GL01573

PROPOSAL TO USAF-ATC

CHARACTERIZATION OF GEOTHERMAL RESOURCES AT LACKLAND AFB

DEPARTMENT OF ENERGY - IDAHO OPERATIONS OFFICE

with

EARTH SCIENCE LABORATORY/UNIVERSITY OF UTAH RESEARCH INSTITUTE

and

EG&G IDAHO, INC.

CONTENTS

		Page
1.0	Executive Summary.	1
2.0	Introduction	2
3.0	Scope of Work.	4
	3.1 Work Breakdown Structure.	4
	3.2 Work Statement.	4
4.0	Management Plan and Capabilities	17
	4.1 Team Organization	17
	4.2 Personnel Experience.	19
5.0	Pricing Proposal	22
6.0	References	23
Appendix A:	Resumes of Key Project Participants.	24

1.0 Executive Summary

This project will establish the characteristics of the geothermal resource under Lackland AFB. The end product will be a final report describing the geothermal characteristics under Lackland AFB based upon hard test data obtained from a production well drilled on the base.

The project will be developed in two phases, with a USAF decision point for withdrawal following Phase I in the event that early indicators from literature searches are not encouraging. Phase I will consist of an Environmental Assessment, compilation, integration and interpretation of available geologic and hydrologic data to select the well location and design of the well. Additionally, the permitting process will be initiated. During Phase II, the permitting process will be completed, subcontractors will be solicited for well drilling and logging, the well will be drilled and logged, test equipment will be procured, the well will be tested, a final report will be prepared, the well will be capped according to local regulations and the site will be restored to original grade.

It is anticipated that the project, from contract signing, through drilling the test well, to final report production, will take up to 29 weeks. Environmental and permitting procedures required for drilling are the primary controlling factors for the early portion of the program, with well drilling and aquifer testing controlling the time required for the later stages of the program.

Phase I of the program is budgeted for a total of $56,000. Phase II costs will largely be controlled by the cost of drilling, which is presently anticipated to be about $400,000. Other costs on Phase II will bring the anticipated total for this portion of the project to $564,000. Total project costs will be approximately $620,000.

2.0 INTRODUCTION

The proposed program to prepare a report on the detailed geothermal characteristics of the Hosston aquifer beneath Lackland AFB is scoped to provide the USAF with adequate data to perform an engineering and economic evaluation of the long-term potential for direct heat geothermal application on the base. The report produced by this program will contain site-specific geological data not available to Woodruff and others (1981) in their regional compilation. The general engineering and economic work of the Radian Corporation (1982) will be supplemented by providing the USAF with site-specific water quality and aquifer productivity characteristics.

A two-phased approach to this report is proposed. Phase I will be relatively inexpensive, and will focus on developing a recommended well location, estimating detailed geological and hydrologic conditions likely to be encountered in the well, and the preparation of an Environmental Assessment, which will identify any potential environmental problems. A briefing at the end of this phase will provide the USAF with information upon which to base a decision to continue or discontinue the program.

Phase II will be the more expensive portion of the program. Data desired by the USAF will require the drilling of a test well somewhere on Lackland AFB. ESL and EG&G Idaho interpretation of the report of the Radian Corporation (1982) indicates that much of the base may be within economic piping distance of potential user sites. Adequate long-term aquifer testing will also be part of Phase II.

The final report will be in three sections. Section I will contain the results of Phase I, Section II will contain the results of the drilling program, and Section III will contain the results of the aquifer testing. These sections will be presented to the USAF during a final briefing on project results.

Figure 3.2 is a task schedule for Phases I and II. It should be noted that this is a rapid but reasonable schedule based upon EG&G Idaho and ESL/UURI experience. External factors such as processing delays in permitting, the availability of drilling rigs and site specific drilling problems may cause minor schedule slippage. Phase I timing is primarily controlled by the Environmental Assessment; other Phase I tasks may comfortably be accomplished during the time required for the Assessment. Phase II timing will primarily be controlled by the time required for well permitting, getting a driller on site, and the actual drilling. At the time of writing this proposal, the downturn in oil and gas well activity in Texas means that drilling rigs are available on relatively short notice. Any major upward economic change, however, could cause a delay in the time to get a rig on site.

Drilling costs are based upon expected depth and well size requirements which include assumptions of aquifer depth and temperature. Drilling cost estimates were obtained from both a drilling consultant and drilling contractor with experience in the San Antonio area. Consistent with well drilling price estimating practice, our estimate assumes normal drilling experience and difficulty in the proposed area, but does not attempt to price the range of drilling problems which could be encountered.

3.0 Scope of Work

This Section discusses the scope of work prepared to accomplish the technical objectives outlined in the Introduction. A Work Breakdown Structure (WBS), detailed work statement, analysis of work statement requirements, reporting procedures and an integrated project schedule are presented in the following subsections.

3.1 Work Breakdown Structure (WBS)

This work is divided into two phases. Each phase is further broken down into individual tasks as shown in Figure 3.1. The WBS, in conjunction with the project schedule shown in Figure 3.2 will assist the Project Manager in efficiently coordinating the efforts of the project team.

3.2 Work Statement

A work statement has been developed by the project team to meet the stated project objectives. The Department of Energy, Idaho Operations Office (DOE/ID) and its subcontractors, EG&G Idaho, Inc. and the Earth Science Laboratory, Univeristy of Utah Research Institute (ESL/UURI) are prepared to furnish all necessary equipment, personnel, material and facilities to satisfactorily accomplish the following work tasks:

