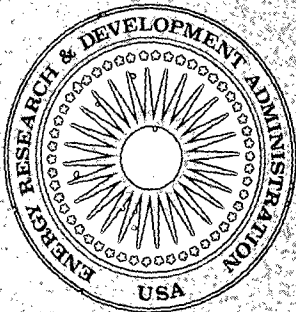


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IDAHO
NATIONAL
ENGINEERING
LABORATORY

DRILLING PLAN BOISE SLIM (2-3/8 in. DIAMETER)
HOLES DEMONSTRATION SPACE HEATING
PROJECT OCTOBER 1975



PREPARED FOR THE
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
IDAHO OPERATIONS OFFICE UNDER CONTRACT E (10-1)-1375

DATE PUBLISHED — OCTOBER 1975

Aerojet Nuclear Company

IDAHO FALLS, IDAHO - 83401

ABSTRACT

This drilling plan covers the drilling of 2 or 3 slim (2-7/8 inch diameter) cored exploratory holes and was prepared by the Boise Geothermal R&D Project of the Idaho National Engineering Laboratory. The document provides a basic plan for the development of the exploration drilling phase of the Boise Demonstration Space Heating Project. The drilling plan outlines the areas of responsibility during the hole drilling and a schedule of activities to accomplish the primary objective - confirmation of the geothermal resource model through exploration hole drilling. Further effort is planned to accomplish the following: 1) demonstration of the resource through the drilling of a larger well and 2) recommendations for production well sites for drilling by the State of Idaho through knowledge gained from the exploration holes and demonstration well.

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1.0 INTRODUCTION

1.1 Background

The area in and around Boise, Idaho, has displayed numerous expressions of geothermal nature (hot wells, warm springs and areas of geothermal deposition and alteration). All occurrences appear to be associated with area faulting, especially the Boise Front Fault. The resource has been used for space heating since 1893 on a modest scale.

The primary end objective of the Demonstration Geothermal Space Heating Project is the construction and successful operation of a demonstration geothermal space-heating system serving selected state owned buildings in Boise, Idaho. The successful results of the research and development should stimulate similar projects by commercial interests throughout the nation.

The Project Program Plan consists of four phases as listed below.

- I. Feasibility Studies
- II. Geological, Hydrological and Geophysical Investigations
- III. Exploratory Slim Holes and Demonstration Well
- IV. Final Design, Construction and Testing

Tentative site selection for the initial geothermal exploratory hole has been made on the basis of previous geologic mapping, known geothermal occurrences, hydrological data, land availability and specific geophysical data. Geophysical data is still being gathered and the exact site for drilling the second and possibly third exploratory slim holes will be selected at a later date. Drilling at the first site, Boise Slim Hole-1, (BSH-1) is scheduled to begin on October 13, 1975.

This document describes the program, plans and procedures to be followed in Phase III during the drilling and completion of the slim (2-3/8 inch) holes and the demonstration well at Boise, Idaho. The

Other programmatic aspects of the Boise Geothermal R&D Project, such as space-heating system design, production well drilling and testing will be presented in other documents.

1.2 Program Description

The Boise Geothermal R&D Project will eventually involve the drilling of two or three exploratory slim (2-3/8") holes. The holes will be drilled to a nominal depth of 1,200 feet for use as observation wells. The evaluation of the geologic characteristics of the holes will permit an optimum selection of the drilling site for the larger demonstration well and the production wells to be drilled by the State of Idaho.

The slim holes will be drilled using the newly acquired Acker drill rig that was purchased jointly by the Idaho Bureau of Mines and Geology (IBMG) and Boise State University (BSU). The drilling will be accomplished under contracts E (10-1)-1536 and E (10-1)-1537 with the aforementioned state institutions.

The demonstration well will be drilled by a private contractor to be selected by Aerojet Nuclear Company. Drilling will be accomplished according to separate contractual specifications.

Program direction and management of the Boise Geothermal R&D Project is provided by the Aerojet Nuclear Company (ANC), a prime contractor of the Energy Research and Development Administration's Idaho National Engineering Laboratory. Responsibility for the drilling rig operation and crews will rest with the Boise State University/Idaho Bureau of Mines and Geology Drilling Supervisor.

