics, (3) interpretation of hydrologic properties, and

- (4) establishment of deep water-quality baseline data.
- (b) hydraulic tests to determine (1) head in and yield of water-bearing zones, and (2) integrity of confining beds.

III. (Water-Chemistry Data) -- baseline water quality in each aquifer penetrated (major and principal trace constituents, light stable isotopes, selected radionuclides).

Coordination: Other test-drilling investigations in the Snake River Plain near the INEL have been discussed or may be proposed. The value of any of these investigations would be greatly enhanced by coordination in their design and location, making it possible to extend interpretation to profiles and cross sections which are not practicable using the data from a single site. Even if no additional new drilling were contemplated, planning the test proposed here should include careful consideration of geologic, geophysical, and other data now available to aid in attaining the best possible design and location for the well.

Schedule and Initial Approach: Because prospective candidates for assignment to the proposed deep-well investigation are now completing other projects it appears practicable to set a target date late in the 1978 fiscal year for transfer of a hydrologist to the USGS project staff at the INEL. Planning of the proposed project will be a complex task involving review of the latest improvements in drilling in the basalt and elsewhere; of the optimum diameter of the well to enable relining and hole reduction to maintain separation of aquifers; and of design of borehole-geophysical, coring, and aquifer-testing investigations. It appears that several months would be required for these activities, partly in individual work and partly in work with the INEL contractor to design the specifications for bidding. In light of these requirements and of the time involved in obtaining contracts it appears that drilling could be done in the 1979 calendar year. Completion of drilling, subsurface observations, and reports would require a total of two years.

Cost: Added costs for the USGS project activity at the INEL in connection with this deep drilling would total about \$50,000 per fiscal year. The costs of contracts for drilling, borehole-geophysical surveys, and packer testing would probably total one million dollars or more.

PROPOSAL FOR THREE INTERMEDIATE DEPTH HOLES ON THE EASTERN SNAKE RIVER PLAIN

Geological and geophysical studies on the eastern Snake River Plain have progressed to the stage where information from intermediate depth drill holes is needed to supplement the data that have been obtained on the surface and in existing drill holes. After reviewing the present knowledge of the geology of the eastern Snake River Plain it is the consensus of the U.S. Geological Survey geologists, geophysicists and hydrologists working in the area that a major contribution to the understanding of the geology of the plain and the appraisal of the geothermal resources of the plain will be made by drilling three intermediate depth holes: one each in a caldera, a rift zone and in an area of rhyolite domes. The drilling of three holes is proposed to provide the following data that cannot be obtained in any other way: (1) heat flow determinations in areas where hydrologic disturbances related to the Snake River Plain aquifer prevent meaningful heat flow measurements in shallow holes; (2) subsurface geologic data in areas representative of major structures; (3) subsurface control for the interpretation of surface geophysical surveys; (4) hydrological data to depths greater than any existing wells in the area.

Three types of geologic structures have been identified on the eastern Snake River Plain: (1) rifts along which most of the Snake River Plain basalt has been erupted; (2) large calderas that are partially covered by younger basalt flows; (3) rhyolite domes. In addition areas exist that are not obviously effected by any of these three structures.

A large caldera in the Rexburg area has been defined by geological and geophysical studies. The caldera is about 45 km in diameter and lies along the southeast margin of the plain. Three geothermal systems occur within the caldera near the edge of the caldera. An intermediate depth drill hole at or near Sugar City (Number 3, Fig. 1) should provide a heat flow determination within the central part of the caldera. The hole will penetrate about 200 meters of basalt and stream sediments and then encounter rhyolite. This rhyolite is probably fractured and is part of the Snake River Plain aquifer. The fractured rhyolite appears to extend to about 500 meters below the surface where a three-fold increase in resistivity occurs. We do not know what this lower unit is but it is most probably volcanic rock that is less fractured. The hole should plan to drill at least 300 meters into the lower unit. Thus a total depth of 800 meters is proposed. The best location appears to be in the City Park at Sugar City (Sec. 4, T. 6N., R. 40 E.).

An intermediate depth hole (Number 1, Figs. 1, 2 and 3) in an area of abundant rhyolite near the axis of the plain on or near the southern boundary of INEL would provide a heat flow determination representative of the eastern Snake River Plain and will penetrate the base of the

basalt and sample the rhyolite. In addition to the heat flow and geologic data obtained, this hole would be of considerable value in the interpretation of magnetotelluric data from the eastern Snake River Plain because it will penetrate the major resistivity unit that underlies the Snake River Plain basalt. The hole should be 650 meters deep. The recommended location is Sec. 22, T. 2 N., R. 32 E.

The third proposed hole is in a volcanic rift zone on INEL (Number 2, Figs. 1, 2 and 3). Recent geologic studies on the eastern Snake River Plain indicate that most of the basalt has been erupted from rift zones trending approximately normal to the axis of the plain. Some of these rift zones have been sources of basalt for long periods of time with the most recent eruptions occurring only a few thousand years ago. The structure of the rift zones is not well understood. Some appear to be extensions of Basin and Range structures but little vertical movement occurs across the rifts on the plain. Magma reservoirs that could be important reservoirs of heat in the crust may occur along the rifts. In addition, the rift zones may contain considerable quantities of coarse pyroclastics and sediments, which would afford the necessary porosity and permeability for geothermal systems in the eastern Snake River Plain. The drill hole will provide information on the geology of the rift zone and determine if a significant thermal anomaly in the upper crust is associated with the rift. A depth of 800 meters is recommended at Sec. 15, T. 5 N., R. 31 E.

The drilling program should be designed to obtain maximum core recovery to provide samples to construct complete lithologic logs, for determination of permanent magnetization, for age dating and for physical properties studies. Geophysical logs should be run and the bottom of the hole completed with a small diameter pipe cemented in for heat flow measurements. Hydrologic tests that are compatible with the heat flow measurement will also be made.

The USGS will assume responsibility for all work on the cores and will work with the DOE contractor on the logging and hydrologic tests. Dave Blackwell, with USGS support, will measure the thermal gradients.

These proposed drill holes are an essential part of the Snake River Plain Program and two will be in direct support of the study of the geothermal resources at INEL. The holes will not be designed to tap a resource; therefore, they will not be in conflict with programs of industry. The data obtained will be a major contribution to the Federal-State geothermal effort to appraise the resource on the plain and to programs of commercial companies and local governments interested in the development of the geothermal resources on the plain.

PROPOSAL FOR A STUDY OF THE GEOTHERMAL RESOURCES OF
THE IDAHO NATIONAL ENGINEERING LABORATORY,
FEBRUARY 14, 1978

INTRODUCTION

The Idaho National Engineering Laboratory (INEL) is located along the northwest margin of the eastern Snake River Plain, a region thought to be favorable for the development of geothermal resources at moderate depth (Fig. 1). A study involving surface geological and geophysical surveys, test drilling and well testing is proposed to determine if wells on INEL can produce hot water or steam in sufficient quantity to be useful in supplying space and process heat for the operations there. Heat from approximately 10,000 gallons per minute of water at 150°C could be used for this purpose. Although the proposed study involves the drilling of only one of the several wells that would be required to produce the desired volume of water, production of this amount of heat is a reasonable ultimate objective of the program.

Available data suggest that the eastern Snake River Plain is an area of generally high thermal gradients and high heat flow. The abundance of young volcanic rocks, both basalt and rhyolite, on the plain and occurrences of warm water, particularly along the plain's margins, suggest that subsurface temperatures are abnormally high. Most genetic models developed to explain the surface features and geophysical anomalies imply that the plain has developed in response to regional extension and is within a region of high heat-flow extending from northern Nevada to Yellowstone National Park. However, because most of the plain is underlain by the cool Snake River Plain aquifer, reliable measurements of deep heat flow cannot be made in shallow drill holes. Thermal gradients have been measured in 17 drill holes on INEL. These holes ranged in depth from 87 to 246 m and the gradients ranged from -10.8 to +100.5°C/km. Gradients greater than 49°C/km were measured in 5 holes. Although all of the measured gradients are probably disturbed by the movement of water in the Snake River Plain aquifer, the presence of high local gradients indicate that geothermal systems underlie INEL. The distribution of these high gradient holes suggests that they reflect more than one local geothermal system. About 35 additional holes in which thermal gradients could be measured are available on INEL.

Existing data -- Although geological, geophysical and hydrological studies have been underway at INEL for more than 2 decades the deepest drill holes are only about 500 m deep. Gravity and aeromagnetic surveys of INEL were made by the U.S. Geological Survey (USGS) in 1964. The data from these surveys has been useful in inferring regional subsurface structure in the area but the data cannot be used alone to develop detailed models of subsurface. Also in 1964, a test on INEL of the feasibility of using seismic techniques in mapping subsurface structure was made by a geophysical contractor. A profile of deep resistivity

soundings was made across the Snake River Plain from Arco to Blackfoot by the USGS in 1971. These soundings, several on INEL, demonstrated the usefulness of resistivity data to obtain subsurface information in this part of the plain.

For the past several years investigations have been undertaken by the USGS and several universities toward developing an understanding of the regional geologic framework of the eastern Snake River Plain. This work was expanded in 1977, as part of a Federal-State Cooperative Program directed toward the assessment of the geothermal resources of southern Idaho. High quality regional geologic maps are being produced. Regional gravity and aeromagnetic maps of the plain have been prepared. Magnetotelluric data have been obtained over much of the plain; magnetic variometer, P-wave delay, and seismic refraction data have been obtained along selected profiles. Heat flow has been measured in most of the available wells and a few holes have been drilled for heat flow measurements. In addition to these studies that are regional in scope, detailed geological, geophysical, and hydrological studies have been made in a few areas. Three intermediate-depth drill holes have been proposed (650-900 m). Two of these are for sites on or near INEL.

The available data suggest the following about the subsurface geology of the eastern Snake River Plain. The basalt which covers most of the plain has a maximum inferred thickness of about 2 km and this maximum occurs in the southwestern part of INEL. The basalt thins northeastward across INEL.

The basalt is underlain mainly by rhyolite. However, the material under the basalt ranges widely in thickness and resistivity and probably consists of Tertiary sedimentary rocks as well as both fresh and altered rhyolite. Underlying this layer of low resistivity is a "basement" of much higher resistivity. This basement does not crop out on the plain nor has it been penetrated in any drill holes. The composition of this basement remains one of the fundamental and critical unknowns of Snake River Plain geology.