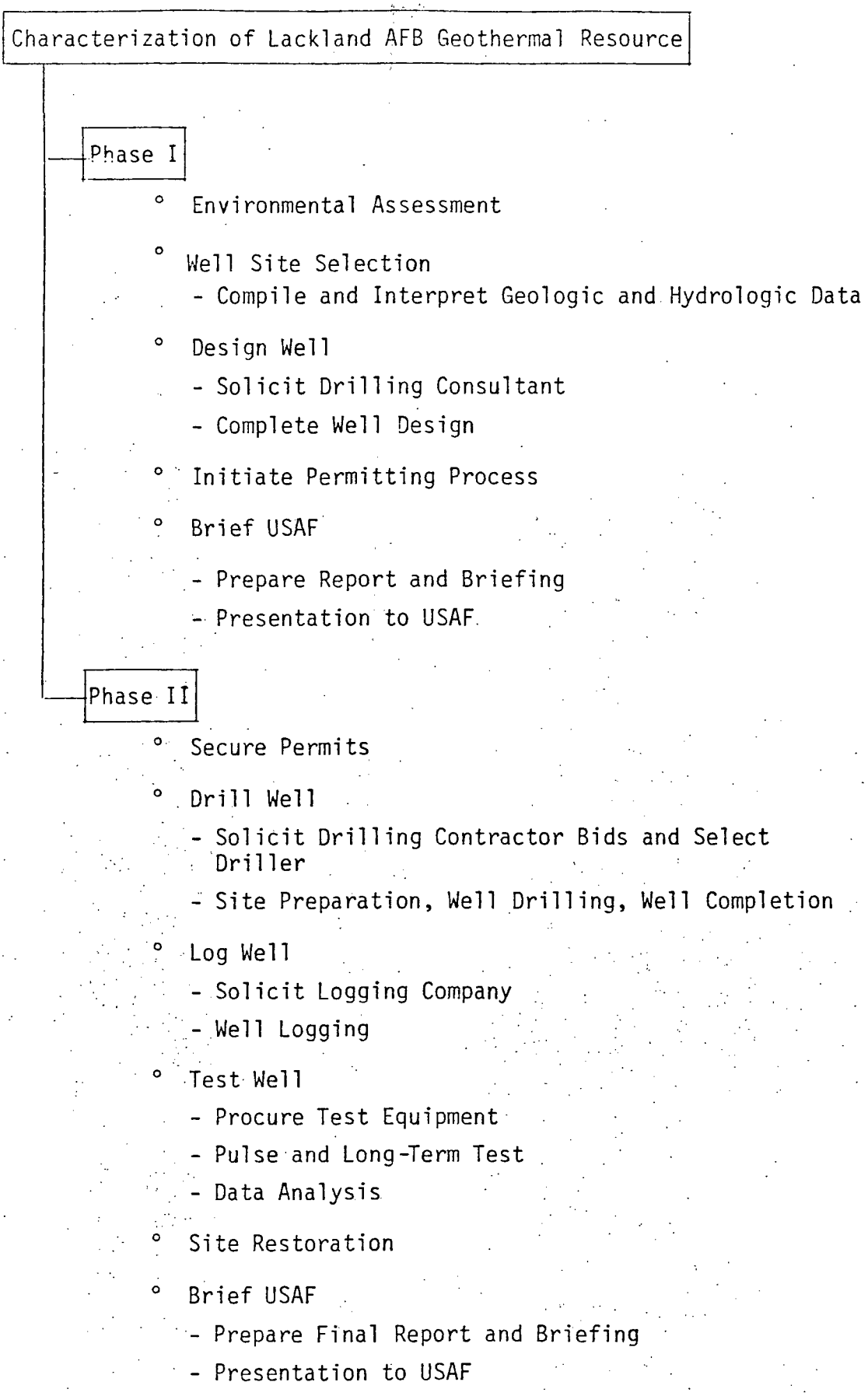

Figure 3.1 - Work Breakdown Structure

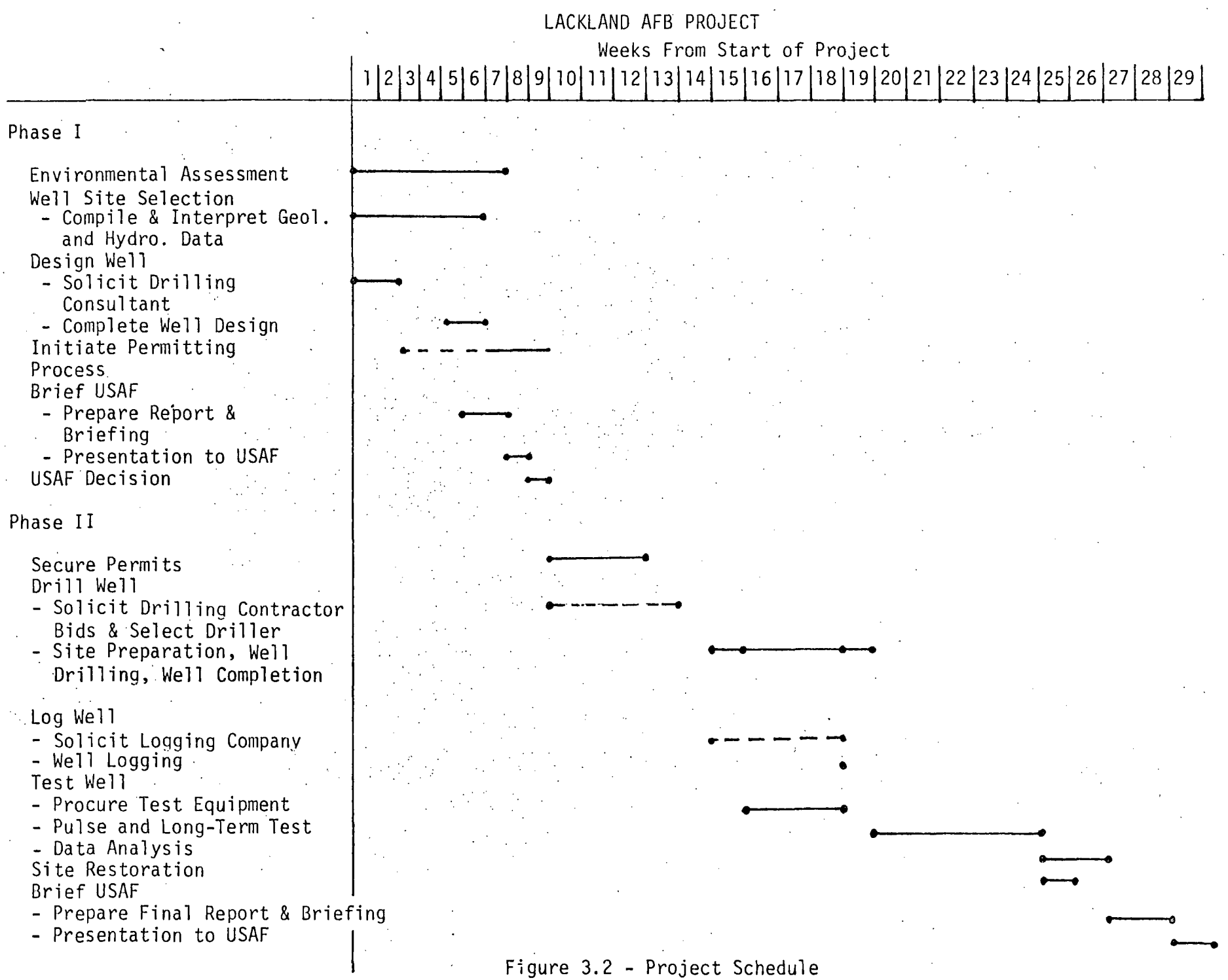

Figure 3.2 - Project Schedule

Key: - - - -Part-time Activity

Phase I

Those tasks required to update geological interpretations of subsurface conditions beneath Lackland AFB, and those required to meet federal, state and local institutional requirements. These include:

° Environmental Assessment

An environmental assessment will be prepared according to the requirements of AFR 19-2. It is anticipated that the environmental assessment will include eight sections as follows:

1. Introduction - Brief overview of the project. The discussion would include such topics as program objectives, location and schedule of major development activities.

2. Description of the Proposed Activity - Discussion of the regions drilling history, exploration program, proposed well design, drilling schedule, well testing, fluid disposal, well control, etc.

3. Description of the Existing Environment and Potential Environmental Concerns - Address geological hazards, air quality, and water quality protection and concerns, floral and faunal impacts, etc.

4. Alternatives - Reaffirm that the trade-offs involved in developing the geothermal resource at that site are favorable compared to other energy options.

5. Restoration - Plans and procedures that would be used to restore the site and/or close the well (if well is to be abandoned).

6. Irreversible and Irretrievable Impacts - Describe such impacts that may result from the proposed development, if any.

7. Monitoring Program - Define the analyses to be performed on the geothermal fluids. Describe any other environmental monitoring programs planned or required for the project.

