

PROPOSAL  
TO  
DEPARTMENT OF BUSINESS, ECONOMIC  
DEVELOPMENT & TOURISM  
STATE OF HAWAII

FOR

TECHNICAL ADVISORY SERVICES  
RELATING TO GEOTHERMAL RESOURCE ASSESSMENT

APRIL 26, 1991

TABLE OF CONTENTS  
PROPOSAL FOR TECHNICAL ADVISORY SERVICES  
RELATING TO GEOTHERMAL RESOURCE ASSESSMENT  
STATE OF HAWAII

INTRODUCTION . . . . .	1
COMPANY BACKGROUND . . . . .	1
ORGANIZATION . . . . .	2
SUMMARY OF EXPERIENCE IN HAWAII. . . . .	3
OTHER SPECIFIC WORK EXPERIENCE . . . . .	4
APPROACH AND WORK PLANS . . . . .	6
FEES . . . . .	9
AVAILABILITY . . . . .	10
DISCLOSURE STATEMENT . . . . .	10

Appendix A - Professional Resumes  
Appendix B - Project List

PROPOSAL FOR TECHNICAL ADVISORY SERVICES  
RELATING TO GEOTHERMAL RESOURCE ASSESSMENT

INTRODUCTION.

This is a proposal to provide Technical Advisory Services Relating to Geothermal Resource Assessment in the State of Hawaii. Our proposal responds to the needs of the Department of Business, Economic Development & Tourism (DBED) and the Department of Land and Natural Resources (DLNR) for a well qualified geothermal consulting firm. From the RFP, we have determined that the following items are of concern for the State:

A. Determine the potential and location, on a regional basis, of those geothermal resources in the State that have a realistic probability of development.

B. Provide advice on methodologies that could accomplish the objectives in A.

C. Provide advice and suggestions to improve the cost effectiveness of the SOH core hole drilling program.

D. Assist in the geothermal/cable project to formulate reasonable development scenarios, description of short term and cumulative impacts, and workable mitigation measures.

E. Provide guidance to DBED and DLNR on permit conditions, demonstration tests, and scheduling that may be applicable to regulatory policies.

Accordingly this proposal addresses these concerns, as well as presents our qualifications to perform this work. Any questions or communications concerning this proposal should be directed to Gerald Niimi at (707) 523-2960.

COMPANY BACKGROUND.

ThermaSource, Inc. is a California Corporation that was established in 1980. Since then, we have been in the forefront of the geothermal industry as a leading provider of consulting services such as drilling and reservoir engineering, field supervision, well testing, and geologic studies. Since the beginning, we have remained exclusively a geothermal service company with a small staff emphasizing quality. The two principals of ThermaSource, Louis Capuano and Gerald Niimi have always been committed to providing consulting services that stress integrity, personal service and reasonable cost.

Our consulting work has taken us to such diverse geothermal countries as Japan, China, Romania, Indonesia, and Costa Rica. Domestically, we have experience in The Geysers, Coso Hot Springs, Nevada, Oregon, Utah, Hawaii, and Idaho. We are also very proud of the broad scope of our clients, many of whom have used our services for many projects over a number of years. For example:

- State Governments
  - State of Idaho, Department of Water Resources
  - State of California, Department of Water Resources
- Utilities
  - Pacific Gas & Electric Company
  - Sierra Pacific Power Company
  - Los Angeles Department of Water & Power
- Financial Companies
  - Bank of America
  - Metropolitan Life Insurance Co.
- Operators
  - True Geothermal Energy Company
  - Oxbow Power Corporation
  - Anadarko Production Co.

Further, our consulting engagements have been, for the most part, oriented toward commercial ventures. Thus we have a full appreciation for the parameters that are expected in commercially viable projects.

