



STANFORD RESEARCH INSTITUTE
MENLO PARK, CALIFORNIA 94025
(415) 326-6200

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May 27, 1977

U.S. Energy Research and
Development Administration
Nevada Operations Office
Post Office Box 14100
Las Vegas, Nevada 89114

Attention: Mr. James B. Cotter, Chairman
Source Evaluation Panel

Reference: Request for Proposal No. EY-R-08-0007 and
Amendment No. 1 dated May 12, 1977

Gentlemen:

In response to the referenced request, we are forwarding herewith ten copies of the Institute's Proposal No. ORU-77-118 entitled "Case Study Analysis of Geothermal Resources in the Vicinity of Roosevelt Hot Springs." Also enclosed are executed forms as listed below.

If you desire further information of a technical nature, please do not hesitate to contact either Mr. J. E. Peline or Mr. M. P. Sweeney. Contractual matters should be directed to the attention of the undersigned.

Very truly yours,

Joseph R. Ribera
Supervising
Contract Administrator

JRR/jh

Enclosures:

Representations and Certifications
SRI Financial Statements Years Ended
January 1, 1977 and January 3, 1976
Optional Form 60 (10 copies)



27 May 1977

Proposal for Research

SRI Proposal No. ORU-77-118

CASE STUDY ANALYSIS OF GEOTHERMAL RESOURCES IN THE VICINITY
OF ROOSEVELT HOT SPRINGS

Technical and Cost Proposal

Prepared for:

Energy Research and Development Administration
Division of Geothermal Energy
Nevada Operations Office
Post Office Box 14100
Las Vegas, Nevada 89114

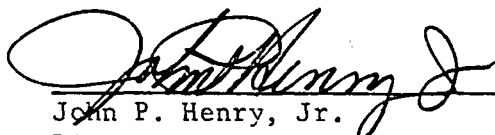
Attention: Mr. James B. Cotter, Chairman
Source Evaluation Panel

Reference: RFP No. EY-R-08-0007 and
Amendment 1

Prepared by:

J. E. Pelling, Manager, Energy Resources, Energy Economics Department
M. P. Sweeney, Energy Economist

Approved:



John P. Henry, Jr.
Director, Energy Center

CONTENTS

A.	PROPOSER IDENTIFICATION.	1
B.	TECHNICAL PROPOSAL	2
	1. Investigation Area.	3
	2. Statement of Work, Data Offered, and Program Description	3
	3. Schedule.	6
	4. Environmental Evaluation.	6
C.	COST AND CONTRACTUAL PROVISIONS.	7
D.	BUSINESS AND MANAGEMENT.	11
	1. Qualifications and Relevant Experience.	11
	2. Project Staffing and Organization	23
	3. Operational Plan and Scope.	37
	4. Business and Technical Contacts	38
	5. General Contract Provisions	38
	6. Program Technical Scope	38

A. PROPOSER IDENTIFICATION

In response to RFP No. EY-R-08-0007, this proposal for a "Case Study Analysis of Geothermal Resources in the Vicinity of Roosevelt Hot Springs" is submitted by

Stanford Research Institute
333 Ravenswood Avenue
Menlo Park, California 94025

B. TECHNICAL PROPOSAL

One outgrowth of the "energy crisis" of the 1970s has been a heightened interest in the potential of alternative energy sources. Geothermal energy is one alternative that offers substantial promise for near-term applications in the generation of electricity. Successful electric generation from hydrothermal dry steam has been accomplished for over 70 years in Italy. In the United States, at The Geysers in California, electric power has been generated at commercially attractive costs since 1960.

Whereas the promise of vapor-dominated systems has been proven commercially, the potential of the more predominant fluid-dominated geothermal resources remains uncertain. No system for generating electricity from this variety of hydrothermal resource has been demonstrated commercially in the United States. If the question of the commercial viability of electric power generation from fluid-dominated resources can be demonstrated, the potential of the resource base in the western United States is vast. Previous work at SRI has suggested that the most promising candidate for competitive electric power generation is the wet steam resources encountered in the Roosevelt Hot Springs area in Utah. If sufficient private investment is to be forthcoming to ensure the orderly development of the hydrothermal resource potential in this and other resource areas in the western United States, the perceived risks need to be reduced. The primary purpose of the program of research outlined in this proposal is to draw together, review, analyze, and synthesize existing information into a single written document focusing on the important reservoir characteristics and performance parameters that are central in assessing the potential of hydrothermal resource utilization for electric power generation.