8. Regulations and Permits - As a minimum the following information should be provided:

   - Document the right to develop the geothermal resource
   - Approval of drilling activity
   - Fluid disposal approval
   - Air discharge waiver (if needed)

° Well Site Selection

- Compile and Interpret Geologic and Hydrologic Data

A primary goal of the data compilation, integration and interpretation task is to develop an evaluation of the geologic and geothermal parameters of the Hosston Formation beneath Lackland AFB, including temperature, water chemistry, and aquifer productivity characteristics. Preliminary investigation of geologic data suggests that Lackland AFB lies over a zone of rapidly changing subsurface conditions. It is likely that a range of geothermal characteristics of the target Hosston Formation may also exist beneath the base, and it is therefore appropriate to compile additional geologic data beyond those of Woodruff and others (1981). Additional goals of this task are to identify a likely drilling site and to identify potential drilling problems that might be encountered during Phase II, such as cavernous limestone and high water flows in the Edwards Formation, or the presence of hydrocarbons. These data will be valuable in designing the well.

Geologic data in existing reports will be supplemented by compilation of additional subsurface information. Woodruff and others (1981) have described the regional geothermal geology, and the Radian Corporation (1982) has described engineering and economics of potential geothermal applications at Lackland AFB. Two major types of subsurface data exist in the Lackland AFB area: data from water wells and data from oil and gas tests. Hydrologic and stratigraphic data will be compiled from the files of the Texas Bureau of Economic Geology, the U.S. Geological Survey, the Edwards Water District, the Texas Water Development Board, the Texas Railroad Commission, and other appropriate agencies and people. Oil and gas well data will be compiled from the files of petroleum libraries in San Antonio, the Texas Railroad Commission, and through contact with

private geologists familiar with subsurface conditions in the San Antonio area. Appropriate USAF and private sector geologic studies will also be compiled. Downhole rock samples from wells in the vicinity of Lackland AFB will be evaluated in the Texas Bureau of Economic Geology sample library to aid in stratigraphic interpretation.

Integration and interpretation of the geological data will take place at both ESL and EG&G. ESL will emphasize geologic conditions, EG&G Idaho will evaluate existing Hosston aquifer productivity data. The ESL geologists assigned to this program are familiar with water and oil and gas data, having experience in more complex geologic terrains. EG&G Idaho hydrologists are familiar with aquifer evaluations based on existing data.

The data compilation, integration, and interpretation task will provide baseline data for the Environmental Assessment, geologic and hydrologic input to the preliminary well design, and required information to pick the well location prior to the USAF Phase I briefing.

° Design Well

- Solicit Drilling Consultant

The objectives of securing a drilling consultant for this project are to run a more economic drilling program and to ensure a safe and successful completion of the well. It is well understood that the inclusion of local drilling expertise in a project of this magnitude is very cost effective. The drilling consultant will be solicited through existing contacts in the San Antonio area. The final choice of the consultant will follow evalutions of their respective credentials and personal communication.

The drilling consultant will aid ESL and EG&G in the following functions, which will include but not be limited to: designing the well, preparing and distributing the drilling contractor bid invitation, selection of drilling contractor, supervision of drilling and geophysical logging operations, supervision of casing the drill hole, and ascertaining that all drilling and testing operations comply with all state and federal regulations.

In meeting responsibilities, the drilling consultant will work closely with ESL and EG&G personnel, and provide special insight into local drilling problems.

- Complete Well Design

The advance planning of all aspects of the drill hole will assure the proper match between the drill hole, geologic conditions and planned fluid production, as well as provide input for the Environmental Assessment and permitting processes. The ultimate controlling factor affecting the well design is the size of casing required to produce geothermal fluid at the prescribed rate. That objective, along with knowledge of the stratigraphic section to be penetrated and special drilling problems (such as cavernous conditions and high water flow rates in the Edwards Formation provide the input for a set of programs that define the drilling and completion of the well. The drill bit program optimizes the types of bits to be used in each depth interval or formation. The drilling fluid program defines the drilling fluids to be used to most efficiently drill each formation; special emphasis will be placed on controlling lost circulation. The casing program will detail the size(s) and length(s) of casing to be placed in the drill hole and at what depths. The cementing program will define in detail the procedures and equipment to be used to cement the casing into the drill hole.

° Initiate Permitting Process

The permitting process will be initiated in Phase I because of the impact that the required lead times could have on Phase II activities. The type of permits required for the proposed development are dependent on two key factors--the chemical contents of the geothermal fluid and the planned method for disposal. According to the Department of Defense (DOD) Regulation AFR 19-2, the Air Force must comply with all applicable federal, state and local regulations. These regulations and the administering agencies are as follows:

- The Texas Railroad Commission (TRC) has regulatory jurisdiction over all geothermal operations. Thus a permit will be required from them for drilling, geothermal production, and disposal. If surface disposal is planned, a public review and exemption process must be followed.

- The Texas Department of Water Resources (TDWR) must also review surface discharge plans. They must also approve the plans to protect the Edwards Aquifer.

- The Environmental Protection Agency (EPA) would review a New Source Environmental Questionnaire (NSEQ) under the National Pollutant Discharge Elimination System (NPDES) if long term surface disposal is planned. It is unlikely that EPA would decide this project is a significant new source, threfore, an Environmental Information Document (EID) and further permitting would not be required.

- The Texas Air Control Board (TACB) would need to issue a permit/exemption if atmospheric emissions from the geothermal operation is expected. It is unlikely that emissions will be great enough to require an EPA Prevention of Significant Deterioration (PSD) permit.

- The Water Board of San Antonio and the Edwards Underground Water District are local agencies that must approve aquifer protection plans for the drilling operation.

° Brief USAF
  - Prepare Report and Briefing
  - Presentation to USAF

The results of Phase I will be summarized in a briefing to the USAF, which will be delivered at Randolph AFB or other USAF designated site in San Antonio. This briefing will include a summary of the anticipated geothermal characteristics of the Hosston aquifer, suggestions for drilling targets to test the aquifer, preliminary well design and well bid package specifications, an evaluation of potential drilling problems, and the results of the Environmental Assessment. Following this briefing, the project will continue into Phase II, including the drilling and testing of the well unless the USAF decides to terminate the project and request an abbreviated final report.

Phase II

The tasks in Phase II will allow completion of a detailed final report. These tasks include:

° Secure Permits

The permitting process initiated in Phase I will be completed.

° Drill Well

- Solicit Drilling Contractor Bids

The product of this task will provide the dimensions of the hole to be drilled, the procedures to be followed, and the anticipated schedule to develop a package detailed enough for bids to be prepared by private drilling companies. This document will be derived largely from the Well Design. The purpose of performing this task is to secure prices from several drilling companies on a competitive basis to allow the drill hole to be completed at the lowest price, consistent with obtaining a quality job.

- Select Driller

This task will choose the drilling contractor for the project from among those submitting bids. This will be accomplished by screening the qualifications of the bidders on the following: cost; experience of the bidder by personnel of ESL, EG&G and/or the drilling consultant; ability of the bidder to meet the schedule; and physical inspection of the bidder's drilling equipment.

This stage of the project will optimize the prospects for an economically drilled, and successfully completed drill hole. The selection will be done by the project management team in conjunction with the drilling consultant.

- Site Preparation, Well Drilling, Well Completion

Site Preparation

Prior to the arrival of the drill rig on the site, a mud pit and a secondary pit for fluid collection and cooling during well testing

will be dug and lined (if necessary). It is anticipated from the topography of most of the base that grading will not be necessary.