North and south of the eastern Snake River Plain large basin and range structures trend approximately normal to the axis of the plain. Some of these structures continue to the margins of the plain while others die out short of the plain. Another fundamental unresolved problem is what happens to these structures at the edge of the plain and what is the structure of the edge of the plain. Rifts across the plain control centers of basalt eruption and appear to be extensions of the basin bounding fault zones beyond the plain. These cross-plain rifts probably control rock and structural as well as hydrologic in homogeneities of the plain and may well influence geothermal fluid movement.

Four basic types of structures have been used to explain the Snake River Plain depression:

- (1) pull-apart rift,
- (2) a graben,
- (3) a down warp,
- (4) a complex of calderas.

Data support each and all four may account for the plain.

Three fundamental problems must be considered in evaluating the geothermal resources of the eastern Snake River Plain and of INEL:

- (1) what is the regional heat flow and thermal gradient of the plain,
- (2) what rocks underlie the volcanic rocks, and
- (3) what structures control the margins and interior of the plain.

These problems are being addressed by the Federal-state program to assess the geothermal potential of the Snake River Plain.

The regional phase of the studies of the eastern Snake River Plain are nearing completion (the major gap in the regional studies is completion of deep refraction profiling recently begun by the University of Utah). During FY-78 a large part of the geothermal effort will be concentrated on obtaining heat-flow data and on intensive studies of an area along the margin of the plain designed to obtain data on the structures at the margin of the plain and underlying the plain.

Proposal for an INEL program in FY-78 -- Because INEL encompasses both a margin and a large segment of the plain extending to the plain axis, it is a logical area upon which to focus the research studies of the USGS and at the same time determine if a source of heat is available on INEL. Funding for much of this effort is available within the existing program.

The USGS is interested in a cooperative program with the Department of Energy (DOE) to explore for a geothermal reservoir on INEL. This program would focus the efforts already planned on the eastern Snake River Plain toward INEL and expand the program to include the work needed to obtain the data required to recommend locations for one or more deep geothermal test wells on INEL. The area of concentrated activity is shown in Figure 2.

All available information suggests that geothermal reservoirs should exist under INEL and that they could be tapped to produce heat useful in the operations at INEL. Three types of reservoirs may underlie INEL:

- (1) hot water or steam in porous rocks,
- (2) hot rock that does not contain producible fluids,
- (3) molten rock.

All three types of reservoirs might eventually be sources of useful heat as extraction technology is developed, but only the first can be considered as an immediate source of large amounts of energy. Reservoirs of hot water require both porous rock containing water and high temperatures. Porosity may have developed as rocks are formed or may result from fracturing related to later deformation. Fluids may be heated at shallow depths in regions of high thermal gradients or by movement through deeper hot zones before transport to shallower levels.

Information that can be used to determine where geothermal reservoirs are likely to occur on the Snake River Plain are geophysical surveys, measurements of temperature in wells, and syntheses of these data within the geologic framework developed from surface mapping. The geophysical surveys should be directed toward mapping subsurface structure and lithology and toward direct and indirect detection of anomalous temperature zones. The subsurface geology and distribution of heat under INEL is probably highly complex, and any program of drilling a few exploration holes can benefit enormously from a combined geological, geophysical, and hydrological study to define drilling targets.

Specifically we propose the following program for FY-78:

- (1) Location of two intermediate depth drill holes on or near INEL (see attached program for intermediate depth drilling). This will provide information on the regional thermal gradients in the area of INEL as well as geologic and hydrologic data to greater depths than is now available. The drilling program will be funded and managed by the Geothermal Division of DOE. Temperature measures will be made by David Blackwell, of Southern Methodist University, with USGS support. Analysis of core logs will be by USGS.

- (2) Geophysical surveys along the margin of the Snake River Plain in the vicinity of INEL to determine the nature of the structure at the plain margin and define structures at depths under the plain. This work would be funded as a part of the USGS Geothermal Research Program.

- (3) Site specific studies on INEL directed toward recommending locations and depths for one or more geothermal test wells. This work

would consist of resistivity, magnetotelluric, refraction seismic, and geologic surveys. Estimated cost of this field work is \$70,000 with funds to be provided by DOE and the work done by USGS.

(4) Completion of the thermal gradient measurements in existing wells on INEL. This work can be done for \$15,000 if DOE makes funds available to Blackwell (SMU).

(5) Analysis of all geological, geophysical and hydrological data available on INEL that might relate to the occurrence of geothermal reservoirs on INEL and the recommendation of a drilling program to test for geothermal reservoirs. This work by the USGS will be supported by the USGS Geothermal Research Program.

The field investigations and the preparation of a drilling recommendation can be completed by August 1, 1978, if approval to proceed is received by March 1, 1978. Subsequent studies to appraise and utilize data resulting from the deep drilling are not covered in this proposal.

Deep Test Well -- The primary purpose of a deep test well (3000 meters is a reasonable projected depth for planning purposes) is to determine if the required volume of hot water or steam can be produced from the rocks underlying INEL; however, the well would provide numerous other benefits. No deep holes have been drilled on the eastern Snake River Plain and data from a deep drill hole are essential to test models developed from the surface studies. A reasonable assessment of the geothermal potential of the eastern Snake River Plain cannot be made until at least one deep hole is drilled. The deep test well will also provide very valuable information needed to estimate the possibility of major accumulations of oil and gas occurring under the plain. In addition to the benefits to the Federal-State Geothermal Program, data from a deep test well is needed by other INEL activities that involve some earth science problems. The well and related work will make a major contribution to studies of the earthquake and volcanic hazards at INEL. Drilling a 2000 meter well at INEL has been proposed as part of the geohydrologic studies related to waste-storage and waste-monitoring activities (see attached letter from W. H. Robinson to C. E. Williams). A program for drilling and testing the geothermal well can be developed that would obtain much of the data needed in the geohydrologic studies.

Production testing will require a well 40 cm in diameter or larger and the well can be converted to a production well. Because of the importance of the well in obtaining data on the subsurface geology, cuttings must be logged and provisions made for obtaining core in critical intervals. A complete set of geophysical logs should be obtained by contracting. Special logs such as temperature gradient and televiwer can be obtained by the USGS. Testing reservoir properties and sampling water will be a major objective of the drilling. Although the geothermal interest will be primarily in testing hot water reservoirs,

other interests dictate the testing of the complete well with a string of the testing costs (see attached request from Barraclough and Rightmire).

Because this will be the first deep well drilled on the eastern Snake River Plain, large uncertainties exist as to drilling conditions to be anticipated. The well will probably penetrate 1000 to 2000 meters of interbedded basalt and sediment underlain by a unit that is predominantly rhyolite or sedimentary rocks of Tertiary age. The hole might penetrate indurated pre-Tertiary rocks, probably sedimentary. Maintaining circulation of drilling fluid may be a major problem, particularly in the basalt.

Although we have no indication of the temperatures that may be encountered, preparation for drilling in temperatures up to 300°C should be made. The well may be located in an area underlain by low-level radioactive wastes. This should not be a major problem in the drilling.

APPENDIX B

SCHEDULE TIE-IN FOR COREHOLES AND SNAKE RIVER PLAIN DEEP HOLE

(Figure Numbers Refer to Figures in This Report)

MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST
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APPENDIX C
SCHEDULE OF MAJOR EVENTS

APPENDIX C SCHEDULE OF MAJOR DRILLING ACTIVITIES

APPENDIX D

SCHEMATIC OF BLOWOUT PREVENTOR CONTROL SYSTEM

APPENDIX D

SCHEMATIC OF BLOWOUT PREVENTER CONTROL SYSTEM

APPENDIX E
SITE RESTORATION FOR TEST HOLE

APPENDIX E SITE RESTORATION FOR TEST HOLE

APPENDIX F

SITE RESTORATION FOR GEOTHERMAL PRODUCTION WELL

APPENDIX F SITE RESTORATION FOR GEOTHERMAL PRODUCTION WELL

APPENDIX G

WELL DRILLING AND TESTING COST ESTIMATES

12/13/78

TIME AND COST ESTIMATE
INEL-1
GEOTHERMAL EXPLORATORY HOLE

	<u>Days</u>	
A. Site Preparation		
Includes construction of access road, leveling, site and compacting drill pad surface with gravel. Construct reserve pit. Construct 8' x 10' x 10' cellar. Install 40' of 30" conductor casing.		27,000.00
B. Rig Operations (700 HP Minimum)		
1. Mobilization		200,000
2. Drill 26" hole to $\pm 1,500'$ using mud. (R/P = 125'/day)	12	86,400
3. Run Logs	1	7,200
4. Run $\pm 1,500'$ of 20" O.D. 106.5 lb/ft., K-55, ST&C casing, cement to surface. WOC. Run NCTL log. Install BOP equipment.	2	14,400
5. Drill 17-1/2" hole to $\pm 3,500'$ using mud. (R/P = 150'/day)	13	93,600
6. Perform coring, logging, and DST operations as directed by Contracting Officer	23	165,600
7. Run $\pm 3,500'$ of 13-3/8" O.D., P-110, 72 lb/ft., casing. Cement to surface. WOC. Run NCTL log. Install BOP equipment.	4	28,800
8. Drill 12-1/4" hole to $\pm 5,000'$ using mud or water. (R/P = 125'/day)	12	86,400
9. Perform coring, logging, and DST operations as directed by Contracting Officer.	8	57,600
10. Run a 1,700' long, 9-5/8" O.D. 40.0 lb/ft., S-95, casing liner. Bottom of liner to be set at $\pm 5,000'$. Cement liner to within 100' of the top of the liner. WOC. Drill cement out of 13-3/8" casing and dress top of liner with diamond point bit. Run NCTL log. Pressure test.	5	36,000

B. 11. Drill 8-1/2" hole to $\pm$ 7,500' using mud or water.	17	122,400.00
12. Perform coring, logging, and DST operations as directed by contracting officer.	9	64,800.00
13. Miscellaneous operations and delays	8	57,600.00
14. Demobilization		<u>150,000.00</u>
Sub Total	114	1,170,800.00

C. Materials and Services

1. Casing

1,000' - 20", 106 #/ft., K-55, ST&C @ \$3,937.64/100'	39,376.40
500' - 20", 94 #/ft., H-40, ST&C @ \$3,388.55/100'	16,942.75
3,500' - 13-3/8", 72 #/ft., P-110 (drifted for 12-1/4" bits). ST&C @ \$3,951.60/100'	138,306.00
1,700' - 9-5/8", 40.0 #/ft., S-95 LT&C @ \$2,123.23	36,095.00
Freight Cost (FOB mill) McKees Port, PA., to Idaho Falls, ID \$4.00/100#'s 571,500# total. 5,715 (100# units) @ \$4.00/unit	<u>22,860.00</u>