The specific objectives of the program, to be accomplished in two phases, are:

- To obtain sufficient geological and geophysical evidence to define the probable extension of the Roosevelt Hot Springs producing area east-northeast toward Sulfurdale.
- To establish a credible basis for hypothesizing the reservoir mechanics of the hot-water geothermal reservoir producing from a fractured basement complex.
- To construct a screening procedure for identifying the successful geothermal well locations based on geological and geophysical analysis.
- The development of a generic analytical program potentially applicable to other fluid-dominated geothermal resources.

1. Investigation Area

The area from which data are to be collected includes nearly all of the most prospective acreage for economically viable geothermal energy development in the vicinity of the Roosevelt Hot Springs KGRA. This area includes the 200 square mile block as outlined in Figure 1.

This site was selected because it is believed that this particular acreage can be demonstrated to exhibit the most promising reservoir rock and fluid properties for fluid-dominated geothermal energy development that have yet been encountered in the United States. Unfortunately, the resource is in a very difficult competitive position from the standpoint of the availability and price of alternative fuels for electric power generation, a factor that could retard its development significantly unless the development is conducted according to a carefully drawn plan designed to minimize exploration and development costs.

2. Statement of Work, Data Offered, and Program Description

Phase I

The Phase I effort will focus on the identification and collection of all the existing data in the public domain with respect to the geology, geophysics, reservoir fluid chemistry, and subsurface hydrology of the area delineated in Figure 1. This effort will begin immediately upon initiation of the project. The type of data to be collected is listed below:

- (1) Data relating to geology, geophysics, geochemistry, and hydrology:
 - Surface geological maps
 - Aerial geophysical surveys
 - Reservoir fracture analyses
 - Temperature gradients and heat flow calculations
 - Geochemical analysis of reservoir water
 - Downhole electrical surveys
 - Reservoir recharge potential
- (2) Data relating to reservoir engineering:
 - Procedures for identification of well locations and well drilling
 - Drill bit programs
 - Casing string design
 - Drilling fluid chemistry