Well Drilling

Project personnel will direct the drilling of a test hole into the objective Hosston Formation at a nominal depth of 4,000 ft. Normal local practices will be used to drill through the potentially troublesome Edwards Formation. At the same time, care will be exercised to prevent contamination of water in the Edwards, as it is the municipal water supply of San Antonio. Following complete penetration of the Edwards, that aquifer will be isolated from the remainder of the drill hole by steel casing cemented permanently in place. This will also prevent cold water intrusion from the Edwards into the geothermal aquifer. Drilling will then continue to the targeted depth.

Drilling will commence at the earliest date consistent with completion of the Environmental Assessment and securing necessary permits. All aspects of drilling will be supervised by ESL personnel with the assistance of the local drilling consultant. Appropriate hydrologic monitoring during drilling will be by EG&G and ESL personnel.

Well Completion

Immediately following initial logging of the wellbore, the well will be completed by installing the production casing, cementing it in place and air-lifting to clean the production zone.

° Log Well

- Solicit Logging Company

This aspect of the project will be done upon selection of the drilling contractor and the finalization of the drilling schedule. Many major logging companies operate in the San Antonio area, and all offer essentially the same services, which means the choice of a logger will be one largely of price for the services requested. It is advisable to establish contact with the chosen logging company early in the project to assure their availability when needed.

- Well Logging

The well will be logged immediately after the completion of drilling and before setting the production casing. The specific logging program will include caliper, temperature and geophysical logs identified by ESL, EG&G and the drilling consultant, as required to answer geologic and hydrologic questions for reservoir evaluation.

° Test Well

- Procure Test Equipment

During the drilling of the well, the hydrologist assigned to monitor the well will arrange local purchase and/or rental of equipment to be used for test. Rentals will include a production well pump, a disposal pump, temporary surface disposal piping and a data recording trailer. Valves and fittings will be purchased and will become the property of the USAF-ATC. Instrumentation and recording devices will be supplied by EG&G Idaho at no cost to the USAF and will remain their property.

- Pulse and Long-Term Test

This task will be initiated upon completion of the well drilling and logging operations. The well will be tested in order to infer reservoir size, evaluate hydraulic characteristics, and assess long-term well production capability. Well testing will consist of a series of short-term (one hour to several days) pulse tests to provide early time data relative to boundary conditions and thermal effects. The data collected from the pulse tests will be utilized to select the optimum flow rate for a long-term constant rate flow test, approximately three to four weeks in duration.

Data will be collected to determine the following well parameters: specific capacity, well efficiency, productivity index, skin factor, wellbore storage, aquifer transmissivity (T) and storage coefficient (S), aquifer permeability (K), or thickness-permeability product (kh), and porosity-compressibility thickness-product ($\phi c_t h$).

- Data Analysis

Analysis of Phase II data will be divided into two parts: geologic results and interpretation of the drilling, logging, and rock and water sampling program, and results and interpretation of the aquifer testing program.

The analysis of the drilling and logging program will include details of the drilling program, downhole interpretation of the rock units encountered, interpretation of the well logs, and results of rock and water chemical analyses. An analysis of the drilling, with suggestions for procedures to be used in a wellfield development program, will be provided.

° Site Restoration

ESL/UURI, EG&G and subcontractor personnel will insure that all surface disturbances made during the drilling and testing portions of this program are repaired. The well will be capped in accordance with Texas regulations.

In the unlikely event that the well does not prove to be suitable for an economic project application, it will have to be plugged and abandoned in accordance with Texas regulations. Most likely this will be discovered before testing has proceeded significantly and possibly before the production casing has been set (immediately after logging). It is therefore likely that sufficient funds originally allocated for other purposes within the scope of this contract will be available for plugging and abandoning the well.

° Brief USAF

- Prepare Final Report and Briefing

The final report to the Air Force will be prepared in three sections. The first of these will cover Phase I activities, including the results of the geologic and hydrologic studies and the Environmental Assessment.

The second and third sections will cover Phase II activities. Section II will be a report on the well drilling, including details of subsurface stratigraphy and well logging. Section III will present detailed

results of the aquifer test, with suggestions for wellfield development, should the USAF decide to continue this project throughout the engineering stages.

- Presentation to USAF

  The three sections of the final report will be delivered to the USAF. Following review by the USAF a presentation of the results will be made and USAF questions will be answered.

4.0 Management Plan and Capabilities

The Lackland AFB Geothermal Resource Characterization will be conducted by the Department of Energy, Idaho Operations Office (DOE/ID). DOE's technical expertise will be supplemented by personnel from their subcontractors, EG&G Idaho and the Earth Science Laboratory, Univeristy of Utah Research Institute. Additionally, a local drilling consultant, a local driller and a local well logging service will be subcontracted.

4.1 Team Organization

The organization of the project team is shown in Figure 4.1. Primary responsibility for performing the study rests with the project manager. The Project Manager will have overall control of the project and will coordinate the activities of all of the project team members. Each position in the project organization is staffed by an experienced and qualified individual. Resumes for key members of the project team are contained in Appendix A.