Sub Total

254,497.85

C. 2. Casing Hardware and Equipment

1 - 20" type 700T male and female tag-in. Float collar @ \$1,870.50/ea.	1,870.50
1 - 20" 8rd. down jet-float shoe @ \$1,175.00/ea.	1,175.00
4-1/2" tag-in adaptor	N/C
4-1/2" x 20" centralizer	N/C
Bowl and slips 4-1/2" D.P. slips and rotary. Plate (rental) @ \$150.00	150.00
15 - 20" centralizers @ \$85.00/ea.	1,275.00
1 - 13-3/8" guide shoe @ \$207.00/ea.	207.00
1 - 13-3/8" float collar @ \$470.00/ea.	470.00
20 - 13-3/8" centralizers @ \$59.00/ea.	1,180.00
1 - 13-3/8" pump down plug @ \$50.90/ea.	50.90
1 - 9-5/8" guide shoe @ \$124.00/ea.	124.00
1 - 9-5/8" float collar @ \$309.00/ea.	309.00
20 - 9-5/8" centralizers @ \$41.00/ea.	<u>820.00</u>

Sub Total

5,948.40

C. 3. Liner Hanger 9-5/8" x 13-3/8" Not Sealed

Liner setting sleeve @ \$1,985.00/ea.	1,985.00
Liner hanger @ \$5,560.00/ea.	5,560.00
Land w/collar @ \$910.00/ea.	910.00
V-set shoe @ \$1,350.00/ea.	1,350.00
Liner wiper plug @ \$1,275.00/ea.	1,275.00
Drill pipe plug @ \$275.00/ea.	275.00
Rental equipment set tool (9-5/8") @ \$350.00/job	350.00
Manifold @ \$240.00/ea.	240.00
Miscellaneous equipment	400.00
Motor freight	100.00
Serviceman for 3 days @ \$325.00/day	975.00
Mileage from Casper, WY to Idaho Falls, ID \$.60/mile @ 1,300 miles round trip	<u>780.00</u>

Sub Total

14,210.00

C. 4. Bits and Hole Openers

4 ea. - 26" bit (M.T.) @ \$6,765.00/ea.	27,060.00
7 ea. - 17-1/2" bit (M.T.) @ \$2,638.00/ea.	18,466.00
2 ea. - 17-1/2" bit (T.C. Sealed Bearing) @ \$8,630.00/ea.	17,260.00
5 ea. - 12-1/4" bit (M.T.) @ \$798.00/ea.	3,990.00
4 ea. - 12-1/4" bit (T.C. Journal Bearing) @ \$5,162.00/ea.	20,648.00
2 ea. - 8-3/4" bit (M.T.) @ \$550.00/ea.	1,100.00
8 ea. - 8-3/4" bit (T.C.) @ \$2,664.00/ea.	21,312.00

Freight costs Houston, TX to Idaho Falls,
ID \$16.87/100#'s 15,199#'s total
152 (100# units) @ \$16.87/unit

2,564.24

Sub Total

112,400.24

C. 5. Well Head Materials
Lump Sum

36,914.08

C. 6. Mud Logging Trailer

Set up @ \$1,000.00	1,000.00
Two-man trailer with 3 extra services: 52 days @ \$475.00/day	24,700.00
Standby: 62 days @ \$315.00/day	<u>19,530.00</u>

Sub Total

45,230.00

C. 7. Mud Chemicals and Lost Circulation Materials:

a. Mud Materials	52,000.00
b. Lost Circulation	<u>20,000.00</u>

Sub Total	72,000.00
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C. 8. Trucking
Lump Sum 15,000.00

C. 9. Welding:

20 days x 10 x \$25.00	<u>5,000.00</u>
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Sub Total	5,000.00
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C. 10. Shock Sub

26" and 17-1/2", wt. est. 2,000#'s	
11" shock tool 5 days min. @ \$1,320.00	1,320.00
Additional days 23 @ \$225.50/day	5,187.00

Freight .80¢/mile x 672 miles	537.60
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\$30.00/hr. wait to unload	
\$30.00/hr. x 1 hr.	<u>30.00</u>

Sub Total	7,074.60
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C. 11. Drilling Jars

Rental \$175.00/day x 20 days	3,500.00
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Freight: .80¢/mile x 2 road trips from Casper, WY to site	
.80¢/mile x 3,040 mi. (2. road trips)	<u>2,432.00</u>

Sub Total	5,932.00
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C. 12. Tubing

a. 7,500 - 2-7/8" 6.5 #/ft., N-80, EUE 8rd. tubing, T&C @ \$425.59/100'	31,919.25
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Los Angeles Handling Charge \$3.30/100'	247.50
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Trucking: 488 (100# units) x \$2.50/100#	<u>1,220.00</u>
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Sub Total	33,386.75
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C. 12. b.	3,500' - 1.9", 2.9 #/ft., J-55 Hydril, CS @ \$565.62/100'	19,796.70	
	Handling Charge \$3.75/100'	131.25	
	Trucking: (100# units) x \$2.50/100#	<u>253.75</u>	
	Sub Total		20,181.70
C. 13. Casing Crews			
a.	Run 1,500' of 20" casing		
	4-man crew w/power unit and tongs	2,190.00	
	20" spider and slips (200-ton)	360.00	
	20" elevators	170.00	
	Standby @ \$18/hr./man	288.00	
	Mileage one (1) R/T 672 @ .75¢ mile	<u>504.00</u>	
	Sub Total		3,512.00
b.	Run 3,500' of 13-3/8" casing		
	4-man crew w/power unit and tongs	1,085.00	
	13-3/8" elevators	70.00	
	13-3/8" spiders and slips	60.00	
	Standby @ \$18/hr./man 4 hrs.	288.00	
	Mileage one (1) R/T 672 miles @ 75¢/mile	<u>504.00</u>	
	Sub Total		2,007.00
C. c.	Run 1,700' of 9-5/8" liner to 7,000'		
	4-man crew w/power unit and tongs	697.00	
	9-5/8" elevators	60.00	
	9-5/8" spider and slips	40.00	
	Standby @ \$18/hr./man 4 hrs.	288.00	
	Mileage one (1) R/T 672 miles @ 75¢/mile	<u>504.00</u>	
	Sub Total		1,589.00

Days

C. 14. Logging Services

a.	At 1,500'	
	Run suite of logs consisting of:	
	Caliper	
	GR	3,750.00
b.	At 1,500'	
	After casing job, run NCTL	3,750.00
c.	At 3,500'	
	Run suite of logs:	
	Caliper	
	Compensated Density w/Caliper	
	Compensated Neutron w/GR	10,106.00
	Focused DIL	
	BHC Acoustic Log	
	Temperature Log	
d.	At 3,500'	
	After casing job, run NCTL	3,606.00
e.	At 5,000'	
	Run suite of logs at	
	c. above	12,202.00
f.	At 5,000'	
	After casing job, run NCTL	4,101.00
g.	At 7,500'	
	Run suite of logs at c. above	18,472.00
h.	Computerized evaluation	2,500.00
i.	Misc. additional services	<u>5,000.00</u>
	Sub Total	63,547.00

C. 15. Stabilizers

a.	26" hole (non-rotating sleeve)	
	Body rental	
	Rental \$220/Tool/Well x 3	660.00
	26" boots	
	3 boots at \$2,200/each	6,660.00

Days

C. 15. Stabilizers, cont'd.

a. Trucking - 1,300 miles at .75¢/mile	975.00	
Sub Total		8,235.00
b. 17-1/2" hole (non-rotating sleeve) Body rental (see above)	N/C	
17-1/2" boots 6 boots @ \$740/boot	4,440.00	
Sub Total		4,440.00
c. 12-1/4" hole (non-rotating sleeve) Body rental (see above)	N/C	
12-1/4" boots 9 boots @ \$485/boot	4,365.00	
Trucking (see a. above)	N/C	
Sub Total		4,365.00
d. 8-1/2" hole integral blade stabilizer and roller reamer		
1 - near bit reamer body rental	165.00	
Reamer cutter (Tungsten Carbide) 6 sets @ \$950/set	5,700.00	
6 - integral blade stabilizers 6 each @ \$1,590/each	9,540.00	
Trucking - 1,300 miles @ .75¢/mile	975.00	
Sub Total		16,380.00

C. 16. Packer Testing (For USGS)
1,500' to 5,000'

Assume 6 packer tests between
1,500' and 5,000'; each test
lasting 2 days/test

a. 2 - Packer tests per call out on two call outs. Includes R/T mileage from Casper, WY to location, serviceman & material costs \$11,834 (2 tests) x 2 (call outs)	23,668.00	
Sub Total		23,668.00

Days

C. 16. Packer Testing, cont'd.

- b. 2 - Packer tests on 12-1/4" hole
3,500' - 5,000'; one call out.
Includes R/T mileage from Casper,
Wt to location, serviceman, and
material costs.

11,064.00

Sub Total

11,064.00

C. 17. Power Tubing Tongs and Slips

- a. Power unit and tongs

2 days

475.00

10 additional days

@ \$120/day

1,220.00

Sub Total

1,695.00

- b. Power slips - 2-7/8"

5 days minimum

220.00

7 additional days

@ \$22.50/day

157.50

Serviceman - 2 trips for servicing
and repair - 2 x .50 x 1320 miles

1,320.00

Sub Total

1,695.50

C. 18. Coring Services

- 11 - 30' long cores required.
7-7/8" core heads @ \$7,500 (50% salvage)
300' ÷ 100 = 3 bits x \$7,500 x 50%

11,250.00

Core barrel rental - 6-1/4" x 4

In use - \$171/day x 19 days

3,249.00

Standby - \$38/day x 82 days

3,116.00

Stabilizer(s)

2 x \$36/day of use x 19

1,368.00

Sub \$10/day of use x 19

190.00

Jars \$185/day of use x 19 days

3,515.00

Expendables \$3/ft. x 300'

900.00

Days

C. 18. Coring Services, cont'd.

Trucking: Vernal, Utah
R/T 812 miles x .75¢/mile

609.00

Serviceman: Vernal, Utah
19 days @ \$270/day

5,130.00

Mileage: 10 trips @ 812 miles x .40

3,248.00

Core barrel service charge

90.00

Sub Total

31,765.00

C. 19. Drill Stem Testing

4 drill stem tests - 5,000' - 7,500'

2 separate DST in 12-1/4" hole from
3,500 - 5,000'

\$3,361/test x 2
(Total 13 hrs./test)

6,722.00

2 separate DST in 8-3/4" hole from
5,000' - 7,500'.