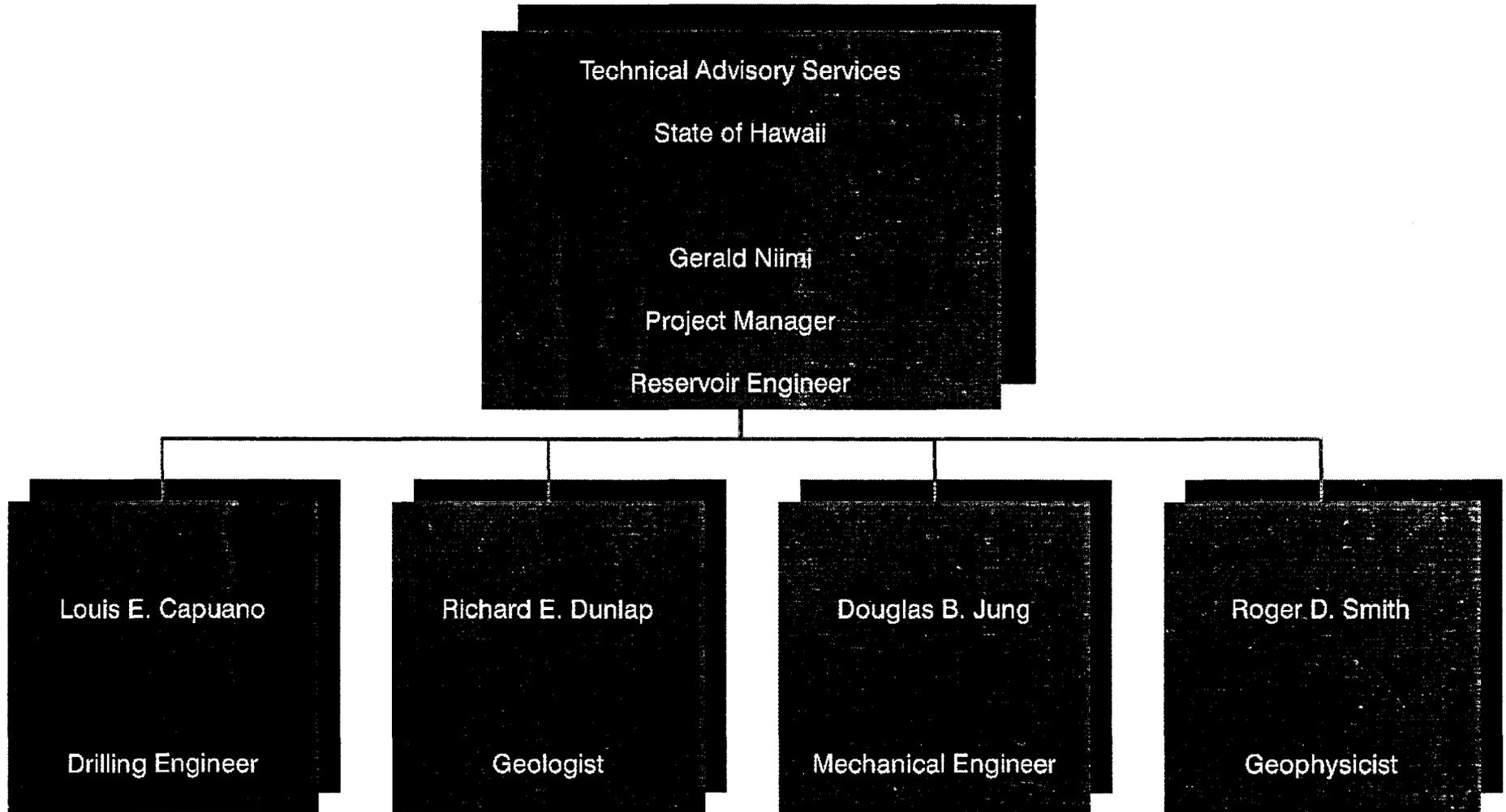
#### ORGANIZATION

ThermaSource, Inc. offers an exceptionally qualified team to meet the requirements of this RFP. All of our staff are experienced in geothermal resource assessment and operations. Should we be successful in this proposal, Mr. Gerald Niimi will act as Project Manager for this work. He is a Reservoir Engineer, is familiar with the geothermal issues in Hawaii, and should interact very well with DBED and DLNR personnel. Mr. Niimi has been involved in day to day geothermal production operations and is familiar with well field design and resource problems. Others that would play a prominent role in this project are shown on Figure 1, Organization Chart:

Louis Capuano is the President of ThermaSource and is also a Drilling Engineer. He was the Drilling Consultant for the True/Mid-Pacific wells.