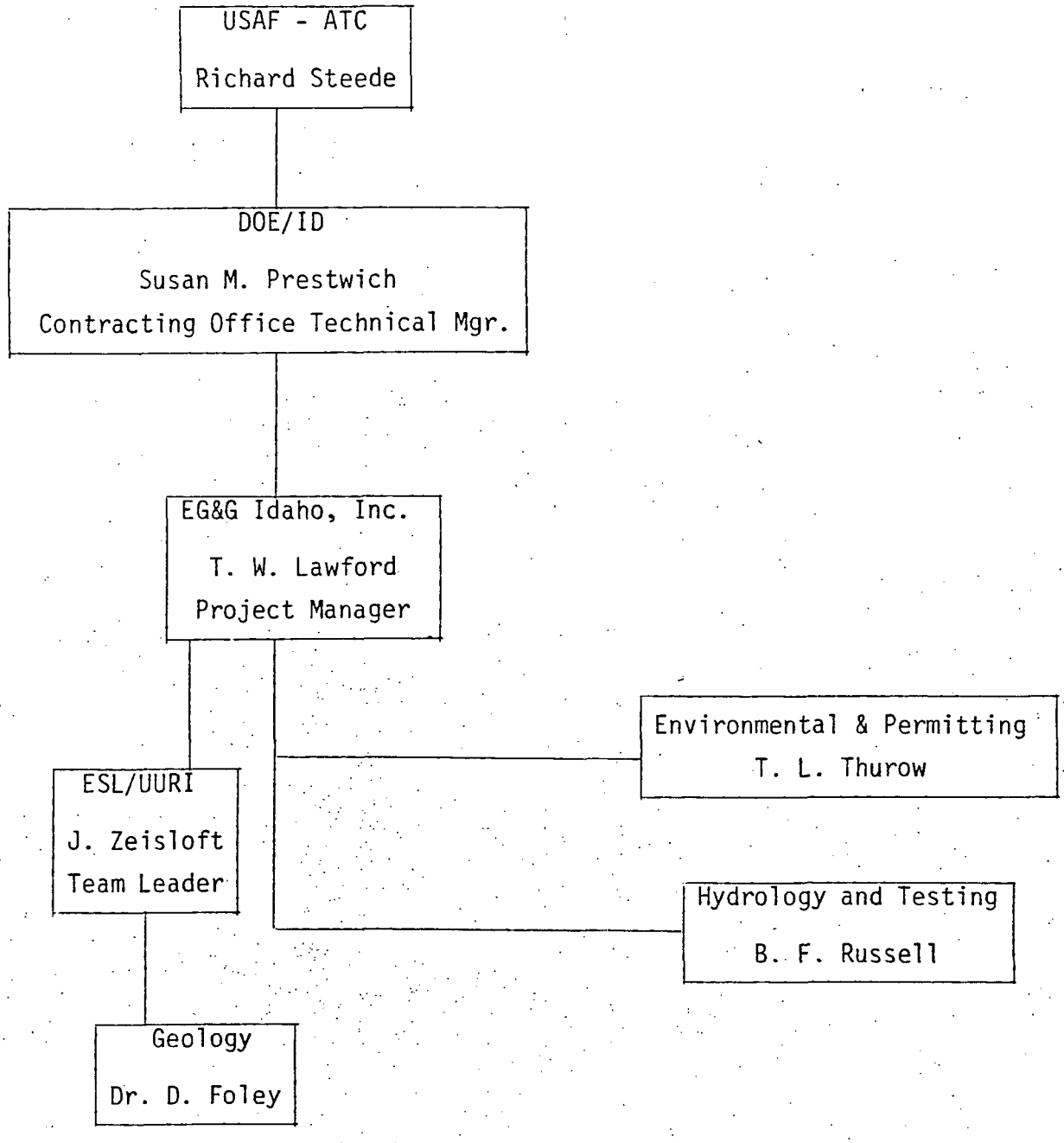

Figure 4.1 Team Organization

Contracting Office Technical Manager

The Contracting Office Technical Manager is responsible for contractual arrangements between the USAF and DOE/ID, and also between DOE/ID and ESL/UURI and EG&G Idaho.

Project Manager

The Project Manager is responsible for meeting the objectives of the study. The Project Manager's responsibilities include planning, coordinating and supervising the project team. The Project Manager will monitor product quality, budget, and schedule to ensure that the study approach and its implementation achieve the planned study objective.

The Project Manager will act as the point of contact with the USAF-ATC. In this capacity, the Project Manager will provide the USAF-ATC with weekly telephone reports of project progress and status.

The Project Manager will also coordinate all tasks associated with the environmental assessment and permitting and the hydrology and well testing. Additionally, he will participate in briefings to the USAF-ATC. He will also have available the full resources of the Idaho National Engineering Laboratory as backup.

ESL/UURI Team Leader

The ESL/UURI team leader will coordinate and actively participate in all tasks associated with the gathering and interpretation of geological data and the physical drilling of the well. He will also participate in briefings to the USAF-ATC. The full resources of the ESL/UURI are available to him as backup.

4.2 Personnel Experience

A team of professionals with geologic, environmental and hydrologic experience as applied to geothermal projects will be committed to completing this project for the USAF-ATC. A brief synopsis of the capabilities of the key project members (as shown in Figure 4.1) follows. Complete resumes for key project participants are contained in Appendix A.

Susan M. Prestwich - Contracting Office Technical Manager

Mrs. Prestwich is a geologist in the Advanced Energy Branch, Energy and Technology Division, DOE/ID. In this position she is responsible for the reservoir engineering, injection technology, user coupled drilling and the federal building programs. Previously, for EG&G Idaho she was responsible for drilling of the geothermal wells for the Raft River 5MW(e) Power Plant.

T. W. Lawford - EG&G Idaho, Inc., Project Manager

Mr. Lawford is a project leader in the geothermal projects section, with six years experience in the analysis and development of geothermal projects. This experience includes technical and economic analysis of geothermal project applicants for federal loan guaranties, development of performance and cost data bases for geothermal power plants and responsibility for federal cost share geothermal projects. He is a recognized expert for the requirements, design performance and costs of geothermal plants.

J. Zeisloft - ESL/UURI Team Leader

Mr. Zeisloft is a Project Manager and Geologist at ESL. He has extensive experience in geothermal exploration and drilling programs. Mr. Zeisloft came to ESL with background in energy and mineral resource exploration, including experience in the rock units that will be encountered beneath Lackland AFB.

Dr. D. Foley - ESL/UURI, Geology

Dr. Duncan Foley is a Project Manager and Geologist with ESL. For the past four years he has worked on the geology of low-and-moderate temperature resources, with specific emphasis on exploration stratigies. He has served as a technical monitor for DOE on geothermal resource evaluations in central Texas.

T. L. Thurow, EG&G Idaho, Inc., Environmental and Permitting

Experience pertaining to environmental issues associated with geothermal development include two and a half years of activity on a wide variety of geothermal programs. These programs, administerd by the DOE Idaho Operations Office, have a nationwide scope dealing with a diverse array of resources, applications and environmental concerns. By providing technical direction and support for these programs, an experienced background in environmental issues and regulations associated with geothermal development has been obtained.

B. F. Russell, EG&G Idaho, Inc., Hydrology and Testing

Mr. Russell is a hydrologist and Manager of the Geosciences Branch. He has been involved in geothermal reservoir assessment studies since 1976 including a reconnaissance study for the Imperial Government of Iran and a geothermal development in Costa Rica. In his current position, he manages a staff of hydrogeologists, geochemists, and engineering geologists. The staff has accumulated more than 20 years of combined experience in low-to moderate-temperature (90-150°C) geothermal reservoir engineering. Current Branch activities include the publication of a handbook for geothermal reservoir engineering and the development of innovative techniques to inject spent geothermal fluids.

5.0 Pricing Proposal

The total cost of the project is estimated to be $620,000, of which $56,000 is for Phase I, and $564,000 is for Phase II. A large portion of this total cost, however, is for subcontracts, most of which is for drilling. Although the EG&G - ESL/UURI team has gotten local estimates for the subcontracted work, a number of external factors (such as drill rig availability) can be expected to influence the cost when work actually starts. For that reason, the project team is supplying the cost estimate for each phase in two parts: a firm quotation for the staff professional services including overhead and travel and an estimate for the subcontracted work. On this basis, the project costs are:

Phase I

Professional services, overhead and travel	-	$54,000	(firm)
Subcontracts		2,000	(estimated)
Total Phase I		$56,000	

Phase II

Professional services, overhead and travel	-	$140,000	(firm)
Subcontracts	-	424,000	(estimated)
Total Phase II		$564,000	

Total Project (Phase I and Phase II): - $620,000

6.0 References

Woodruff, C. M., Jr., C. D. Henry, Christine Gever, 1981, "Geothermal Resource Potential at Military Bases in Bexar, Travis, and Val Verde Counties, Texas;" in Geothermal Resource Assessment for the State of Texas; Appendix H, Texas Bureau of Economic Geology, 85 p., U.S. Dept. of Energy Contract DE-A507-79ID12057.

Radian Corporation, 1982, "Life Cycle Cost Effectiveness Studies for Direct Utilization of Geothermal Energy at Four Military Installations in South Central Texas;" U.S.A.F. Contract F41689-81-C-0040, Vol. 1, 110 p.