\$3,094/test x 2

6,188.00

Sub Total

12,910.00

C. 20. Cementing

a. Cement 1,500' of 20"

44,197.00

b. Cement 3,500' of 13-3/8"

47,215.00

c. Cement 1,700' of 9-5/8" liner

11,985.00

Sub Total

103,397.00

C. 21. Misc. Freight Charges

Lump Sum

5,000.00

C. 22. Surveying

Gyro-Survey to 7,500' in and out
run on 100' stations; using heat shield

6,375.00

Mileage - 1,300 miles @ .55¢/mile

715.00

	<u>Days</u>	
C. 22. Surveying, cont'd.		
Equipment and operator - extra travel expenses		1,050.00
Hoisting service: logging contractor 1 L.S.		<u>1,500.00</u>
Sub Total		9,640.00
23. Rental Equipment		
Lump Sum		<u>50,000.00</u>
Sub Total		932,685.12
D. Fenix & Scisson, Inc.		
1 - drilling engineer	60	
3 - drilling specialists	114	
Reports, specifications, technical writing		<u>91,000.00</u>
Sub Total		2,271,485.12
Contingency - 20%		<u>454,297.02</u>
TOTAL		<u><u>2,725,782.14</u></u>

APPENDIX H
BID PROPOSAL SPECIFICATIONS
SECTION II SPECIAL CONDITIONS
SECTION IV TECHNICAL PROVISIONS AND EXHIBITS

SECTION II

SPECIAL CONDITIONS

SECTION II
SPECIAL CONDITIONS
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SECTION II
SPECIAL CONDITIONS

SC-01. STATEMENT OF WORK

- A. Location. The INEL-1 geothermal exploratory hole will be located on the Eastern River Plain in southeastern Idaho (see Figures 1, 2, and 3). The hole location is NE1/4NW1/4, Sec. 1, T3N, R29E, Butte County, Idaho. A minimum access road is available to the drilling location.
- B. Description of Work. The work consists of furnishing all personnel, equipment, facilities, materials, supplies, fuel, and services, unless otherwise specified, to perform the following:
1. A concrete cellar and 40 feet of 30-inch conductor will be completed by others prior to mobilization.
 2. Drill, run and cement 20-inch surface pipe to a depth of ± 1500 feet.
 3. Drill, run and cement 13-3/8 inch casing to a depth of ± 3500 feet.
 4. Drill, run, hang and cement a 9-5/8 inch liner to ± 5000 feet.
 5. Drill 8-3/4" open hole to $\pm 7500'$.
- C. Government-Furnished Items. The Government will furnish, for the work under this contract, the items listed in Exhibit B.
- All Government-furnished items will be delivered to and picked up from the drill site by others; however, the Contracting Officer, or his representative(s) may direct the Contractor to perform this work as a reimbursable item as provided in SC-08, paragraph 4.
- D. Contractor Minimum Equipment Requirements. The minimum equipment and services to be furnished and operated by the Contractor at no additional cost to the Government are listed in Exhibit C.
- E. Contractor-Furnished Government-Reimbursable Items. The equipment and services which the Contractor may be required to furnish and the cost thereof reimbursed under the provisions of SC-08, paragraph 4, "Special Items and Services," shall include but are not limited to, items listed in Exhibit D.

SC-02. COMMENCEMENT AND COMPLETION

The Contractor shall be required to complete mobilization within 30 calendar days after the date of receipt of written Notice to Proceed and to complete the entire work on or about 160 days after contract award as required by the Contracting Officer.

SC-03. WORKWEEK AND CREW REQUIREMENTS

- A. The Contractor shall furnish sufficient qualified personnel to maintain a 24-hour day, 7 day week (with exceptions as noted) operation as follows:
- 1 Drilling Supervisor available at all times
 - 1 Driller for each crew
 - 1 Derrick Man for each crew
 - 2 Rotary Helpers for each crew
 - 1 Motor Man for each crew
 - 1 Combination Heavy Duty Welder-Repairman for daylight hours and for 24-hour call out when required.
- B. In addition to welding on Contractor-furnished equipment, the combination heavy duty welder-repairman will be required to perform welding on Government-furnished materials and equipment, including fishing tools, as necessary. The Contractor will not receive any additional compensation for these welding services or for welding supplies required for these services.

SC-04. ACCOMMODATIONS FOR CONTRACTOR'S PERSONNEL

There are no messing and recreation facilities available at the INEL-1 Site.

SC-05. SURFACE LOCATION

The surface location of the holes, drilling sites, and any pits required will be established by the DOE. Exhibit A indicates the approximate location of the work.

SC-06. WATER

- A. The Government will furnish water at the location through a pipe line or by hauling from a nearby source as needed. The Contractor shall be responsible for storing water for all operations. This includes providing sufficient water for drilling operations and cementing operations. Should water storage required for cementing services exceed the 1,000 barrel storage tank furnished by the Contractor, the Government will provide such additional storage.
- B. Drinking water shall be furnished by the Government.

SC-07. SUBSURFACE INFORMATION

- A. Subsurface formations are anticipated to be basalt, rhyolite, and Paleozoic sediments. Other data concerning possible subsurface conditions to be encountered may be obtained from the F&S Engineer's Office at Mercury, Nevada. This includes information based upon the drilling of other holes in Idaho.
- B. The subsurface information and data furnished both in these specifications and at the Engineer's office are not intended as representations or warranties but are furnished for information only.
- C. It is anticipated that the information contained herein generally represents the conditions that will be encountered in the performance of this contract; however, any interpretation or conclusion reached by the Contractor in preparing its Unit Price Schedule based upon the information contained herein will be its responsibility solely.

SC-08. UNIT PRICE SCHEDULE ITEMS DEFINED

Paragraph headings in this Special Condition correspond to the items of the Unit Price Schedule.

- 1. Mobilization. The Contractor shall perform all work required for the site preparation other than that furnished by the Government as outlined in Exhibit B. The Contractor shall move in and rig up its equipment, rig up subcontractor's equipment, rig up all Government-furnished equipment, including but not limited to the Government-furnished input and discharge testing lines. Drill and case the rat hole and mouse hole, and pick up first drilling assembly. All work and services required for mobilization by the Contractor as outlined above shall be paid for under Item 1. of the Unit Price Schedule but only after all equipment, as outlined above, is on site and rigged up.
- 2. Government-Directed Operations. All work shall be on an hourly rate basis and be performed with a full complement of Contractor's personnel under the supervision of the Technical Project Officer (TPO).

If it becomes necessary to shut down the Contractor's rig for repairs while the Contractor is performing work on an hourly rate basis, the Contractor shall be allowed compensation for such repair time at the appropriate hourly work rate commensurate with the type of operations then in progress.

Request for Proposal No.
DE-AC07-79ID12023 (Cont'd)

SC-08. UNIT PRICE SCHEDULE ITEMS DEFINED (Cont'd)

The number of hours devoted to repair work for which the Contractor may be compensated will be limited as follows:

8 hours for any one repair job
24 hours total during any 30-day period from end of mobilization to completion of the work.

a. With Drill Pipe

Operations conducted while using drill pipe will be paid for under Item 2.a. of the Unit Price Schedule.

b. Without Drill Pipe

Operations conducted without using drill pipe will be paid for under Item 2.b. of the Unit Price Schedule. Operations in this category may include but are not limited to:

- (1) Repair or replacement of Government-furnished equipment.
- (2) Survey runs and logging operations.
- (3) Geothermal test operations.

3. Standby

When directed by the TPO, the Contractor shall cease all operations and stand by in a ready or secured condition, whichever is directed by the TPO:

a. Ready. A full operational complement of personnel and equipment shall be maintained at the work site or at a site selected by the Contracting Officer and/or TPO ready to resume operations immediately. Time spent under standby-ready will be paid for under Item 3.a. of the Unit Price Schedule.

b. Secured. All equipment may be secured and personnel need not be in attendance. A 24-hour notice will be given before the Contractor is directed to go on standby-secured. Standby-Secured rates will continue until normal operations are resumed, but under no circumstances shall exceed 24 hours after receipt of notice from the Contracting Officer and/or TPO to resume operations. Time spent under standby-secured will be paid for under Item 3.b. of the Unit Price Schedule.

SC-08. UNIT PRICE SCHEDULE ITEMS DEFINED (Cont'd)

4. Special Items and Services

Special items and services shall be procured only at the direction of the Contracting Officer.

- a. For purchases of \$10,000 or less, the Contractor shall follow its own procurement policies and practices. Prior to purchases in excess of \$10,000, the Contractor with approval of the Contracting Officer and/or the TPO shall secure competitive quotations to the maximum extent practicable. The contractor and/or TPO shall fully justify, prior to actual purchase, any procurements made on a sole source basis. The Contractor and/or the TPO shall document its procurement actions by showing what competitive prices were obtained, or if competition is not practical, shall document the reasonableness of price by other means. Such documentation shall be submitted to the Contracting Officer or his designated representative for approval prior to procurement. In emergency situations, verbal submissions and approvals may be made but must be confirmed in writing.
- b. In the event the Contractor should purchase or rent special tools, materials, and services at the direction of the TPO, the Government will pay the Contractor the actual invoice cost, including sales tax where levied, of such tools, materials, and services delivered to the work site less all discounts, refunds, rebates, and salvage allowances to which the Contractor is entitled. DOE shall deduct from pay estimates any discounts, refunds, rebates and salvage allowances offered by vendors whether or not the Contractor has taken advantage of such benefits, except in those cases where the Contractor provides in writing a valid explanation for failure to take advantage of such deductions. Payment will be made under Item 4. of the Unit Price Schedule upon receipt by the Government of paid invoices evidencing receipt of materials by a Government representative. No separate payment will be made to cover overhead or profit for this service. Title to all tools and materials purchased by the Contractor pursuant to the direction of the Contracting Officer as provided above shall pass directly to the Government and all purchase orders and/or invoices shall so provide.