Roger D. Smith is a practicing Geophysicist with experience in volcanic environments with MT, CSAMT, resistivity, and magnetic surveys. He has supervised geophysical surveys in the Hatchobaru Field in Japan, in the jungles of Papua New

Figure 1  
**ORGANIZATION CHART**  
ThermaSource, Inc.  
Geothermal Consulting Services



Guinea, and The Geysers.

Richard E. Dunlap is a Geologist with direct experience in Hawaii and many other geothermal areas. He has analyzed the drill cuttings from the True/Mid-Pacific wells and trained the contract mudloggers on the proper logging of the cuttings.

Douglas B. Jung is a Mechanical Engineer with experience in geothermal facilities and power plant technologies. His experience is in The Geysers and the Phillipines with UNOCAL and in binary power plants in Nevada.

Resumes of these professionals are included in Appendix A.

#### SUMMARY OF EXPERIENCE IN HAWAII.

Our experience with geothermal resources in Hawaii began in 1982. Both Mr. Capuano and Mr. Niimi testified as experts before the BLNR at the Kahauale'a CDUA contested case hearings on behalf of The Estate of James Campbell and True/Mid-Pacific Geothermal Joint Venture. Mr. Capuano discussed drilling practices that would be followed. Mr. Niimi testified on the impacts of water injection and answered questions concerning resource exploration and assessment. Since then, we have been retained by True/Mid-Pacific to advise them on many technical aspects of geothermal operations, including drilling strategies, permit acquisition, specific technical details of regulatory compliance, development economics, rig mobilization, and field operations. We have completed analyses of the geology and drilling results of the lower East Rift Zone in order to extrapolate this information to the Kilauea Middle East Rift Zone (KMERZ). As a matter of public record, we completed an extensive analysis of the regional exploration techniques used to site the HGP-A project. This analysis may be found in the Kahauale'a Exploration Plan filed with BLNR in 1983. Mr. Niimi has appeared as a geothermal resource expert in additional contested case hearings involving establishment of Geothermal Resource Sub-Zones in Kahauale'a and the KMERZ. We have assisted in arranging tours of the Geysers Geothermal Field for Hawaii's political leaders, lay people, and regulators. Since True/Mid-Pacific began field operations in late 1989, we have supervised the drilling of over 28,000 feet of hole, and conducted three well tests. The Hawaii resource presents a challenge because of the young volcanic environment, high rainfall, and corrosive gases. True has also asked that we work with and train their operations personnel, which we have done.

Through this long relationship with the many people involved in Hawaii's geothermal program, we have acquired a deep knowledge of the issues, many controversial, that have been

expressed by all factions. By being continuously involved, our professional people represent one of the few entities that has such a long running background on the issues. We intend to continue our role as consultants to True Geothermal Energy Company. However, we believe that we can also provide high quality technical services to agencies in the State of Hawaii without incurring a conflict of interest. Most of the people that have a real interest in geothermal would know who we are and probably agree that we have been objective and conducted ourselves with professional integrity. It is our sincere belief that we can provide the services the State is looking for without impairing our ability to work for True when they require our services.

#### OTHER SPECIFIC WORK EXPERIENCE

In Japan we are currently engaged in a major geothermal exploration project on the Island of Kyushu. This project started in 1986 and has been operating at peak activity level for about the last year. Currently two rigs are drilling with a third being prepared for operation. ThermaSource has played a dominant role in this operation by supplying drilling engineering services, well testing services, rig supervision, and as well as coordinating the delivery of service company manpower, equipment, and supplies from the U.S. The project encompasses three separate sites that encompass the Mt. Aso region. The Hatchobaru Geothermal Field is also related to this geologic feature.