APPENDIX A

Resumes of Key Project Participants

THOMAS W. LAWFORD

EDUCATION: MSME Carnegie Institute of Technology - 1962
BSME Carnegie Institute of Technology - 1957

MEMBER: ΠΤΕ - Mechanical Engineering Honorary
American Nuclear Society
Geothermal Resource Council

PROFESSIONAL EXPERIENCE:

1973 - Present EG&G Services and EG&G Idaho

Present position:
External consultant on costs and economics of geothermal electric power generation and geothermal direct applications projects.

Manager of an engineering group responsible for:

- -Technical and cost evaluations of applications for federal geothermal loan guaranties for DOE
- -Development and implementation of a plan to use geothermal space conditioning in federal buildings
- -Planning assistance to DOE to establish a realistic evaluation of geothermal power on line by the year 2000 and justification of geothermal R&D and financial incentive programs
- -Analysis and development of a test plan for the Raft River 5 MW(e) Primary Power Plant
- -Monitoring and evaluation of federal geothermal direct applications demonstration projects and feasibility studies

Previous position:

Supervisor of an engineering group responsible for verification of computer codes used to predict nuclear reactor behavior during accident conditions.

1962 - 1973 Westinghouse Bettis Atomic Power Laboratory

-Fluid systems design and analysis on naval nuclear power plants with emphasis on the secondary (steam) plant. Determination of cycle heat balances leading to rating of nuclear cores and overall plant size.
-Safeguards analyses on the light water breeder reactor leading to plant licensing.

1957 - 1962 Elliott Company, a division of Carrier Corp.

-Application, development and testing of steam and gas turbines, including blading design, performance analysis, and laboratory and field testing of units in power plants.

RECENT PUBLICATIONS AND PAPERS:

-The Prospects and Limitations of Geothermal Energy - American Society of Engineering Educators - June 1979
-Todays Geothermal Power Economics and Risks - Intersociety Energy Conversion Engineering Conference - Aug. 1979
-A New Perspective on Geothermal R&D Programs - Geothermal Resources Council - Oct. 1979
-An Advanced Binary Power Plant for Big Creek Hot Springs - 8th Energy Technology Conference - March 1981

RESUME

Jon Zeisloft

BIRTHDATE: January 31, 1940

POSITION: Geologist/Project Manager, Earth Science Laboratory, University of Utah Research Institute, Salt Lake City, Utah.

EDUCATION: B.S., Geology, 1964, Purdue University.
Graduate study in Geology, University of Montana, 1964-1967.
Graduate courses at Univ. of Utah:
1972 - Economic Geology
1973 - Mesozoic Stratigraphy of the Basin and Range
Plus: Mining and Mechanical Institute, Freeland, Pennsylvania (Engineering Preparatory curriculum, 1957-58).
Short courses and seminars since 1967:

1981-Introduction to Geothermal Log Interpretation, Geothermal Resources Council; 2 days.
1980-An Introduction to the Exploration and Development of Geothermal Resources, Geothermal Resources Council; 2 days.
1980-Basic Geothermal Drilling and completion technology, Geothermal Resources Council; 3 days.
1979-Management Principles, given by a consultant for employees of Utah Power and Light Co.; 2 days.
1979-Upper Cretaceous Sandstones, AAPG-Rocky Mtn. Section Annual Mtg, Casper, WY; 1 day field trip.
1977-Depositional Environments as Interpreted from Primary Sedimentary Structures and Stratification Sequences, SEPM short Course #2, Denver; 3 days.
1976-Energy Resources of NW Colorado, GSA Annual Mtg; 2 day field trip.
1975-Fluvial and Deltaic Sedimentation-modern processes and their ancient analogs, presented in the field for employees of The Anaconda Co. by two Univ. of Texas faculty; 8 days.
1975-Uranium and Thorium Resource Conference, U.S. Geological Survey; 3 days.
1972-Basic Financial Analysis in Minerals Exploration given by consultants for employees of Getty Oil Co.; 2 days.
1971-Wyoming Tectonics and their Economic Significance, WY, Geological Association; 3 days.
1970-Dakota and Related Rocks of the Front Range, Colorado, Rocky Mtn. Association of Geologists; 3 day field conference.
1970, 74, 78 and 80-Uranium Industry Seminars by AEC, ERDA and DOE; 2-3 days each.
1969-Exploration Analysis Seminar (Economics), given by consultants for employees of Pan American petroleum Corp; 2 days.
1969-Geology and Pennsylvanian-Permian Stratigraphy of South Park and Howard Area, Colorado; Rocky Mtn. Section; 2 days field conference.

1968-AAPG Short Course on Carbonate Dep'n + Diagenesis, at Denver; 3 days.
1968-San Juan--San Miguel--LaPlata Region, Colorado, 3 day; field conference, New Mexico Geological Society.

SOCIETY AFFILIATION: Utah Geological Association

PROFESSIONAL EXPERIENCE:

1/81-present Geologist/Project Manager, Earth Science Lab
Project manager for ESL's position on the monitoring team for the Department of Energy's User coupled Confirmation Drilling Program. Responsibilities include coordinating proposal review and subsequent stages of project implementation in the geotechnical and drilling disciplines. This is accomplished by assimilating interpretations and data provided by ESL's geologists, geophysicists and geochemists, and providing pertinent recommendations to the Department of energy. Areas of work have involved Colorado, Oregon, Idaho and northern California.

4/80-present Geologist, Earth Science Lab
Provide technical assistance under the Department of Energy's Technology Transfer Program. Responsibilities include geologic mapping and related geologic studies to aid in evaluating the potential of geothermal resource areas. Also, provide similar functions for proprietary geothermal exploration contracts. Areas studied have been largely in the Basin and Range of Utah, Nevada and Idaho, with additional contact in Oregon and Washington.

8/78-4/80 Senior Geologist, Utah Power and Light Company, Salt Lake City, Utah. Was responsible for uranium acquisition program involving evaluation of submittals and generation of new prospects. Submittals and generative work involved Precambrian to Recent geologic settings throughout the western United States, from known districts to rank frontier situations. Detailed evaluations of Kaiparowits Plateau coal properties through traditional subsurface methods. Work included the supervision of one or two Junior Geologists, recommending land acquisitions, occasional court house record searches.

2/75-8/78 Staff and Project Geologist, Anaconda Company, Salt Lake City, Utah. Performed uranium exploration functions from regional evaluations, through generating prospects and directing drilling operations. Projects primarily involved Mesozoic strata of the Colorado Plateau and, secondarily, Tertiary units of the Basin and Range Province. Field geologic work included facies mapping and section measuring to augment detailed subsurface studies. Responsibilities included working with land personnel and doing a limited amount of courthouse land research. Interviews conducted

with prospective geological employees, and field assistants and junior-level geologists frequently supervised.