The schedule of major activities is as follows:

	<u>Activity</u>	<u>Due Date</u>
1.	Initiate slim hole (BSH-1) drilling	October 13, 1975
2.	Complete BSH-1 drilling	October 27, 1975
3.	Initiate slim hole (BSH-2) drilling	October 29, 1975
4.	Complete BSH-2 drilling	November 12, 1975
*5.	Initiate slim hole (BSH-3) drilling, if necessary	November 14, 1975
6.	Select site for demonstration well (BHW-1)	November 15, 1975
7.	Initiate demonstration well BHW-1 drilling	November 17, 1975
8.	Complete BSH-3 drilling, if necessary	November 28, 1975
9.	Monitor observation wells on a periodic basis	December 1, 1975
10.	Complete BHW-1 drilling	December 17, 1975
*11.	Select site for demonstration well BHW-2, if necessary	December 17, 1975
12.	Complete BHW-2 drilling, if necessary	January 9, 1976
13.	Initiate BHW-1 testing	January 9, 1976
14.	Complete BHW-1 testing	February 27, 1976

BSH - Boise Slim Hole

BHW - Boise Hot Well

* Data evaluation from previous holes will determine whether or not it is necessary to drill BSH-3 or BHW-2.

at points convenient to each significant structure or piece of equipment. Extinguisher types will be varied for control of Class A, B, or C fires, as appropriate.

3.4 Sanitation

BSU/IBMG will provide potable water for drinking. Toilets are locally available at BSU and other public facilities.

3.5 Safety Equipment

Hard hats and safety glasses will be provided by ANC to accommodate all workers and visitors to the drilling site. Gloves, safety shoes and other personal safety items will be provided by individual workers. BSU/IBMG will provide a safety belt and line for use by individuals required to work on the mast of the drilling rig.

4.0 DRILLING OPERATIONS

4.1 General

The site will be prepared in conjunction with moving the rig onto the site. Site preparation includes the digging of settling ponds, leveling of the drilling rig and equipment layout.

The flush joint casing will be spun in using bentonite mud to bedrock or other consolidated formation. In either case, the casing will be set to at least 18 feet below ground level. See Drawing No. 2.

The hole will then be drilled down using "BOWL" size tools and drill rod with water employed as the drilling fluid. The nominal depth of the hole will be 1,200 feet.

During drilling, core samples will be retrieved on an average of 30 foot of core per 100 feet of drilling or as otherwise directed by ANC.

Daily drilling logs will be prepared by BSU/IBMG drillers and will include lithology and other pertinent drilling information. These logs will be maintained for transmittal to ANC on a daily basis.