In 1981, Louis Capuano went on a two week mission to the Peoples Republic of China sponsored by the United Nations Development Programmes. He was asked to review the current state of China's drilling practices and make recommendations for upgrading their technology. He also gave several seminars as is usual in these missions. Gerald Niimi was selected by the U.N. in 1984 to assist the Romanian Ministry of Geology with their reservoir engineering analysis problems and to review their capabilities. Both Mr. Capuano and Mr. Niimi have been to Indonesia several times on behalf of local companies to enhance the credibility of the services that they wish to market to operators and to Pertamina, the State Oil Company. The exposure resulting from these visits have been rewarding as we have received a contract from Mobil Oil Company to supply special logging equipment, originally designed for geothermal wells, to their Arun gas field operation which has unusually high bottomhole temperatures. Work should begin this summer. In 1980, Mr. Capuano and Mr. Charles Beighle, one of our field supervisors, took control of the drilling at the Miravalles Geothermal Field in Costa Rica. They were responsible for drilling three successful wells for this project.

The principals of ThermaSource got their initial geothermal experience in The Geysers. Over the years, we have worked for such companies as Phillips Petroleum, Occidental, Thermogenics, GRI Operator Corporation, Trans-Canada Pipeline Company, California Department of Water Resources(CDWR), and Calpine Corporation. On most of these projects, we supplied engineering services in drilling or reservoir engineering. Currently we have a contract with CDWR for lease maintenance of a four well lease in The Geysers. We are also doing technical service work for Calpine, consulting work for PG&E, and consulting work for a banking group with major credits in The Geysers. Working with many companies in different areas of The Geysers Field has exposed us to new experiences and new challenges. While testing a well for Phillips in 1982, we encountered a reservoir with such high levels of CO2 that the entire wellhead, separator, and flowline froze. Today steam chemistry is one of the major problems confronting Geysers operators. Since most of our clients were operating on the margins of the proven reservoir, even then we could see that the steam resources in the fringe areas were not the same as the main Geysers area. Bottomhole pressures were considerably higher, permeabilities were lower, and non-condensable gas concentrations were much higher than usually encountered.

Our experience at Coso Hot Springs, a liquid dominated reservoir, involved a review of earlier work performed for the Los Angeles Department of Water and Power and rendering an opinion concerning drilling costs and proven power potential. In Nevada, our experience has been varied and interesting. We have been exposed to practically every geothermal area in the State in one way or another. Our earliest engagements go back to 1983 when we repaired a hot water well for the City of Elko. In subsequent years we have been retained by Oxbow Power Corporation to supervise the drilling and workover of their wells. All downhole operations are supervised by ThermaSource, even pulling of chemical injection tubing. We worked for Yankee-Caithness for about two years in startup of their field at Steamboat Hills, drilling wells, and initiating their downhole scale inhibitor program. During the past two years, Mr. Niimi has testified as an expert in two Nevada lawsuits concerning diligent performance of geothermal operations. This work relied heavily on his experience as operations manager for Thermogenics. In early 1990, Mr. Niimi was retained as a consultant to Sierra Pacific Power Company to advise the utility in their power purchase contracts with potential geothermal power generators. This engagement is continuing and has been expanded to include performance of power producers under existing contracts.

In 1989, Mr. Niimi was retained by Anadarko Petroleum Company to witness and evaluate a well test on a geothermal discovery in the Alvord Desert in eastern Oregon. In Utah, we drilled the first successful steam well for Mother Earth Industries at Cove Fort. This was a shallow steam reservoir with high initial gas concentrations. Our engagement lasted for about one year. During this time we provided drilling supervision, well testing, and reservoir engineering services.

Idaho is a new area where we were awarded a contract by the Department of Water Resources last year to inventory 5000 wells, build a database, and assist them with recognition and diagnosis of problem water wells. Because most of the problem wells are in known thermal areas of Idaho, our overall expertise in geothermal resources and well repair was an important factor in our selection. This is a year long project that should be concluded this summer.

Our skills span steam and hot water resources in many areas of the U.S. and the world. One of the reasons for our success is that our principals, Mr. Niimi and Mr. Capuano, are involved in each project. Thus we have many long running relationships with clients that have been mutually beneficial. Appendix B contains a representative list of our clients and projects.

#### APPROACH AND WORK PLANS.

With our professional organization and experience in the geothermal industry, we propose the following approach to the requested scope of work.