2/74-2/75	Senior Geologist, Consulting Geologist on contract to Urangesellschaft, USA, Inc., Denver, Colorado. Responsible for operating a reconnaissance uranium exploration program throughout Alaska. Duties included the compilation of known data, the planning and direction of one field party, and the supervision of another operated by a consulting group. Field work included geologic mapping, airborne gamma-ray spectrometry surveys and geochemical sampling of rocks and stream waters. Responsibilities included land acquisition based on the interpretation of geological, geophysical and geochemical data. Reconnaissance studies were done in several uranium settings in the upper Great Plains from North Dakota to Oklahoma.
2/70-1/74	Geologist, Getty Oil Company, Salt Lake City, Utah. Performed all phases of uranium exploration from generating prospects and evaluating submittals through field geology and the planning and direction of several large, multi-rig exploration drilling programs. Planned and carried out several airborne radiometric and hydrogeochemical surveys. Responsibilities included working with the land department and, on occasion, doing short-term courthouse land checks. Supervised geologists, geological technicians, and field foremen throughout this employment. Worked primarily in Wyoming and Colorado, but had contact with uranium geology throughtout the Rocky Mountain states. Projects involved Precambrian, Mesozoic, and Tertiary host rocks. A few coal, fluorite, and metals submittals were evaluated.
7/67-2/70	Geologist (Junior and Intermediate Grades), Pan American Petroleum Corp., Denver, Colorado. Petroleum geology, from evaluating prospects and submittals through well site geology and field work. Responsibilities included working closely with the geophysical and land departments. Supervised geological professional assistants on various projects. The work involved the Four Corners area, the Las Animas Arch, and northwest Nebraska.
9/66-6/67 and 9/65-6/66	Instructor (Graduate Student), Department of Geology. University of Montana. Introductory Geology, Geologic Maps and Air Photos, and a field course in Geologic Mapping.
9/66	Exploration Geologist, Bear Creek Mining Company, Spokane, Washington. Doing geologic mapping and geochemical prospecting for copper and molybdenum on a short-term basis.
6/65-9/65	Geologist, Atlantic Refining Company, Corpus Christi, Texas. Completed a Cretaceous surface stratigraphic study from the literature research and field sampling through a final report, and a subsurface facies study of the Oligocene of the Texas Gulf Coast.

9/63-1/64 Purdue University, Department of Geology. Conducted all aspects of preparation, presentation, and grading of Introductory Geology laboratory classes (simultaneous with senior year studies).

6/63-8/63 Vibra-Tech Engineers, Inc., Hazleton, Pennsylvania. Assistant to geophysicist on shallow seismic refraction (twelve-channel seismograph) and earth resistivity surveys. Also, worked independently recording strip-mine and quarry blasting with a three-component seismograph for client's defense against damage suits.

PUBLICATIONS:

"Detrital Dolomite in the Maywood and Amsden (?) Formations, Granite County, Montana," Strickler, B. and Zeisloft, J., Billings Geological Society, 16th Annual Field Trip Guidebook (1965).

"The Geology and Geothermal Setting of the Magic Reservoir Area, Blaine and Camas Counties, Idaho," Struhsacker, D. W., Jewell, P. W., Zeisloft, Jon and Evans, S. H., Jr. in, Bonnichsen, B. and Breckenridge, R. M., eds., 1982, Cenozoic Geology of Idaho, Idaho Bureau of Mines and Geology.

RESUME

Duncan Foley

BIRTHPLACE AND DATE: Appleton, Wisconsin, December 17, 1947

POSITION: Geologist, Project Manager, Earth Science Laboratory, University of Utah Research Institute, Salt Lake City, Utah

EDUCATION:
B.A., Geology, 1971, Antioch College, Yellow Springs, Ohio
M.Sc., Geology, 1973, Ohio State University; emphasis on environmental geology
Ph.D., Geology, 1978, Ohio State University; emphasis on volcanic geology

PROFESSIONAL AFFILIATIONS:
1982, American Association of Petroleum Geologists (application being processed)
1980, Utah Geological Association
1979, American Geophysical Union
1978, Geothermal Resources Council
1976, Society of Sigma-Xi
1972, Geological Society of America

PROFESSIONAL EXPERIENCE:

7/79-present Geologist, Project Manager, Earth Science Laboratory, University of Utah Research Institute, Salt Lake City, Utah. Duties include management of programs in low- and moderate-temperature geothermal resource assessment in western states, transfer of resource assessment technology to private sector explorationists, estimation of national geothermal market potential, evaluation of geothermal potential of federal facilities and proposed wilderness areas, and coordination with USGS geothermal resource assessment efforts. Ongoing project in geology of central Idaho geothermal systems.

1979-present Instructor, Yellowstone Institute, for "Calderas and Hydrothermal Systems," a week-long lecture and field course that emphasizes interpretation of ash-flow tuff stratigraphy, caldera evolution, and the geological nature of hydrothermal systems in calderas; taught in Yellowstone National Park.

1/78-7/79 Associate Geologist, Earth Science Laboratory, University of Utah Research Institute, Salt Lake City, Utah. Duties included tasks on program for low- and moderate-temperature geothermal resource assessment in western states; coordination with engineers, planners, and legal personnel; and coordination with U.S. Geological Survey personnel.

9/73-1/78 Teaching Associate, Department of Geology and Mineralogy, Ohio State University. Environmental geology, historical geology, introductory geology, oceanography, field methods, and three summers at central Utah field camp. Taught "Geology and the Environment." Also held research position in K-Ar Isotope

Geochronology Lab.

7/73-8/73 Dr. Wayne A. Pettyjohn, Ohio State University. Water sampling in acid mine drainage areas and detailed observations of reclamation progress as part of ground control for remote sensing of strip-mined lands.

6/72-9/72 Field Assistant, Dr. James W. Collinson, Ohio State University, N.S.F. Grant. Measuring sections and collecting fossils during regional study of Upper Paleozoic limestones and associated sedimentary rocks of east-central Nevada.

6/71-9/71 and 9/72 Field Assistant, U.S. Geological Survey, Western Mineral Resources Branch, Menlo Park, California. Geologic mapping near Goldfield, Nevada, with emphasis on volcanic stratigraphy.

9/69-12/69 Assistant Community Manager, Community Government, Antioch College, Yellow Springs, Ohio. Management of diverse student programs, involving financial and personnel matters, with extensive college and community contact.

4/69-8/69 Physical Science Aide, U.S. Geological Survey, Pacific Mineral Resources Branch, Menlo Park, California. Sample preparation for K-Ar dating of diverse rock types; geochemical sampling of alteration assemblages and detailed geologic mine mapping in Goldfield and Silver Peak, Nevada.

9/66-12/66 Assistant, Geology Department, Field Museum of Natural History, Chicago, Illinois. Fossil Invertebrates; curating trilobite collection.

Other undergraduate work experience included engineering drafting, surveying, city planning, and city management.

PROFESSIONAL ACTIVITIES:

Presented talks on geologic parameters of geothermal energy to American Association for the Advancement of Science (1980), Industrial Development Research Council (1980), National Water Well Association (1979), U.S. Department of Energy Contractors (1978, 1979, 1980), Intermountain Institute of Food Technologists (1982), and Snake River Section of American Institute of Mining Engineers (1982).

Co-leader of Geothermal Systems of the Yellowstone Caldera fieldtrip, Geothermal Resources Council (1980).

President, Basin and Range Section, Geothermal Resources Council (1980-82).

Secretary, Utah Geological Association (1981-)

Participant - Geothermal Resources Council/Oregon Institute of Technology Workshop, "Direct Utilization of Geothermal Energy: Development of Four Educational Reports" (1979).

Courses and workshops attended: Geothermal energy in the Cascades (1981); Geochemical fundamentals for geothermal exploration and reservoir evaluation (1980); Geothermal geology of Yellowstone (1978); Volcanic rocks and their vent areas (1978); Direct utilization of geothermal energy (1978).

PUBLICATIONS:

"Geology and Land-Use Planning on the Big Darby Creek, Ohio, Watershed," Foley,D. and McKenzie, G. D., Geol. Soc. of Am., Abstracts with Programs, 6, No. 6, 508 (1974).