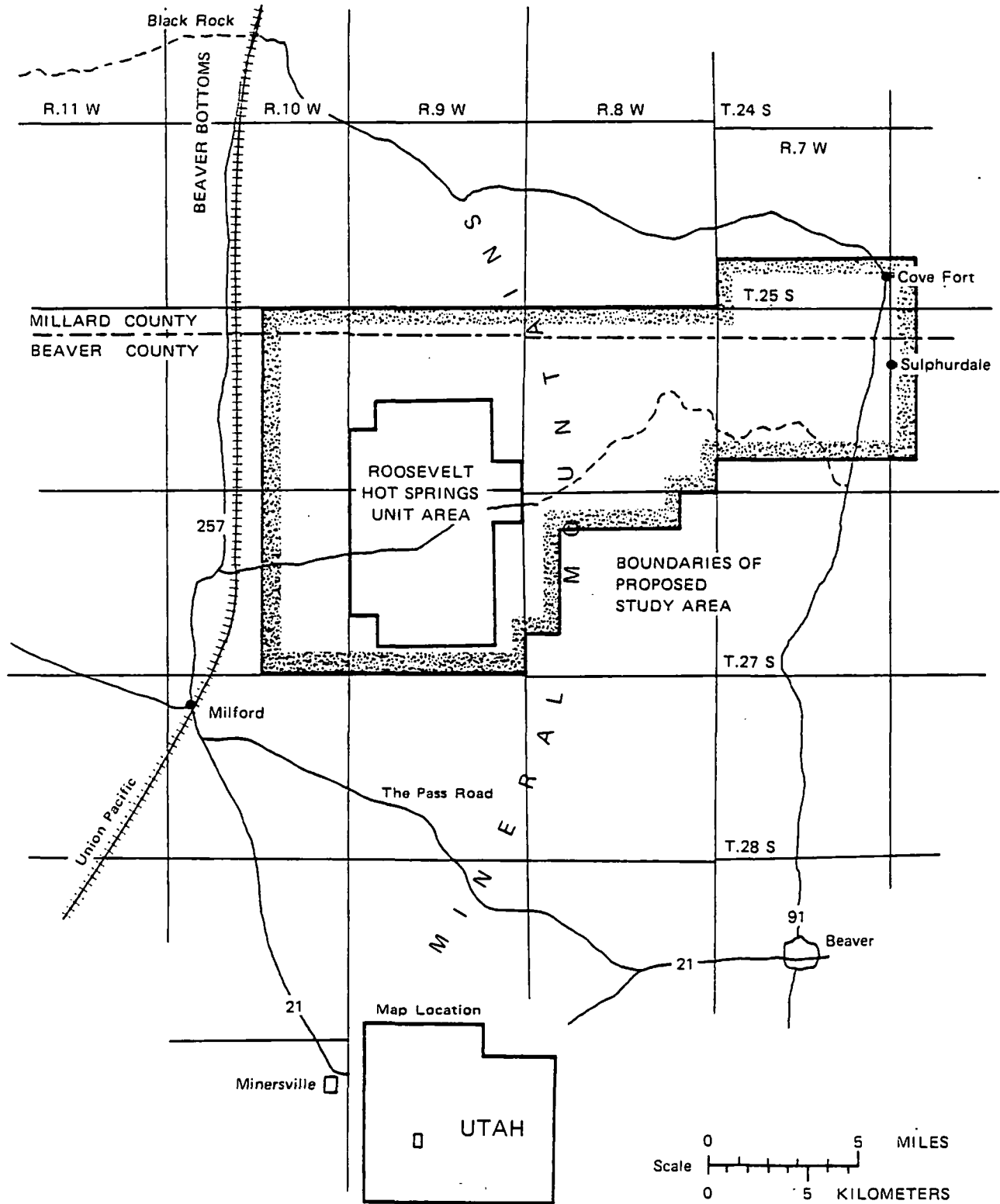


FIGURE 1 ROOSEVELT — COVE FORT/SULPHURDALE GEOTHERMAL REGION:
BOUNDARIES OF PROPOSED STUDY AREA

- Completion techniques
- Reservoir pressure and temperature surveys
- Drilling costs.

Once the data identification and collection part of Phase I has been completed, the material will be reviewed, synthesized, and integrated into a single volume. The review process will include trips by project staff members and principal consultants to interview the persons responsible for the collection of existing data. We are already familiar with some of the excellent geological, geophysical, and geochemical analysis that has been carried out under NSF and ERDA funding by professors in the Department of Geology and Geophysics at the University of Utah. In this analytical process, emphasis will be placed on drawing together data which sheds light on the important question of reservoir performance as related to potentially viable commercial electric power generation. One goal of the Phase I effort is to permit identification of areas where important gaps or deficiencies may exist in the available data and to identify specifically the areas where additional work needs to be done. The Phase I program will culminate in a delivered final report drawing together the important findings of all available work already in the public domain. This report will represent a synopsis of the broad spectrum of work that has already been done and provide a solution to the data gathering problems confronting geothermal developers operating in the Roosevelt-Cove Fort-Sulfurdale areas.

Phase II

The performance of Phase II of the research program presented in this proposal is contingent on our ability to obtain existing data that is currently closely held by the developers active in the Roosevelt area, principally Phillips Petroleum Company.

If the proprietary data necessary to perform Phase II of the program can be obtained with the understanding that it will become publicly available within the 3-year time period specified in the request for proposal, SRI will be able to proceed with Phase II.

The Phase II effort would consist of the following steps:

- A thorough review and analysis of the data collected in Phase I to determine the extent to which inferences can be supported as to the geothermal reservoir characteristics in the subject area (delineated in Figure 1).
- The preparation of geologic cross sections and a geologic base map with appropriate overlays of geophysics and geochemistry.
- The development of a geothermal reservoir model of the Roosevelt field.

- The correlation of geology with drilling procedures and recommendations for improvements in drilling technology and practices in the Roosevelt field.
- The preparation of lithologic well logs, and the correlation and interpretation of all types of well logs.
- The presentation of a list of recommendations for standard logging procedures for drilling activities in the subject area.

The results of the Phase II program would be incorporated into a printed report containing the above specified items and a detailed estimation of the geographic outline of the producing area and expected reservoir behavior. This would be derived from a geological map compilation and a geological cross section across the producing area incorporating subsurface data derived from well drilling experience.

3. Schedule

The final report of the Phase I program can be delivered within 6 months of the execution of a signed contract. This report can be made publicly available on submission.

The schedule of deliverables for the performance of Phase II of this research program can only be developed following a firm determination of the specific information that can be obtained and when this information could be made available for public distribution. ERDA can fund the Phase I effort with no commitment to support the proposed Phase II program.

4. Environmental Evaluation

Environmental Evaluation: No work proposed to be conducted in Phase I of the research program outlined in this proposal will have any adverse environmental impacts requiring the filing of an environmental assessment or an environmental impact statement.

C. COST AND CONTRACTUAL PROVISIONS

1. Time and Cost

The estimated time required to complete Phase I of this project is 6 months. The Institute could begin work on receipt of a fully executed contract.

Attached are a cost breakdown and support schedules for Phase I, in lieu of the Optional Form 60. Also, enclosed is a signed form complete except as to the "Detail Description of Cost Elements."

2. Contract Form

It is requested that any contract resulting from this proposal be written on a fixed-price level-of-effort basis, with provision for monthly progress payments in accordance with the applicable procurement regulations.

3. Acceptance Period

This proposal will remain in effect until July 15, 1977. The Institute will be pleased to consider an extension if requested.