\* "Assist DBED and DLNR in establishing priorities among available resource assessment methods.."

Upon consultation with DBED and DLNR, we propose preparing a reconnaissance plan that would be consistent with project objectives and budget constraints. This plan would endeavor to collect sufficient sub-surface information to characterize the State's inventory of geothermal resource potential. In the future this information would be useful to guide geothermal development only into areas that have a reasonable probability of success. There is even the possibility that the State could be reimbursed if the information led to discovery of a commercial resource.

Before discussing methods, overall strategy should be addressed. The RFP seemed to emphasize that regional surveys were favored over site specific surveys. Our opinion is that from a cost standpoint, regional surveys can provide more information than a detailed survey in a small area. However, regional surveys must not be too broad in

Hawaii because actual drilling results show that reservoir characteristics can change rapidly over a short distance. For example, the Lani Puna wells and HGP-A are very close but have very different results. As discussed below, our proposal is to calibrate the survey first, so that the proper perspective can be determined and then reconciled with the available budget.

At this time, our choice of reconnaissance methodology is a Controlled Source Audio Magneto-Telluric Survey (CSAMT) that would be coordinated with the SOH program. This survey has not been attempted in Hawaii, but has been successful in identifying resources in volcanic environments such as the Cascades and southern Japan. A special high power source would be used to overcome salt water interference. A conventional magneto-telluric survey and spontaneous potential (SP) survey would also be conducted simultaneously at a relatively low incremental cost. In order to validate the results, we recommend doing an initial survey in the lower Puna (HGP-A) area and SOH#1 area. This will enable calibration of the survey to known sub-surface information. This initial survey will also determine the spacing of the survey lines in order to obtain reliable information. If the terrain permits, aerial photography could be used to screen areas before a CSAMT is attempted.

In terms of CSAMT coverage, the main areas of commercial geothermal interest are the Kilauea East Rift, the Kilauea Southwest Rift Zone, Hualalai, and the Haleakala Southwest Rift. These areas would be further limited to those areas where geothermal development would be an acceptable land use. Upon completion of the surveys, maps would be generated to show the location of anomalies and the contrast to known information. Additional data could be gained by drilling a SOH near the anomaly. Of course, we would supplement the CSAMT survey with geologic maps, drilling results, core holes, etc. in order to portray the most complete description possible.

We believe that the relative cost in money and environmental impact of geophysical surveys, if they are meaningful, is much less than drilling a well to obtain information.

\* "Assist DBED and DLNR in planning the direction of and managing the SOH program and evaluating available exploratory drilling methods,..."

We have one of the foremost geothermal drilling engineers in the world, Louis Capuano, who can review the SOH program and recommend changes to make the program more cost effective. Our approach would be to allow Mr. Capuano to work with the field people and Tonto management to go over every aspect of the operation to see if procedures or equipment can be

changed to improve operations. We would also set up a telephone consultation service so that the field people can discuss problems and procedures with Mr. Capuano. Since we have supervised a Tonto Core Rig in Nevada, we have an understanding of its capabilities.

\* "Assist DBED and DLNR in designing and planning appropriate well tests, surface and aerial surveys, and/or mapping projects.."

We view this task as being specific projects within the broad framework of the reconnaissance plan. In terms of well tests, we have considerable experience in well testing and Gerald Niimi can provide a test plan to meet a specific situation. In the case of flow testing slim hole wells, a plan can be designed to get fluid information and formation permeability information. Use of downhole sample chambers to get fluid samples may be a reasonable approach. An injectivity test could be performed so that disposal problems could be eliminated and yet offer a reasonable estimate of permeability.

\* "assist DBED and DLNR by providing technical guidance relative to the geothermal/cable project master plan and EIS.."

For this task, we can draw on our overall familiarity with the environmental impacts of geothermal development. We can assist the EIS preparer and the State to properly describe the magnitude of impacts and develop workable mitigation measures.

\* "assist DBED and DLNR by providing technical guidance relative to planning and design of the geothermal/cable project .."

Our primary input to this task will be to provide a realistic schedule of power plant buildup that would be used to plan the cable installation. We can further advise as to tests or milestones that need to be met in order to maintain the schedule.