SC-08. UNIT PRICE SCHEDULE ITEMS DEFINED (Cont'd)

- c. The withholding provisions of paragraph (c) of Article 7 of the General Provisions do not apply to special items and services to be furnished by the Contractor pursuant to Exhibit D. Reimbursement will be included with the partial payments made pursuant to paragraph (b) of Article 7.
 - d. Commercial bills of lading covering shipment of tools or materials under the provisions of this Special Condition must include the following statement: "This statement is for the account of the U. S. Government which will assume the freight charges, and is subject to the terms and conditions set forth in the standard form of the U.S. Government bill of lading and to any available special rates or charges."
 - e. Records and accounts relating to reimbursable costs are subject to inspection and audit. The Contractor agrees to keep books of accounts, records, documents, and other evidence bearing on payments to be made under the provisions of this above. The methods of accounting employed by the Contractor with reference to such costs shall be subject to the approval of the DOE but no material change shall be required therein, if it conforms to generally accepted accounting practice. All such books of account, records, documents, and other evidence relating to such reimbursable costs shall be subject to such other disposition as may be agreed upon by Contractor and DOE. The Contractor shall have a period of three years after completion or termination of this contract to preserve such other books of account, records, documents, and other evidence relating to reimburseable costs as are not furnished by the Contractor to the Government in support of payments under the contract.
5. Demobilization. Demobilization shall include the final laying down of Government-furnished equipment, irrespective of the time when this occurs. This includes but is not limited to drill bits, drill collars, drill pipe, kelly, swivel, and rotary hoses. After all work on a hole is completed as directed by the Contracting Officer, the rig shall be demobilized and all Contractor equipment removed from the INEL-1 Site. The above work and all materials and services required for demobilization will be paid for under Item 5. The Contractor will not be responsible for leveling the work site or draining and backfilling pits.

SC-08. UNIT PRICE SCHEDULE ITEMS DEFINED (Cont'd)

Contractor-furnished equipment shall be demobilized and moved from the INEL-1 Site within 10 days after the rig is released.

SC-09. RECORDS AND OBSERVATIONS

Providing the following records and observations shall be a part of the Contractor's general responsibility for which no additional payment will be made.

- A. A Daily Drilling Report shall be kept on the IADC Official Standard Daily Drilling Report. The Unit Price Schedule quantities for pay estimate purposes will be taken from the IADC Daily Drilling Report. The general remarks section shall contain an accurate record of hole conditions and work performed and time required for all work to the nearest quarter-hour. The original and six copies of the Daily Drilling Report shall be submitted daily to the Contracting Officer or his authorized representative.
- B. An Automatic Drilling Recorder shall be used to measure the rate of penetration, drilling weight, rpm, torque, and air pressure. All rig operations such as depth, round-trip time, coring time, lost circulation intervals, equipment breakdowns, conditioning time, and other important drilling data shall be clearly identified on the recorder charts. The original and one copy of the Drilling Recorder Chart shall be submitted daily to the Contracting Officer or his authorized representative at the drill site.
- C. Bit and Cutter Records shall be maintained daily and posted in the dog house. A complete record shall be furnished to the Contracting Officer monthly. Records shall show bit types, footage, depths, rotary speeds, bit weights, and cutter serial numbers.
- D. Accurate Pipe Tallies shall be the Contractor's responsibility and shall be available at the drill site for inspection at all times. Copies of steel line measurements of pipe and casing shall be furnished as directed by the Contracting Officer. The Contractor shall keep an accurate record of the total number of joints of all drill pipe, drill collars, and tubing on location at all times.
- E. The Contractor shall be responsible for the inventory control of all Government-furnished and reimbursable items. Contractor's

SC-09. RECORDS AND OBSERVATIONS (Cont'd)

inventory shall include a record of when Government-furnished and reimbursable items were received by the Contractor and conditions under which such items were expended or removed from the work site. This record shall be maintained at the work site and submitted monthly to the Contracting Officer or his authorized representative.

- F. Accurate records of water volumes injected into and removed from the hole shall be the Contractor's responsibility, and shall be submitted with his daily drilling reports.

SC-10. DERRICK MISALIGNMENT

- A. If, at any time, the Contractor's derrick becomes misaligned over the nole, the Contractor shall be required to commence realignment operations within 24 hours of the misalignment. If such misalignment occurs as the result of fault or negligence on the part of the Contractor, the Contractor shall receive no compensation for the time or cost spent in realignment. If the misalignment is not the fault or negligence of the Contractor, the Contractor shall be compensated under Item 2.b. of the Unit Price Schedule.
- B. If, at any time, the components (individual beams) or the entire substructure furnished by the Contractor becomes misaligned, the Contractor shall commence realignment of the individual structural members or the entire substructure as soon as the misalignment is discovered. The alignment of the substructure or its components parts is the sole responsibility of the Contractor. All time spent in realigning the substructure or its individual parts is to be considered repairs to the rig and payment for time spent in making these repairs is to be made as stated in SC-08, paragraph 2.

SC-11. RESPONSIBILITY FOR LOSS OR DAMAGE TO EQUIPMENT

- A. Contractor's Surface Equipment. Contractor shall be liable at all times for damage to or destruction of Contractor's surface equipment including all drilling tools, machinery, and appliances for use above the surface, and for any other type of equipment including in-hole equipment when such in-hole equipment is above the surface, regardless of when or how such damage or destruction occurs. The Government shall be under no liability to compensate the Contractor for any such loss except loss or damage thereto caused by negligence of the Government, its agents, or employees.

SC-11 RESPONSIBILITY FOR LOSS OF DAMAGE TO EQUIPMENT (Cont'd)

- B. Loss of Tools in the Hole. When it is necessary to fish for tools in the hole, the Contractor shall notify the Contracting Officer or his authorized representative of the existing conditions immediately, confirmed in writing as soon as practicable. The TPO will review and evaluate the circumstances resulting in the loss of the tools in the hole.
1. If the investigation of the Contracting Officer shows that the Contractor was neither negligent nor in violation of good drilling practice, the Contractor will not be held responsible for costs resulting from the loss of tools or for costs of fishing efforts conducted to recover lost tools.
 2. If the TPO's investigation shows that the Contractor was negligent or was in violation of good drilling practice in the performance of its duties, the Contractor will be held responsible to the Government for the value of any Government-owned tools or equipment which may be lost or damaged. All costs incident to such loss of or damage to Government tools or equipment will be determined by negotiated agreement of the parties.
 3. Any dispute concerning a question of fact under this paragraph shall be subject to Article 6 "Disputes," of the General Provisions.
- C. Government Equipment. Except as provided for in paragraph B above, "Loss of Tools in the Hole," all machinery, tools, materials, and equipment furnished by the Government, or procured under provisions of SC-08, paragraph 4, shall, at the completion or abandonment of the hole, be returned to the Government in as good condition as when received by the Contractor, ordinary wear and tear excepted. The Contractor shall be liable to the Government for any loss or damage to such equipment beyond such ordinary wear and tear, and for loss or damage due to the negligence or carelessness of the Contractor.

SC-12. LOST HOLES

A hole shall be termed "lost" if the Contracting Officer determines that the condition of the hole will present its successful completion, or if for any reason the Contracting Officer deems it impractical to continue drilling. If the Contracting Officer determines that a hole has been

SC-12. LOST HOLES (Cont'd)

lost before required depth has been attained, and that further attempts to complete it will be impractical, he shall order work on the hole stopped, shall investigate the circumstances contributing to its loss, and shall notify the Contractor of his decision in writing. The Contracting Officer may, at his option, order the commencement of work at an alternate location.

- A. If the Contracting Officer determines that the hole has been lost for reasons beyond the control of the Contractor, and that loss of the hole was unavoidable in spite of diligent precautions on the part of the Contractor to prevent it, the Contractor shall be paid in accordance with the Unit Price Schedule for work performed on the hole.

If the Contracting Officer determines that a hole has been lost for reasons set forth in this paragraph A, and the Contracting Officer orders commencement of drilling operation at an alternate location, adjustments to cover the time and cost of rig-down, move, and rig-up will be paid for under Item 2. of Unit Price Schedule. Drilling and other work at the alternate location shall be performed and paid for in accordance with the provisions of and at the unit prices contained in these specifications.

- B. If the Contracting Officer determines that a hole has been lost for reasons within the control of the Contractor or due to inefficiency, negligence, or incompetence or malpractice on the part of the Contractor or Contractor's personnel, or to the use of defective or unsuitable equipment, the Contractor shall not be paid for any drilling, demobilization, or other services performed in the lost hole, except to the extent that the Contracting Officer determines that portions of the work performed in the lost hole have beneficial value to the Government.

If the Contracting Officer determines that a hole is lost for reasons set forth in this paragraph B, and orders a commencement of drilling operations at an alternate location, the Contractor shall receive no payment for a location-to-location move to such alternate location. All drilling and other work performed by the Contractor at such alternate locations shall be performed and paid for in accordance with the provisions of and at the unit prices contained in these specifications.

SC-13 ABANDONMENT

In the event that, prior to completion, a hole covered by this contract is abandoned, upon direction of the Contracting Officer, the Contractor will be paid for work performed under the applicable items of the Unit Price Schedule.

Special items or service, if any, required at the direction of the Contracting Officer in connection with such abandonment shall be furnished by the Contractor and payment will be made under the item "Special Items and Services" of the Unit Price Schedule.

The term "abandonment" as used in this paragraph shall mean abandonment to suit the convenience of the Government, as directed by the Contracting Officer, under conditions which do not come within the scope of paragraph "Lost Holes" of these specifications.

SC-14. INSPECTION OF MATERIALS FURNISHED BY GOVERNMENT

A visual field inspection of all Government-furnished equipment, machinery, tools, or other items shall be conducted jointly by the Contractor and the Engineer immediately upon delivery of these materials at the drill site. If any defects are found therein sufficient to make the use of any such items unsuitable or unsafe, the Contractor shall immediately notify the Contracting Officer of such defect or defects and confirm such notification in writing within 48 hours.

It shall be the Contractor's responsibility to request such a joint inspection and should the Contractor fail to request such joint inspection or fail to submit a written report of any defects in Government-furnished items, the Contractor shall be deemed to have accepted the Government-furnished items as suitable for their intended purpose and the Contractor shall assume responsibility for any mishap which may occur by reason of the failure of such equipment, machinery, tools, or other items except for failure due to latent defects.

SC-15 ABNORMAL CONDITIONS

Due to the nature of the work under this Contract, it is not possible to anticipate all the unusual conditions which may be encountered in drilling this hole. If abnormal conditions arise, it is the responsibility of the Contractor to bring this information to the immediate attention of the Contracting Officer.

SC-16. MAINTENANCE OF SITES AND STORAGE AREAS

The Contractor's equipment shall be maintained in an orderly manner at all times at the work sites. Upon completion of work after each operation, all of the Contractor's debris and waste materials shall be removed by the Contractor to an area designated by the Contracting Officer.

SC-17. ENGINEER (TPO)

The Engineer shall have the authority to establish controls for the work, to inspect the work for quality and for compliance with plans and specifications as a representative of the Contracting Officer, and to recommend changes as a representative of the Contracting Officer, and to recommend changes strictly in accordance with Article 3, "Changes," of this Contract for issuance of written orders by the Contracting Officer.

SC-18. USER AGENCY

The User Agency for the work under this Contract is the United States Department of Energy, who shall have free access to the work sites and all drilling records and geologic data.