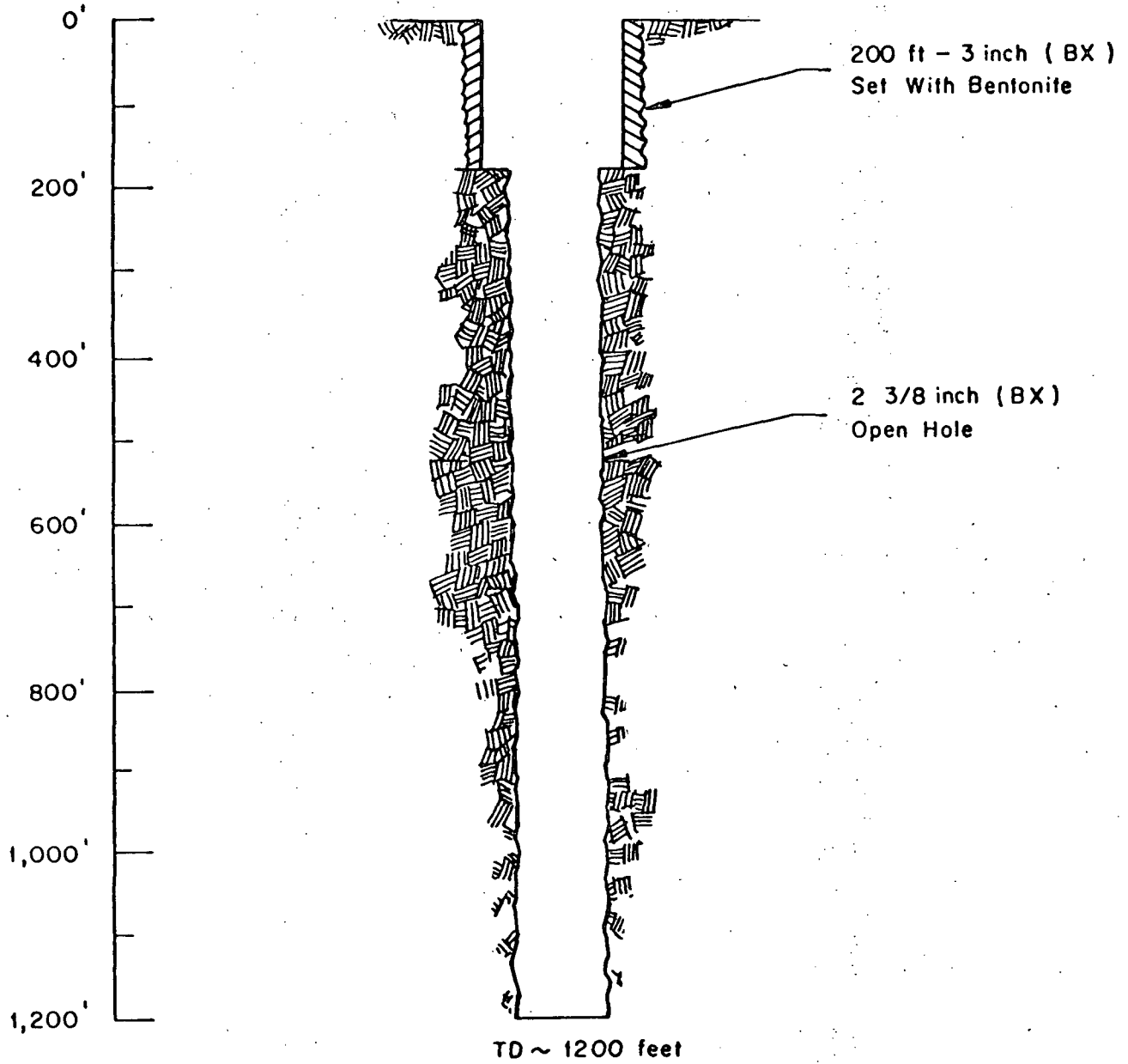
The hole will be completed as an observation well by hanging plastic or steel tubing from the flush joint casing down to total depth. The tubing will extend above ground level at least 2 feet and be equipped with a cap. Abandonment of the hole will conform to state regulations governing that operation. See Drawing No. 3.

4.2 Drilling Materials

ANC will be responsible for providing at the drill site the following drilling materials for each hole drilled:

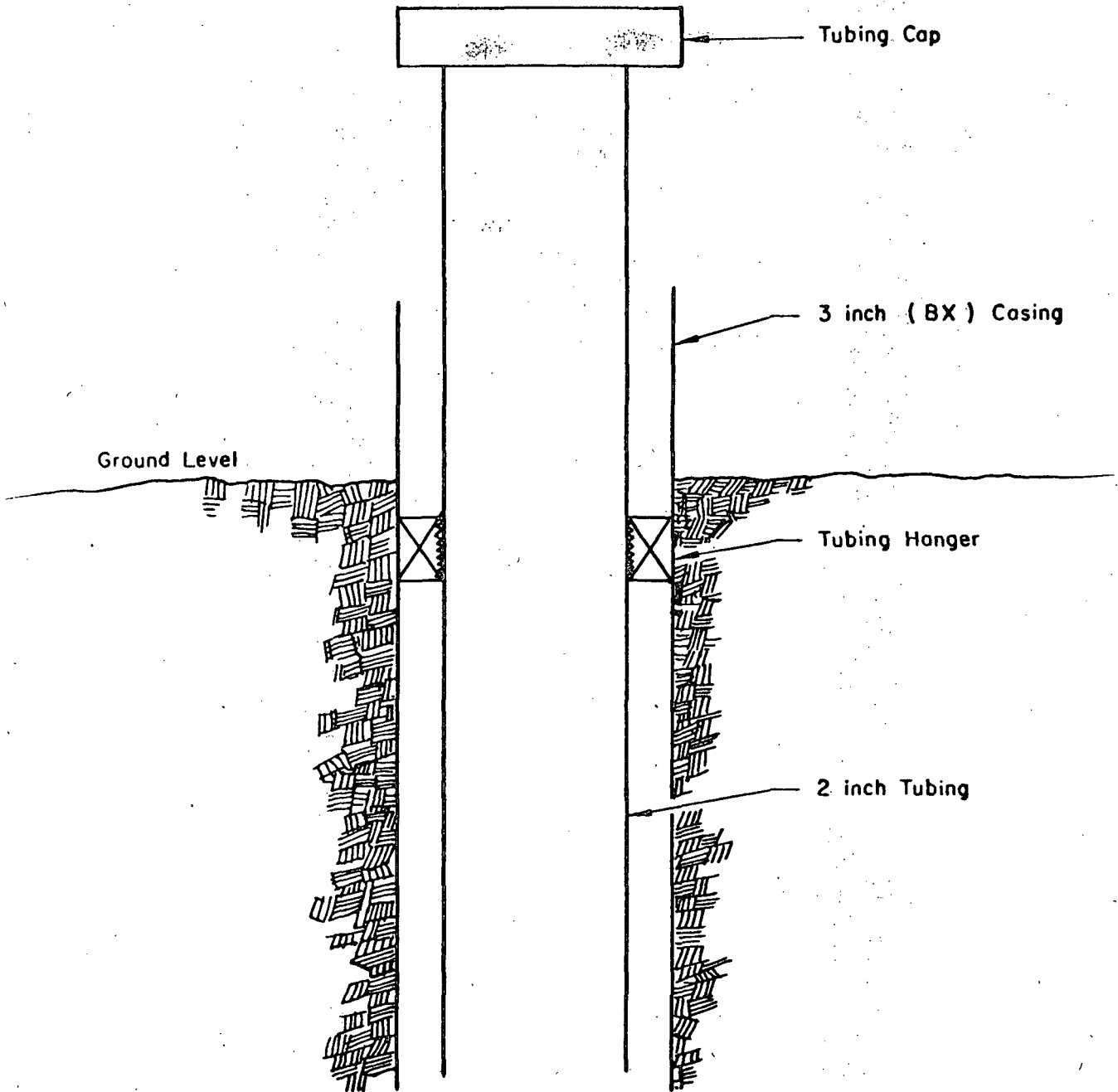
1. Casing
 - A. 60 feet of BW flush joint casing.
 - B. One casing shoe.
 - C. One packing gland for BW flush joint casing.

Drawing No. 2
Boise Project
BSH #1 & #2
Schematic Well Section



ANC - A - 6268

Drawing No. 3
Boise Project
BSW #1 & #2
Well Completion



ANC - A - 6267

2. Drill Bits

- A. Three BQWL diamond core bits.
- B. One BQWL diamond ring type reaming shell.
- C. One drag carbide insert bit.

3. Coring Equipment

- A. One 15 foot BQWL core barrel.
- B. One 15 foot BQWL inner tube assembly.
- C. One BQWL overshot assembly.
- D. Three BQWL core lifter cases.
- E. Three BQWL core lifters.

4. Drill Tools

- A. One sub; A rod pin to NW rod box.
- B. One sub; AW rod box to A rod pin.
- C. One quick disconnect adaptor with NW rod pin.
- D. One 7.5 ton hoisting plug with NW pin.
- E. One wommer foot clamp.
- F. One set of jaws for BQ rod.
- G. One sub; BW casing pin to NW rod box.
- H. Two BQWL open end wrench.
- I. Two BQWL inner tube wrench.
- J. One sub; BQ rod pin to NW rod box.

5. Drill Rod

- A. 120 sections (10 foot lengths) BQWL drill rod.
- B. 5 sections (5 foot lengths) BQWL drill rod.

- C. 3 sections (2 foot lengths) BQWL drill rod.
- D. 2 sections (1 foot length) BQWL rod.

6. Tubing

- A. Adequate plastic or steel tubing to extend from ground level to the total depth of hole.