\* "assist DBED and DLNR to make reasonable judgements and to reach objective, scientifically supported, conclusions about the extent and characteristics of geothermal resources .."

One of the chief services that clients retain us for is to provide technical opinions on geothermal resources. Their two common questions are:

What is the capability of the resource?

and

How long will it last?

We have provided such opinions many times; to the City of Provo, Utah for a municipal bond issue, to Metropolitan Life Insurance on two occasions for financing, and others.

\* "assist DBED and DLNR on well-field design and management in order to assist them in adopting appropriate policies,..."

Although we have not advised agencies on their regulatory policies, we have appeared at hearings to testify on proposed rules. We believe we can relate to regulators what the impact of various rules would be. We can also provide conditions or tests that operators would meet to demonstrate the adequacy of resources. The primary method to avoid premature depletion is to know the resource and to control the magnitude and scheduling of power plant installation.

Many of the current DLNR rules affecting drilling practices do not recognize changes that have taken place since the rules were originally promulgated. Mr. Capuano can assist in pointing out those changes. In fact we would recommend conducting a technical seminar for State Agency Staffs that would cover drilling, testing, power plants, production, abandonment, and safety.

\* "additional work efforts and products..."

ThermaSource will be responsive to requests to attend meetings or discuss issues with DBED, DLNR, or any other State agency. We acknowledge the deadlines for the required deliverables should we be awarded this contract.

Given the general nature of the scope of work, we could not generate an accurate schedule of work. If we are awarded the contract, we will prepare a mutually acceptable work schedule at no cost.

FEEES.

The following professional fee schedule is quoted for the contract work on a time and materials basis. These fees represent an hourly rate that includes all overhead and G&A costs. A maximum of 8 hours per day are to be billed:

NAME	RATE (\$/HR)
Gerald Niimi - Project Manager	75.00
Louis Capuano - Drilling Engineer	75.00
Richard Dunlap - Geologist	65.00
Douglas B. Jung - Mechanical Engineer	65.00
Roger D. Smith - Geophysicist	70.00

All direct costs such as telephone and fax, reports expenses, and postage are to be reimbursed at cost. Travel costs, rental cars, hotels are to be billed at actual cost. A per diem charge of \$30/day will apply for meals while on a travel status. For work away from the office, fees are charged from the time personnel leave Santa Rosa until return.

Additional services such as chemical analysis or geochemistry will be sub-contracted on an as-needed basis. Our approach will be to use as many qualified local professionals as possible. These fees will be passed on at cost.

#### AVAILABILITY.

Availability of personnel for this contract will depend on the workload of the firm and the nature of specific tasks. We can assure DBED that we will do everything possible to meet the requests for assistance in a timely manner. Practically, we must work for more than one client to stay in business. All of our clients understand this. We try to adjust our schedules to be mutually beneficial to all our clients.

In terms of accessibility, Hawaii is no less accessible than many of the other areas that we commonly work in. We could be in Honolulu in 6 - 8 hours, which is about the time we need to reach sites in Nevada.

#### DISCLOSURE STATEMENT.

As a matter of record, ThermaSource has worked for True Geothermal Energy Company and Barnwell Industries. Both are geothermal operators in Hawaii. We have worked for True without a contract for almost ten years. Our last engagement with Barnwell was about two years ago. We believe that we can provide the requested consulting services to the State without a conflict of interest. Our relationships with the two private companies demonstrates that we can provide services without compromising our integrity or the quality of service. If during the performance of the contract, instances occur where a conflict might arise, we will bring such instances to the

State's attention. We believe that as long as there is no bias toward any entity during the resource assessment process, then no conflict will occur.