SC-19. ADMINISTRATIVE APPROVALS, REGISTRATION AND BADGES REQUIRED

The work to be performed under this contract is in an "administratively controlled area" and will require approvals and badging in accordance with paragraph GC-1(b) of the General Conditions.

SC-20. PRESERVATION OF ANTIQUITIES, WILDLIFE AND LAND AREAS

Federal law provides for the protection of antiquities located on land owned or controlled by the U.S. Government. Antiquities include Indian graves or campsites, relics and artifacts. The Contractor shall control the movements of his personnel and his subcontractor's personnel at the jobsite to ensure that any existing antiquities discovered thereon will not be disturbed or destroyed by such personnel. It shall be the duty of the Contractor to report the existence of any antiquities so discovered. The Contractor shall also preserve all vegetation except where such vegetation must be removed for survey or construction purposes. Further, all wildlife shall be protected.

SC-21. CONTRACTOR'S EQUIPMENT

The Contractor's equipment, tools, and materials shall be inspected and inventoried upon arrival at the INEL-1 Site, shall be in good operating

SC-21. CONTRACTOR'S EQUIPMENT (Cont'd)

condition, and shall be subject to periodic inspection by the Contracting Officer or his authorized representative for the purpose of judging its safe and usable condition.

In the event any equipment, tools and materials are considered by the Contracting Officer to be unsatisfactory for the performance of the work, as required herein, such unsatisfactory equipment, tools and materials shall be placed in acceptable conditions by repair or removed from the INEL-1 Site and replaced with satisfactory equipment or materials. The repair or replacement of any equipment, tools or materials, including time expired by the Contractor for such work, will be at the sole expense of the Contractor. All such equipment repair or replacements shall be judged satisfactorily completed only with the authorized approval of the Contracting Officer.

SECTION IV
TECHNICAL PROVISIONS
AND EXHIBITS

TECHNICAL PROVISIONS

TP-01. DRILLING METHOD

- A. This INEL-1 geothermal exploratory hole will be drilled using rotary drilling methods with a fully stabilized bottom hole assembly which shall include the following:
 - 1. A three point bottom hole stabilizer immediately above the bit for the 17-1/2 inch, 12-1/4 inch and 8-3/4 inch hole.
 - 2. A square drill collar for the above sized holes.
 - 3. A non-rotating blade sleeve type stabilizer and a shock absorber sub above the square drill collar and below the standard round drill collars for the above sized holes.
- B. While drilling, weight on the bit shall not be allowed to exceed 70 percent of the combined buoyed weight of the packed bottom hole assembly.
- C. The Contractor shall conduct drilling operations using water or mud as the circulating media.

TP-02. CONTRACTOR MINIMUM EQUIPMENT REQUIREMENTS AND STANDARDS

- A. Minimum equipment and services required to be furnished and operated by the Contractor at no additional cost to the Government are listed in Exhibit C.
- B. The following American Petroleum Institute Standards and Recommended Practices of the latest issue, as of the date of bid opening, form a part of these specifications.
 - 1. API Std. 4A Specifications for Steel Derricks
 - 2. API Std. 4E Specification for Drilling and Servicing Structures
 - 3. API Std. 7 Specification for Rotary Drilling Equipment
 - 4. API Std. 8A Specification for Hoisting Equipment
 - 5. API Std. 9A Specification for Wire Rope

6. API RP-5C1 Recommended Practice for Care and Use of Casing, Drill Pipe and Tubing
7. API RP-9B Recommended Practice on Application, Care and Use of Wire Rope for Oil-Field Service
8. API RP-13B Recommended Practice and Standard Procedures for Testing Drilling Fluids
9. California Petroleum Safety Orders

The State of California, Department of Industrial Relations, "Petroleum Safety Order," from California Administrative Code, Title 8 (latest issue as of date of bid opening), will apply for equipment and practices not covered by the API Standards and Recommended Practices specified above. Manufacturer's ratings shall apply for equipment not covered by the API Standards or the California Safety Orders.

TP-03. MAINTENANCE OF SURFACE DISCHARGE AREAS

The Government shall provide labor and equipment to maintain adequate clearance at the discharge line, shale shaker outlet or cuttings discharge line.

TP-04. SURVEYS AND LOGS

Surveys and logs may be run at the direction of the TPO.

TP-05. CASING

	<u>Diameter</u>	<u>Length</u>	<u>Hole Diameter and Depth</u>
Conductor	30"	40' approx.	36" $\pm$ x 40'
Surface	20"	$\pm$ 1,500'	26" x $\pm$ 1,500'
Intermediate	13-3/8" O.D.	$\pm$ 3,500'	17-1/2" x $\pm$ 3,500'
One Casing Liner	9-5/8"	$\pm$ 1,700' (approx.)	12-1/4" x $\pm$ 5,000'

The surface casing, casing liner, liner running tool, casing welding, cementing program cementing services and cement materials will be Government-furnished. The concrete cellar with 40 feet of 30 inch pipe set and cemented to the bottom of the cellar will be Government furnished.

TP-06. ALIGNMENT

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1° per 100 feet and 3° per 1,000' for the 17-1/2" and 12-1/4" holes and 8-3/4" hole.

TP-07. HOLE COMPLETION

The hole will be completed in accordance with the requirements of the Contracting Officer.

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EXHIBIT A
SITE LOCATION

EXHIBIT A

The Exploratory Well INEL-1 will be located as shown in
Southeastern Idaho

EXHIBIT A-1

Geologic map of southern Idaho showing the location of INEL

EXHIBIT A-2

Map of Idaho National Engineering Laboratory showing location of proposed geothermal study

EXHIBIT A-3

The exploratory well will be located within a reasonable distance from ICPP

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EXHIBIT B

GOVERNMENT FURNISHED ITEMS

EXHIBIT B

GOVERNMENT FURNISHED ITEMS

1. Concrete celler, leveled location, maintained access road. 30-inch conductor pipe set at ± 40 feet.
2. Cement and cementing services.
3. Logging services, both mud and electric.
4. Communications, telephones and radio.
5. Power, distribution of power to site trailers, pumps and other Government-furnished equipment will be provided as required. Four daylight-sensitive flood lamps will be furnished.
6. Water for drilling, by either a pipeline or by hauling from a nearby source.
7. General operational and logistic support.
8. Directional surveys other than Contractor-furnished inclination surveys.
9. Casing
 - a. 40 feet of 30-inch O.D., 3/8-inch wall, conductor pipe.
 - b. 1500 feet of 20-inch, 106.5 lb./ft., K-55, ST&C, 8-round thread casing.
 - c. 3500 feet of 13-3/8 inch, 72 lb./ft., P-110, 8-round thread casing, drifted for 12-1/4 inch O.D. drill bits.
 - d. 1700 feet $\pm$ 9-5/8 inch O.D., 40.0 lb./ft., S-95, LT&C casing, with a liner hanger for 13-3/8 inch casing.
10. Bits, hole openers and coring equipment.
11. Mud services and mud logging.
12. Casing head for 20" casing with two outlets and valves.
13. 12-inch Master valve.
14. 20" x 12" WKM Geothermal Expansion Spool.
15. 20" gate valve if available.
16. A 600 GPM fluid capacity, 25 HP air fan, 200-ton cooling tower to control mud temperatures if necessary.
17. Tubing - 2-3/8 inch or 1.90 inch O.D. for remedial cementing if required.

EXHIBIT C

MINIMUM EQUIPMENT AND SERVICE REQUIREMENTS
TO BE FURNISHED BY THE CONTRACTOR

EXHIBIT C

MINIMUM EQUIPMENT AND SERVICE REQUIREMENTS

TO BE FURNISHED BY THE CONTRACTOR

Listed below are the minimum acceptable requirements for the Contractor drilling equipment. This is not intended to be a complete list of items to be furnished by the Contractor. The Contractor is required to furnish all drilling and maintenance tools, materials and equipment not herein designated, but which are normal components for a complete drilling rig required for drilling and testing operations of the scope of these specifications.

1. Drilling Location. A maintained minimum access road to drill site, leveled drilling location, 500 foot by 500 foot drill pad, 10 feet long by 8 feet wide by 10 feet deep concrete lined cellar with 30 inch conductor pipe set at about 40 feet depth will be furnished by others prior to mobilization.
2. Mast or Derrick. Minimum capability API static hook load of 400,000 pounds with minimum 1-1/8 inch wireline. Combined racking capacity for 7,500 feet of 4-1/2 inch drill pipe and related drill collars. Minimum overall height sufficient to pull and rack thribble stands of drill pipe (minimum length 90 feet).
3. Substructure. Load capacity (gross nominal) - 550,000 pounds. Casing load capacity - 350,000 pounds with a height adequate to accept BOP stack described in Exhibit C, No. 45.
4. Drawworks. Minimum of 700 horsepower rated input. Main drum grooved for 1-1/8 inch minimum wireline. Clutches, air operated. Maximum hoisting capacity in the lowest gear and with 10 lines strung must not be less than 400,000 pounds.
5. Drawworks Power. A minimum of two prime movers with a minimum of 700 intermittent horsepower for hoisting at $\pm$ 5,600 feet above sea level with an Elmagco #5019 brake or an approved equal auxiliary brake compatible with drawworks.
6. Rotary Table. Minimum 27-1/2 inch API oil bath.
7. Crown Block. 250-ton, minimum of six sheaves.
8. Traveling Block and Hook. 200-ton, minimum of five sheaves.
9. Swivel. 200-ton minimum with 3-inch bore.
10. Drilling Line. 1-1/8 inch minimum diameter.