4.3 Drilling Procedure

1. Drilling will be conducted on a two shift operation from approximately 0700 to 1500 and 1500 to 2300 hours, Monday through Friday.
2. The workday and work-week may be adjusted to conform to good drilling practices and for the integrity of the hole.
3. The holes will be drilled as exploratory holes and conform to State of Idaho regulations governing the drilling of such wells.

4.4 Drilling Fluid

A bentonite mud will be used during the setting of the flush joint casing. Water will be used as the drilling fluid thereafter.

4.5 Coring

Coring will be accomplished as required and on an average of 30 feet per 100 feet of drilled depth. Actual cores will be taken at depths as determined by ANC.

4.6 Security

BSU/IBMG will be responsible for providing off shift security for the drilling rig. Drilling bits will be secured under lock and key or personal possession when not being used for drilling. The driller will be accountable for all diamond bits used in the drilling operation.

4.7 Logging

All logging will be accomplished by INEL personnel (ANC) and in general will consist of the following logs:

1. Self potential/single point resistivity.
2. High resolution thermometer.
3. Caliper/natural gamma.

4.8 Abandonment

If ANC directs the abandonment of the holes because of the inability to locate a sufficient geothermal resource, or for any other reasons, development of abandonment procedures will be the responsibility of ANC. BSU/IBMG will perform abandonment work required at the drilling site and ANC will be responsible for providing funding and coordinating the procedure with the appropriate parties.

Abandonment procedures will be based upon the following criteria:

1. prevent contamination of freshwaters or other natural resources;
2. prevent damage to geothermal reservoirs,
3. prevent loss of reservoir energy, and
4. protect life, health, environment, and property.
5. compliance with existing state regulatory guidelines.

5.0 PERMITS

ANC, through ERDA, will be responsible for acquiring all necessary permits to drill either on federal, state, city, private or jointly owned lands.

6.0 ENVIRONMENTAL ASSESSMENT

During drilling of the slim hole and demonstration wells for the Boise project, the primary environmental impacts will be directly relatable to the operation of the drill rig itself; with careful planning, no long-term detrimental impacts should result. The drilling operation will be supervised by a licensed and qualified well driller and will adhere to all applicable state regulations. The drilling supervisor will be responsible for insuring that all environmental impacts are minimized either through precautionary measures or through mitigation efforts.

For those drill sites located in the Foothills where erosion is a serious consideration, special care will be taken during site preparation work. Although a nominal 1/4 acre will be required for each site, land will be disturbed only where absolutely necessary. Revegetation in the past has been extremely difficult, if not impossible, in this area; therefore, removal of ground cover will be kept to a minimum.

The most serious potential impact will be contamination of waters or soils near the drill sites. For this reason, settling pits will be dug to contain all drilling fluids and cuttings. In areas where contamination from seepage is critical, these pits will be lined. Above ground mud tanks, rather than pits, will be used in "developed" locations (e.g. near the state capitol) where pits would not only be unsightly, but could cause problems in site restoration. No fluids from the drilling operation, whether they be drilling mud or geothermal brine, will be intentionally allowed to be discharged directly into any stream or irrigation ditch where water is currently flowing or may be flowing in the near future. This will be a restriction for all drill sites. If it is anticipated that large volumes of fluids will be encountered, either a reserve pond will be excavated or some sort of storage tank will be on hand for containing these fluids. The demonstration wells

will be cased and cemented past any fresh water aquifers to prevent contamination of ground water supplies.

The noise levels associated with the drilling operation and the movement of people and vehicles are not expected to be a nuisance in the urban areas. If drilling takes place near residential sections and the drilling noise levels cause an impact, the rig will be shut down at night. Because all drilling will take place in the fall and winter, the only wildlife to be affected would be those species migrating to lower elevations. If the drill sites are located in previously developed areas, even this will not be a problem. Control of access to the drill sites will be maintained either through the posting of signs or through the fencing of each site, both for security and for safety reasons.