"Geology of the Stonewall Mountain Volcanic Center, Nye County, Nevada," Foley, D. and Sutter, J. F., Geol. Soc. of Am., Abstracts with Programs, 10, No. 3, 105 (1978).

"The Essence of Urban Environmental Geology," McKenzie, G. D., Utgard, R. O., Foley, D. and McKenzie, D. I., Journal of Geological Education, 26, 32-37 (1978).

"Geology in the Urban Environment," Utgard, R. O., McKenzie, G. D. and Foley, D., eds., Burgess Pub. Co., Minneapolis, Minn. (1978).

"Western States Cooperative Direct Heat Geothermal Program of DOE," Wright, P. M., Foley, D., Nichols, C. R. and Grim, P. J., Geothermal Resources Council, 2, Section 2, 739-741 (1978).

"Geology Effects," Environmental Overview Report on Utah Geothermal Resource Areas, White, K. L., Hill, A. C. and Ursenbach, W. O., eds., Lawrence Livermore Lab UCRL-13955, 1, 6.1-6.13 (1978).

"State Coupled Resource Assessment Program - An Update," Foley, D., Wright, P. M., Struhsacker, D. W., Nichols, C. R., Mink, L. L., Brophy, G. P., Grim, P. J. and Berry, G. Geothermal Resources Council Transactions, 3, 217-219 (1979).

"Nature and Distribution of Geothermal Energy," Muffler, L. J. P., Costain, J. K., Foley, D., Sammel, E. A. and Youngquist, W., Direct Utilization of Geothermal Energy: A Technical Handbook, D. H., Anderson and J. W. Lund, eds., Geothermal Resources Council Special Report No. 7, 1-1 to 1-15 (1979).

"The State Coupled Program - A New Emphasis," Foley, D., Brophy, G. P., Mink, L. L. and Blackett, R. E., Geothermal Resources Council Transactions, 4, 779-781 (1980).

"Geothermal Exploration Program Hill Air Force Base, Davis and Weber counties, Utah," Glenn, W. E., Chapman, D. S., Foley, D., Capuano, R. M., cole, D., Sibbett, B. S, Ward, S. H., University of Utah Research Institute, Earth Science Laboratory, Rept. 34, 77 p. (1980).

"Geothermal Systems of the Yellowstone Caldera," Foley, D., Nielson, D. L., Nichols, C. R., Geothermal Resources Council, Davis, CA., Field Trip Guide, 71 p. (1980).

"Geologic Map of the Mud Lake Quadrangle, Nevada," Ashley, R. P., Bonham, H., and Foley, D., USGS Map (in prep.)

"Geochronology of the Stonewall Mountain Volcanic Center, Nye County, Nevada" Foley, D., Sutter, J. S. (in prep.).

THOMAS L. THUROW
2043 John Adams Pkwy.
Idaho Falls, Idaho 83401
Home: (208) 522-3547
Work: (208) 526-0481 FTS 583-0481

EDUCATION:

B.S. Wildlife Resource Management, 1977, University of Idaho, Moscow, ID (GPA 3.3/4.0).
M.S. Wildlife Biology/Range Management, 1979, Brigham Young University, Provo, UT (GPA 3.9/4.0).

EXPERIENCE:

1979 - Present — EG&G Idaho, Inc., Idaho National Engineering Laboratory (INEL), Idaho Falls, ID 83415 (Prime contractor for the Department of Energy).

1981 - Present: Manager, Geothermal Environmental Program

Provide technical direction and support for the nationwide geothermal programs administered by the INEL. Interact with scientists with specialties in hydrology, geochemistry, engineering, ecology, and energy technology development. Responsible for developing new research projects and maintaining project commitments. Interface routinely with regulatory agencies. Conduct research on silviculture and wetland biomass production for energy conversion.

1979 - 1981: Scientist - Energy Programs

Managed the Raft River Geothermal Environmental Program. Participated in various applied research and monitoring tasks in alternate energy fields, including geothermal, alcohol fuel, biomass, solar and conservation, and hydropower. Directed a 15 person task force to develop closure and post-closure criteria to be implimented at all DOE low-level radioactive waste disposal sites.

July - Aug. 1979 — Biome research at Prudhoe Bay on the Alaskan North Slope.

May - July 1978-79 — Research on the effects of energy development on bird of prey populations. The study emphasized identifying tolerance levels and establishing buffer zones necessary to protect the Ferruginous Hawk. The findings of this research have since been applied by land management agencies throughout the western U.S.

Aug.- Jan. 1978 — Graduate research in southern Africa on several birds of prey.

Apr.- May 1978 — Tropical ecology research at the Smithsonian Tropical Research Station, Panama.

May - Sept 1976-77 — Research on small mammals in the Idaho Primitive Area at the Wilderness Research Station. Also supported ongoing Bighorn Sheep studies.

1974 - 1979 — Short term consulting for the National Park Service an various coal development projects concerning faunal and flora assessments.

CURRICULUM VITAE

Name: Brent F. Russell

Company and Position: EG&G Idaho, Inc., Branch Manager, Geosciences Branch, Earth and Life Sciences Office

Education:	School	Degree	Year	Discipline
	University of Idaho	BS	1976	Wildlife-Fisheries
	California State University, Fullerton	MS	1978	Environmental Sciences (Hydrology)

Professional Experience:

EG&G Idaho, Inc., Program Manager. Responsible for development of Biomass Energy Program at the Idaho National Engineering Laboratory. Primary duties were to define and authorize the scope of work of twelve major DOE contracts, monitor contractor performance, conduct program reviews, and plan program activities.

EG&G Idaho, Inc., Program Specialist. Evaluate small-scale hydroelectric feasibility study and licensing loan applications for the DOE. Determine technical, economic, and environmental feasibility for site developments. Conduct site reconnaissance and hydrologic evaluations of potential project developments. Developed methodology to accommodate the US FWS Aquatic Base Flow Policy in the New England States. Evaluated completed feasibility studies for adequacy of material and recommended projects for FERC licensing application.

EG&G Idaho, Inc., Scientist. Inventory geothermal resource potential in the State of Idaho. Identify optimal development schemes with consideration to marketing, technical and environmental concerns. Conducted field analyses of geothermal fluids and observation well data at the Raft River geothermal site in Idaho. Coordinated activities with the State of Idaho Department of Water Resources.

Rogers Engineering, Hydrologist. Performed hydrologic analyses on basin and site-specific conditions for two major projects: Geothermal Resource Assessment of Iran, and the Guanacast Geothermal Project in Costa Rica. Supervised research and development of a downhole heat exchanger at Stanford University, California. Coordinated field work and reporting of subcontractors for the Iranian and Costa Rican Projects.

Graduate research and thesis was concerned with a resource assessment of the hydrothermal system located near Desert Hot Springs, California. The project included an inventory of existing well log data, reservoir engineering, and delineation of the optimal location of spent fluid reinjection. The project was conducted with support from Jet Propulsion Laboratory and the California Energy Commission.

Societies and Organizations:

Sigma Chi, Geothermal Resources Council, Limnology and Oceanography, Water Pollution Control Federation, and Who's Who in American Colleges and Universities.

Publications:

Several publications dealing primarily with geothermal resource inventories and surface hydrology of hydroelectric developments.