11. Drill Collars. Nominal 6-3/4 inch O.D. collars with total weight of 50,000 pounds in air and nominal 8-inch O.D. collars with a minimum total weight of 80,000 pounds in air. A tuboscope inspection must be made on boxes and pins prior to drilling under this contract and a copy of the inspection report and certification is to be delivered to the Government representative before drilling operations begin.
12. Drill Pipe. Minimum of 7,700 feet of 4-1/2 inch O.D., 16.60 lbs./ft., Grade E or better. All drill pipe is to have been inspected by Scanalog 400 (or equal) with end area inspection or better and certified Grade 2 or better prior to spudding on this hole, and a copy of the inspection report and certification is to be delivered to the Government representative before drilling operations begin. (NOTE: If 9-5/8 inch liner is run to an approximate depth of 5,000 feet, it will be necessary for the drilling Contractor to provide a minimum of 3,300 feet of 4-1/2 inch O.D. drill pipe, 16.6 lb./ft., Grade G, or 3,300 feet of 5 inch O.D. drill pipe, 19.5 lb./ft., Grade E drill pipe.)
13. Stand Pipe. Schedule 160 pipe single (including valves).
14. Rotary Hose. One 55 foot by 3-1/2 inch I.D.
15. Mud Pumps and Power. Two required, one pump rated at 1,000 input H.P. and the second pump rated at a minimum of 700 input H.P. (with compatible engines), belt driven with tail drive optional.
16. Lights Plants. Two minimum 37 kW generators.
17. Doghouse and Trailer House.
18. Catwalk and Ramp.
19. Pipe Racks. Two sets of steel construction.
20. Subs. For all Contractor-furnished drill pipe and drill collars.
21. Steel Mud Pits. Three, with total volume capacity of 500 + barrels, equipped with two jets and two mud guns on each unit. Includes all valves and piping so that any one pit can be isolated for cleaning without interruption of drilling activities. (NOTE: A vertical Government-furnished cooling tower cross-air flow, 25 HP air fan, 600 GPM fluid capacity with approximate 200 ton cooling capacity with water consumption of 1,000 to 1,500 barrels per day, is anticipated due to evaporation losses in the surface mud system when high temperatures are required.
22. Shale Shaker, Desander and Desilter. Capable of handling a minimum of 600 GPM will be required with a high speed, double-screen shale shaker.

23. Kelly. One 5-1/4 inch square or hexagon by 40 foot with bushing for 27-1/2 inch rotary table, all crossover subs. Kelly Spinner with reverse.
24. Weight Indicator. Martin Decker, type FS, or equal, also torque gauges for rotary and drill collar make-up.
25. Winterizing. Rig covers and heating equipment.
26. Rat Hole Liners.
27. Lighting System for Rig. With UL approved vapor-proof lights.
28. Core Boxes and Sample Containers.
29. Drilling Recorder. Six-pen, to record penetration, weight, rotary RPM torque, stand pipe pressure and pump strokes on both pumps.
30. Nondirectional Survey Instrument. Totco or equal, 0-10 degrees.
31. Handling Tools. For Contractor's drill collars and drill pipe. This item includes, but is not limited to, tongs, safety clamps, spiders, slips, links and elevators. (NOTE: All handling tools are to be checked by magnetic particle inspection at Contractor's expense prior to use.)
32. Fuel and Lubricants. For Contractor's equipment.
33. Mud-Testing Equipment. Viscosity funnel, weight balance, filter press and content kit.
34. Portable Water Pump. 100 gpm at 50 psi. For low pressure mud circulating system a minimum of three centrifugal pumps are required.
35. Cellar Jets or Pump.
36. Hole Covers.
37. Mud-Mixing Hopper.
38. Drill Pipe Wipers and Drill Pipe Protectors.
39. Tool Joint and Casing Thread Lubricant.
40. Chemical Toilet Facilities for Contractor Personnel.
41. Pipe and Fittings for all mud and water lines.
42. Fishing Tools shall include a Bowen overshot (or equal) and accessories for Contractor-furnished drill pipe and drill collars.

43. Welder, Welding Machine and Welding Supplies. For maintenance of Contractor-furnished equipment.
44. Containment Services, Kelly Stopcock and Float Subs. To be run in drill pipe.
45. Blowout Prevention for 20 inch Casing.
- A. Fill up line and 2 inch choke assembly.
 - B. A single 20 inch gate valve. Government-furnished, if available.
 - C. A single Hydril MSP 20" 2000 psi BOP or equal with 21-1/4 inch open bore, with a Cameron Type U single gate BOP or equal, and banjo box 8-inch flow spool.
 - D. Rotating drilling head with a 6-inch flow line to shaker.
 - E. Cameron type "F" cup tester, plug, or equal for 20 inch casing with drill pipe connection up.

Blowout Prevention Equipment for 13-3/8 inch Casing

- A. A single 13-5/8 inch bore 3000 psi master gate valve with a 3000 psi working pressure expansion spool shall be installed in the cellar below ground level. This item will be Government-Furnished.
- B. Above the master valve shall be a Cameron type SS or equal double 12 inch 3000 psi BOP and a 12 inch 3000 psi banjo box flow spool.
- C. Hydril type "GK" annular BOP, or equal, Series 900 (3000 psi working expansion spool pressure) with 13-5/8 inch bore bolted flange type body or equal.
- D. A flow nipple, 3000 psi and a 3000 psi rotating head shall be installed above the spherical annular preventer.
- E. All control equipment shall be rated to handle temperatures to 200°C with sour and corrosive fluids.
- F. A hydraulic pressurized BOP closing unit. Hydril, Koomey, Payne or equal shall be remote from the rig with both remote and rig floor controls.
- G. A 3000 psi kill control manifold shall be provided by the drilling Contractor. (See Exhibit H).

H. Provisions shall be made for the installation of an 8 inch geothermal testing manifold on one outlet of the drilling spool (this manifold will be Government-furnished).

I. Cameron 13-3/8 inch type "F" cup tester or plug type tester with drill pipe connection UP.

46. An Automatic Driller.

47. An Independent Wire-line Depth Measuring Unit Halliburton or equal, with lubricator for surface connections.

48. Water Storage. A 1000 Barrel storage tank for continuous drilling and cementing requirements.

EXHIBIT C
EQUIPMENT AND SERVICES
CONTRACTOR WILL FURNISH
TO BE SUBMITTED WITH PROPOSAL

1. Mast or Derrick. _____

2. Substructure. _____

3. Drawworks. _____

4. Drawworks Power. _____

5. Rotary Table. _____

6. Crown Block. _____
7. Traveling Block and Hook. _____
8. Swivel. _____
9. Drilling Line. _____
10. Drill Collars. _____

11. Drill Pipe. _____

12. Stand Pipe. _____
13. Rotary Hose. _____
14. Mud Pumps and Power. _____

15. Lights Plants. _____
16. Doghouse and Trailer House. _____
17. Catwalk and Ramp. _____
18. Pipe Racks. _____
19. Subs. _____
20. Steel Mud Pits. _____

21. Shale Shaker, Desander and Desilter. _____

22. Kelly. _____

23. Weight Indicator. _____

24. Winterizing. _____
25. Rat Hole Liners. _____
26. Lighting System for Rig. _____
27. Core Boxes and Sample Containers. _____

28. Drilling Recorder. _____

29. Nondirectional Survey Instrument. _____
30. Handling Tools. _____

31. Fuel and Lubricants.
 32. Mud-Testing Equipment.
 33. Portable Water Pump.
 34. Cellar Jets or Pump.
 35. Hole Covers.
 36. Mud-Mixing Hopper.
 37. Drill Pipe Wipers and Drill Pipe Protectors.
 38. Tool Joint and Casing Thread Lubricant.
 39. Chemical Toilet Facilities for Contractor Personnel.
 40. Pipe and Fittings for all mud and water lines.
 41. Fishing Tools
 42. Welder, Welding Machine and Welding Supplies.
 43. Containment Services, Kelly Stopcock and Float Subs.
 44. Blowout Prevention for 20 inch Casing.
 - A. _____
 - B. _____
 - C. _____
 - D. _____
 - E. _____
- Blowout Prevention Equipment for 13-3/8 inch Casing
- A. _____

- B. _____

- C. _____

- D. _____

- E. _____

- F. _____

- G. _____

- H. _____

- I. _____

45. An Automatic Driller _____

46. An Independent Wire-line Depth Measuring Unit _____

47. Water Storage. _____

RIG AVAILABILITY

1. Location of Rig proposed for this hole. _____

2. Date Rig will be ready to mobilize. _____

3. Date Mobilization can be complete and rig ready to spud. _____

EXHIBIT D

CONTRACTOR-FURNISHED GOVERNMENT REIMBURSABLE ITEMS

EXHIBIT D

CONTRACTOR-FURNISHED GOVERNMENT REIMBURSABLE ITEMS

The equipment and services which the Contractor may be required to furnish includes, but is not limited to, the following items:

1. Reamers, Stabilizers, Monel Drill Collars, and Lubricators for Stabilized Drilling Assemblies.
2. Mud, Detergent Additives, and Chemicals. Not provided through the Government.
3. Special Rental Fishing Tools (except as specified in Exhibit C).
4. Shock Sub and Drilling Jars.
5. Casing Handling Tools.
6. Well Head Components.
7. Float Equipment, Guide Shoes, Packer, Liner Hangers, Centralizers.
8. Casing Crews.
9. Welding of all items.
10. 5-Inch "Hevi-Wate" Drill Pipe (approximately 25 joints)
11. Logging services, electric. Not provided by the Government.

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EXHIBIT E

TENTATIVE DRILLING PROGRAM

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INEL-1
Geothermal
Exploratory
Hole

EXHIBIT E
TENTATIVE DRILLING PROGRAM

1. The location site on the Eastern Snake River Plain in Southern Idaho will be leveled and the drill pad surface will be compacted with run-of-bank gravel.
 - a. Slopes shall be stablized and the mud-reserve pit shall be excavated.
 - b. A concrete cellar, 8 foot x 10 foot x 10 foot shall be constructed.
 - c. 30-inch conductor pipe shall be set to a depth of +40 feet and cemented back to the bottom of the cellar.
 - d. The site and access road shall be maintained during drilling and testing operation.

All of the above shall be completed by others prior to mobilization of the drill rig.

2. The contractor shall move in, rig up, drill mouse and rat hole and complete mobilization prior to spudding the hole.
3. Spud and drill 26-inch hole to a depth of +1500 feet with a high viscosity mud adequate to remove cuttings from the hole using both mud pumps with maximum sized liners.
 - a. The drilling assembly shall consist of 80,000 lbs. dry weight of 8 - inch nominal drill collars with a stabilizer 60 feet above the bit and another stabilizer 120 feet above the bit.
4. Logs shall be run as required by the contracting officer.
5. 1000 feet of 20-inch, 106.5 lb./ft., K-55 ST&C, 8-rd., and 500 feet of 94#, H-40, ST&C, 8-rd. casing shall be run and cemented from a depth of +1500 feet to the surface.
6. A nuclear cement top log shall be run inside the casing prior to and, if necessary, following the cementing operations.

7. The 20-inch casing shall be nipped up with a 20-inch casing head containing 2 side outlets for a fillup line and a 2-inch choke assembly.
8. Next a single 20-inch gate valve, then a single gate 2000 psi BOP or equal with a 21-1/4 inch opening with a banjo box sideflow spool on top, next a Hydril 20-inch type GK or equal blowout preventer.
9. A flow nipple and a rotating drilling head shall complete the assembly.
10. The BOP stack shall be pressure tested using a Cameron type "F" cup tester plug or equal prior to drilling the cement from the shoe joint.
11. A 17-1/2 inch intermediate hole shall be drilled below the 20-inch casing to a depth of +3500 feet using mud (LSND).