Appendix A  
Professional Resumes

Appendix B  
Project List

## PROJECT LIST

### DRILLING ENGINEERING

TCPL Geothermal Ltd., Calgary, Alberta, Canada  
- Drilling Engineering and well site supervision  
- Well testing, resource assessment, and economics,  
The Geysers Field  
- Property appraisal and formulation of purchase offer  
for producing property in The Geysers

Oxbow Geothermal Corporation, Reno, Nevada  
- Well design and drilling program management  
- General Reservoir Engineering services and well  
testing

Ben Holt Company, Pasadena, California  
- Drilling engineering and well site supervision, Casa  
Diablo Hot Springs Geothermal Project, California

Los Alamos National Laboratory, Los Alamos, New Mexico  
- Well site supervision of Hot Dry Rock Project

Mother Earth Industries, Carefree, Arizona  
- Drilling Engineering and well site supervision  
- Well testing, resource assessment, Sulphurdale, Utah  
Geothermal Field  
- Development of economic evaluation to determine  
damage claim in civil lawsuit

Bonneville Pacific Corporation, Salt Lake City, Utah  
- Drilling Engineering, well site supervision, well  
testing and resource assessment, Mammoth Lakes,  
California

Department of Water and Power, Los Angeles, California  
- Drilling program review and resource assessment

International Communications & Energy, Inc., Hyannis,  
Massachusetts  
- Design of exploration well program  
- Coordinate rig mobilization and shipment of drilling  
supplies to a foreign country

Pacific Energy Corporation, Los Angeles, CA  
- Drilling Engineering services, Casa Diablo Hot  
Springs

## RESERVOIR ENGINEERING

Bank of America, San Francisco, California  
- Reservoir assessment and property appraisal for project financing of two producing properties in The Geysers  
- Market value appraisal of undeveloped geothermal leases in The Geysers

Anadarko Production Company, Santa Rosa, California  
- Reservoir engineering services, Alvord Desert, Oregon, Salt Wells, Nevada, and The Geysers, California. Well testing services, Salt Wells, Nevada  
- Retained as advisor to assist in-house staff in acquisition offer for a property in The Geysers  
- Drilling program designed for Salt Wells Geothermal Exploration well

United Siscoe Mines, Toronto, Canada  
- Appraisal of Fair Market Value of geothermal properties for asset restructuring

Department of Water Resources, State of California  
- Appraisal of Fair Market Value of Francisco Lease, The Geysers Field  
- Well testing and lease maintenance

True Geothermal, Casper, Wyoming  
- Reservoir Engineering and Drilling Engineering Consultants, Kilauea East Rift Geothermal Project, Hawaii  
- Resource assessment of properties in northern Nevada

Well Production Testing, Carlsbad, California  
- On-site monitoring and data collection, Fee #6 Well Test, Niland Geothermal Project  
- Well Test Analysis and Well Interference Analysis

City of Provo, Utah  
- Resource assessment opinion for Municipal Bond Prospectus

Sierra Pacific Power Company, Reno, Nevada  
- Assessment of geothermal resources dedicated to power sales contracts

## DIRECT USE

George Nolte and Associates, Sacramento, California  
- Resource Assessment of Lake County Direct Use  
Geothermal Resources

County of Lake, California Ag Park Greenhouse  
- Geophysical survey  
- Drilling and testing of direct use geothermal wells

Blaydes and Associates, Santa Rosa, California  
- Preliminary Geothermal Resource Assessment for the  
City of Clear Lake, California

## FOREIGN

United Nations, New York, New York  
- Technical assistance and classroom instructor in  
Drilling Engineering to Peoples Republic of China  
- Technical advisor in Reservoir Engineering for low  
temperature resources to Socialist Republic of  
Romania

Exlog, Sacramento, California and P.T. Exlog Sarana,  
Jakarta, Indonesia  
- Well testing and resource assessment for geothermal  
fields in Indonesia

Tobishima Construction Company, Tokyo, Japan  
- Classroom instruction on geothermal resources and  
drilling techniques

## OTHER

Dravo Recovery Systems, Pittsburg, Pennsylvania  
- Management of waste dewatering operation in The  
Geysers  
- Economic feasibility study

Humboldt Associates, Santa Rosa, California  
- Drilling Engineering and well site supervision of  
oil and gas project in Central Nevada

County of Sonoma, California  
- Resource assessment for EIR covering Aidlin Power  
Plant Development at The Geysers Field

Department of Water Resources, State of Idaho  
- Artesian well inventory and database creation