If for any reason a drill site is abandoned, the hole will either be plugged in conformance with the Idaho Department of Water Resources standards for well abandonment, or be maintained in a standby capped condition. To facilitate site restoration, there will be no permanent disposal of any waste on site. All materials not directly connected with the wellhead will be removed from the site upon termination of drilling and testing and disposed of properly, the mud pits and any reserve ponds will be backfilled, and each site will be graded to approximate pre-existing land contours and reseeded where possible.

7.0 INDUSTRIAL RELATIONS

ANC/ERDA-ID will be responsible for the determination as to whether the Davis-Bacon Act applies to this project.

8.0 PROGRAM MANAGEMENT

8.1 General

This section describes the basic authorities and responsibilities of the principal participants in the drilling operations. The principal participants include the following:

1. ERDA - Idaho Operations Office.
2. Aerojet Nuclear Company (ANC).
3. Boise State University (BSU).
4. Idaho Bureau of Mines and Geology (IBMG).

8.2 Energy Research and Development Administration (ERDA) - Idaho Operations Office

The Manager, ID, shall be responsible for all project related activities assigned to the government by contract E(10-1)-1375 (between ERDA-ID and ANC) E(10-1)-1536 (between ERDA-ID and IBMG) and E. (10-1)-1537 (between ERDA-ID and BSU).

8.3 Aerojet Nuclear Company (ANC)

ANC will appoint a Project Manager who will be responsible to the General Manager of ANC and the General Manager of ANC will be responsible to the Manager of ID for all project related functions being accomplished in an effective and timely manner. The ANC Project Manager will continuously monitor the activities of all the program participants so as to assure that all the participants have plans to and are accomplishing all the activities required by this drilling plan. The ANC Project Manager will also assure that the appropriate technical expertise is available to allow the tasks,

as defined in this drilling plan and as stated in the Demonstration Geothermal Space Heating Project, to be accomplished. The ANC Project Manager is further charged with the primary responsibility of accomplishing the goals of the Demonstration Geothermal Space Heating Project.

The ANC Project Manager will appoint an ANC Task Manager who will be responsible to the ANC Project Manager. The ANC Task Manager responsibilities will include the following:

1. Provide technical criteria for the development of the drilling plan including identifying the requirements for technical data to be obtained during the drilling operation.
2. Provide technical program direction and technical program support to BSU/IBMG to assure that the objectives of the project are accomplished.
3. Provide on-site logistical support activities as specified in Section 2.0 of this report.
4. Management of ANC activities on-site.
5. Be continually aware of all drilling site-related activities and assure that the project participants are cognizant of any development which may impair the drilling program or the objectives of the Demonstration Geothermal Space Heating Project.

8.4 Boise State University (BSU)/Idaho Bureau of Mines and Geology (IBMG)

BSU/IBMG, under direction of ANC will provide the necessary equipment, material, and personnel to conduct the drilling operations as described in this plan. BSU/IBMG will also be responsible for all procurement of materials and services directly related to drilling operations that are not assigned to ANC in Sections 2.0 and 4.0 of this plan.

BSU/IBMG will conduct the drilling using their new jointly owned Acker drilling rig. The drilling will be performed under existing contracts E(10-1)-1537 (BSU) and E(10-1)-1536 (IBMG) and in accordance with this drilling plan.

9.0 FUNDING AND COST REPORTING

Costs incurred by BSU/IBMG will be reported to ANC on a weekly basis by BSU/IBMG. It is recognized and agreed to by parties that such costs are unofficial and subject to change when official monthly costs are reported.

BSU is funded under contract E(10-1)-1537 and IBMG under contract E(10-1)-1536 for this drilling project.

10.0 TECHNICAL DOCUMENTATION AND REPORTING

10.1 General

The documentation and reporting requirements during the drilling of the Boise Slim Holes (BSH) will be limited to those necessary for the participants to maintain a thorough working knowledge of day-to-day operations and the final hole configuration.

10.2 Reports

The required reports for the slim holes include:

1. A daily drilling report covering the progress of drilling during the previous 24 hours. Specific information covering depth drilled, bit condition, drilling fluid use, lithology, and non-productive time will be covered.
2. A hole completion report estimated to be issued within 60 days of drilling completion. This report will cover all slim holes drilled and document the drilling and completion procedure. It will be prepared by BSU/IBMG and ANC as an ANC report.

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