The drilling assembly shall consist of 80,000 lbs. dry weight of 8-inch nominal drill collars with a stabilizer 60' above the bit, a second stabilizer 120' above the bit.

12. Coring, drill stem testing and logging through the above section shall be as required by the Contracting Officer prior to running the 13-3/8 inch O.D. casing. Testing shall occur at approximate 750 feet intervals.
13. 13-3/8 inch O.D., P-110, ST&C, 72 lb./ft. casing drifted for 12-1/4 inch bits shall be run and cemented from a depth of +3500 feet to the surface.
14. A nuclear cement top log shall be run inside the casing prior to and, if necessary, following each cementing operation.
15. Wait on cement 12 hours. Nipple up, install WKM 20-inch to 12-inch expansion spool with master valve and BOP equipment as shown on the BOP diagram for drilling below the 13-3/8 inch casing shoe and test same.
16. Pick up 12-1/4 inch bit and stabilized drilling assembly.
17. Drill to a depth of +5000 feet with water, corrosion inhibitors, and mud as needed.
18. Logs, DST, coring etc., shall be as required by the Contracting Officer during the drilling operation below the 13-3/8 inch casing to +5000 feet.

19. A +1700 foot, 9-5/8 inch O.D., 40.0 lb./ft., S-95, LT and C thread liner, liner hanger, etc., shall be run using either a 4-1/2 inch O.D., 16.6 lb./ft., Grade G or 5-inch O.D., 19.5 lb./ft., Grade E drill pipe.
20. The bottom of the 9-5/8 inch O.D. liner shall be set a +5000 feet
21. The liner shall be circulated with cement to +100 feet above the top of the liner. The cement shall be drilled out of the 13-3/8 inch casing and the top of the liner dressed with a diamond point bit. A nuclear cement log shall be run prior to cementing and following the cement drilling operation.
22. After dressing the cement top of the liner, the liner top shall be pressure tested. Remedial squeeze cementing shall be conducted using a retrievable squeeze packer if necessary.
23. Drilling shall continue with 8-3/4 inch bits to + 7500 feet with a stabilized drilling assembly of a minimum of 60,000 lbs. dry weight using 6-3/4 inch O.D. drill collars, and 25 joints of 5-inch "Hevi-Wate" drill pipe.
24. Coring, sampling, drill stem testing and logging below the 9-5/8 inch liner to total depth shall be as required by the Contracting Officer.
25. At completion of the hole, well head equipment shall be used to replace the BOP equipment as required by the Contracting Officer.

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EXHIBIT F

BOP FOR DRILLING BELOW THE 13-3/8 INCH CASING SHOE

BOP FOR DRILLING BELOW THE 13-3/8" CASING SHOE

RFP No.: DE-AC07-79ID-12023

EXHIBIT G

BOP FOR DRILLING BELOW THE 20-INCH CASING SHOE

EXHIBIT G

BOP FOR DRILLING BELOW THE 20-INCH CASING SHOE

RFP No.: DE-AC07-79ID-12023

EXHIBIT H

CHOKE MANIFOLD ASSEMBLY

EXHIBIT H

- 13 SETS OF 2"-900 LB FLANGE BOLTS & NUTS
- 2 SETS OF 2"-1500 LB FLANGE BOLTS & NUTS
- 4 R-57 RING GASKETS
- 13 R-31 RING GASKETS
- 2 R-24 RING GASKETS
- 3 2"-3000 LB X 2" THREADED FLANGES
- 1 2" HI-PRESSURE BULL PLUG W/ 1/2" SIDE OPENING
- 1 5000 LB. GUAGE
- 1 2"-3000 LB. BALL CHOKE
- 1 1/2" NEEDLE VALVE

+ CHOK MANIFOLD +
ASSEMBLY

RFP No.: DE-AC07-79ID-12023

EXHIBIT I

CONCRETE CELLAR CONSTRUCTION DETAIL

INEL-1
Geothermal
Exploratory Hole

UNIT PRICE SCHEDULE

<u>Item No.</u>	<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
1.	Mobilization	1	Job	\$ _____	\$ _____
2.	Government-Directed Operations				
	a. With Drill Pipe	2256	Hour	\$ _____	\$ _____
	b. Without Drill Pipe	480	Hour	\$ _____	\$ _____
3.	Standby				
	a. Ready	96	Hour	\$ _____	\$ _____
	b. Secured	96	Hour	\$ _____	\$ _____
4.	Special Items and Services				<u>\$150,000.00</u>
5.	Demobilization	1	Job	\$ _____	\$ _____
	TOTAL ESTIMATED AMOUNT				\$ _____

In the event of an overrun or underrun of estimated quantities in Items 2 or 3, the unit price shall prevail.

The estimated amount in Item 4 is a Government estimate and all special items and services procured by the Contractor under Special Condition SC-08, paragraph 4, shall be reimbursed as specified therein. The Contractor shall promptly advise the Contracting Officer if and when it appears the amount to be reimbursed will exceed the estimated amount shown in Item 4., above.

APPENDIX I

EMERGENCY PREPAREDNESS PLAN

EMERGENCY PREPAREDNESS PROCEDURE

INEL-1 WELL

I. PURPOSE

The Emergency Preparedness Procedure lists emergency conditions which may adversely affect or threaten the personnel working at the INEL-1 Well. It also sets forth the responsibilities and procedures for emergency actions.

II. RESPONSIBILITIES

A. The INEL-1 Well Emergency Director (ED) and his alternate will be named by the Drilling Contractor. They will be responsible for:

1. Emergency preparedness and for assuring that all personnel working at INEL-1 Well respond to emergency conditions.
2. Summoning emergency help by notifying the ID Warning Communications Center (WCC) of emergencies at INEL-1. This is done by calling telephone extension 6-1515 or by radio by calling KID-240.
3. Reacting to emergencies at other INEL activities. Emergency notification at INEL-1 Well will be by word-of-mouth.
4. Directing evacuation, emergency activities, and recovery operations in cooperation with EG&G Management and civil authorities who may be involved.

B. All Personnel Working at INEL-1 Well are responsible for:

1. Combating fires until relieved or the fire is out.
2. Knowing emergency procedures.
3. Notifying the ED of impending or existing emergencies at the INEL-1 Well.
4. Immediately summoning required emergency help.
5. Responding quickly to emergency instructions.
6. Other emergency activities as directed by the ED.

III. EMERGENCIES

An emergency exists at the INEL-1 Well whenever an incident endangers personnel or property anywhere on the INEL.

A. Emergencies Resulting from Actions at other INEL Sites

In the event occurrences at other facilities require emergency action at the INEL-1 Well site, instructions received from the WCC will be implemented by the ED. (See Note, Appendix C)

B. Fire Emergency

If there is a fire at the INEL-1 Well, any one shall:

1. Notify the DOE Fire Department by calling 6-2211.
2. Notify the INEL-1 Well ED.
3. Assist in combating the fire until relieved or the fire is out.

C. Threat or Act of Violence

In the event of a threat or act of violence (bomb threat, mob, riot, terrorism, etc.) personnel working at INEL-1 Well shall:

1. Immediately report the incident to the ED, who will notify the WCC by radio or telephone.
2. If there is a telephone threat to personnel or property, get all information possible (i.e., name, age, and sex of caller; background noises, such as music, traffic, laughter, etc.) including details the caller may give about the threat, the bomb or device, etc. Information obtained shall be relayed to the ED who will immediately notify the WCC.
3. Follow instruction from the ED and WCC as to evacuation or other action required by the emergency.

D. Natural Emergency

A natural emergency is defined as one caused by a storm, tornado, earthquake, flooding, etc. In the event of such emergencies, the personnel at the INEL-1 Well shall:

1. Follow the instructions of the ED. Notification of the impending emergency will usually be made to the ED by the WCC.
2. At the direction of the ED, leave the INEL-1 Well and follow the instructions received through WCC. Personnel working at the INEL-1 Well area are assigned Civil Defense shelter at TRA.

IV. EVACUATION PROCEDURE

At least one vehicle will be located at the INEL-1 Well site at all times.

Should it become necessary to evacuate the INEL-1 Well, personnel shall utilize available vehicles located at the area to evacuate to a destination announced by the ED. The evacuation shall be directed by the ED. He is responsible for assuring all personnel working at the INEL-1 Well are evacuated. The ED shall take the WCC radio with him when he leaves the area for an evacuation.

APPENDIX A
EMERGENCY EQUIPMENT

The following emergency equipment is located at the INEL-1 Well:

1. WCC handie-talkie located in the Drilling Superintendent's Office trailer. When this trailer is not manned, the radio will accompany personnel to the Rig Dog House.
2. Fire extinguishers are located in the trailers and at the drill rig. Additional portable fire extinguishers will be located at the work areas as determined to be required by the job Safety Engineer.
3. First aid supplies are located in the Drilling Superintendent's trailer.
4. Anti C clothing is located in the Drilling Office trailer. It is provided for personnel who may be required to stay at the rig during certain operations, in the presence of low level airborne contamination. EG&G will have the responsibility for dispatching an EG&G HP to INEL-1 when necessary.
5. Respiratory equipment is located in the Drilling Office trailer.
6. Emergency lights are provided by diesel-powered electrical generators which are started when there is commercial power failure.
7. Area monitoring will be provided using thermoluminescent dosimeters.

APPENDIX B
DESIGNATED EMERGENCY PERSONNEL
AND
PHONE NUMBERS

Warning Communication Center (WCC)	Radio or	6-1515
DOE Fire Department		6-2211
Ambulance		6-2211
Emergency Director	Ext	_____
	Home	_____
Alternate	Ext	_____
	Home	_____

APPENDIX C

Information relayed to INEL-1 Well concerning occurrences at other sites must be provided with reliability and detail. Some well drilling operations cannot be stopped, once they are started, without serious consequences to the well. Therefore, the information supplied the Emergency Director must be sufficient for a decision to be made on whether the required crew will be given self-contained breathing apparatus (SCBA) and protective clothing to continue operation or to abandon the well.

In an emergency where INEL-1 Well operations are to be continued, it is expected that the INEL emergency director will dispatch a qualified person with appropriate monitor equipment to INEL-1 Well. Through emergency communications, a knowledge of the accident, and continuous monitoring, INEL-1 Well will not be abandoned during critical operations unless conditions justify.

During routine drilling, however, an emergency evacuation will be delayed only long enough to raise and support the bit off the bottom and shut down operations to a safe condition.

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