4. Government Audit Agency

The Institute's cognizant government audit agency is Defense Contract Audit Agency, 400 Cambridge Avenue, Suite 404, Palo Alto, California, 94306, telephone (415) 327-8411.

COST BREAKDOWN
Phase I

Personnel

Supervisory (114 hours)	\$ 2,169
Senior professional (840 hours)	12,595
Professional (520 hours)	4,508
Clerical (80 hours)	<u>484</u>
Total Direct Labor	\$19,756
Payroll Burden @ 31%	<u>6,124</u>
Total Salaries and Wages	\$25,880

Research Overhead @ 86.8% of salaries and wages 22,464

General and Administrative @ 21% of salaries and wages 5,435

Support Costs

Travel (Schedule C)	
4 RTs, San Diego-San Jose	\$ 254
2 RTs, San Diego-Salt Lake City	296
4 RTs, S.F.-Salt Lake City	568
2 RTs, Tucson-Salt Lake City	340
Subsistence (Schedule C), 52 days @ \$30.00	1,560
Surface transportation	
12 days @ \$15.00	180
40 days @ \$30.00	1,200
Airport limousine, 12 RTs @ \$20.00	240
Communication (Schedule C)	1,000
Materials and supplies (Schedule C)	500
Consultants (Schedule D)	
65 days @ \$280	18,200
15 days @ \$450	6,750
Report preparation (Schedule E)	<u>3,514</u>
Total	\$34,602
Support Cost Burden @ 3.6%	<u>1,246</u>

Total Support Cost 35,848

Total Cost \$89,627

Profit 8,963

Total Contract Price \$98,590

SUPPORT SCHEDULES

A. Direct Labor

Direct labor charges are based on the actual salaries for the staff members contemplated for the project work plus a factor of 2.5% of base salary for merit increases during the contract period of performance. The precise factor applied is dependent on the estimated period of performance. Frequency of salary reviews and level of merit increases are in accordance with the Institute's Salary and Wage Payment Policy as published in Topic No. 505 of the SRI Administration Manual and as approved by the Defense Contract Administration Services Region.

B. Research Overhead, Payroll Burden, and G&A Rates

These rates are based upon our proposal which has been submitted for approval as interim bidding and billing rates for the year 1977. These rates reflect a revision in our methods of allocating indirect expenses, effective January 2, 1977, as required by Cost Accounting Standard 410. Included in payroll burden are such costs as vacation, holiday, and sick leave pay; social security taxes; and contributions to employee benefit plans.

C. Travel, Subsistence, Materials and Supplies, and Communications

Air fares are based on prices established in the current Official Airline Guide.

Domestic subsistence rates and travel by private auto are quoted at published standards.

Surface transportation, shipping, materials and supplies, and communications cost estimates are based on current experience for contracts of this size.

D. Consultants

Consultant expense is based on the current rates for Eugene Ciancanelli and Frank G. Miller.

E. Report Preparation

Report costs are estimated on the basis of the number of pages of text and illustrations and the number of copies of reports required in accordance with the following rates:

Editing	\$ 4.12 per page
Composition	3.83 per page
Coordination	1.12 per page
Proofreading	1.68 per page
Illustration	24.96 per illustration
Press and bindery	Based on a sliding scale

D. BUSINESS AND MANAGEMENT

1. Qualifications and Relevant Experience

For this proposed project SRI has drawn together a highly qualified and experienced team of professional staff members and outside consultants. The qualifications and relevant experience of each component of the proposed project team are described in this section.

a. Stanford Research Institute

1) General

SRI is an independent, nonprofit corporation providing contract research services to business, industry, and governments. The Institute, founded in 1946, now has a staff of approximately 3000, including a full-time professional staff of about 2000. Education is an important qualification, but experience has been a prime consideration in the selection of the Institute's professional staff. Many staff members held policymaking positions in business, industry, and government before joining the organization. All have demonstrated ability to undertake research on a broad range of problems. In addition, each member specializes in at least one research field.

Headquarters are in Menlo Park, California. SRI's offices are also located in Washington, D.C.; New York City; Chicago; Huntsville, Alabama; Los Angeles; Houston; London; Stockholm; Zurich; Tokyo; Paris; Milan; Tehran; Madrid; Sao Paulo; and Saudi Arabia.

All research activities at SRI, except those undertaken to develop SRI's internal skills and programs or to perform public service, are conducted under specific contract with clients. SRI's clients are commercial corporations, associations, foundations, and organizations and agencies of local, state, and federal governments. Research and consultant services are SRI's only products. The Institute does not manufacture or market any product, nor is it connected with any manufacturing organization.

SRI is an applied research organization, working in the fields of physical sciences, engineering, economics, management systems, life sciences, and social sciences. Of special interest is SRI's experience in performing research requiring various combinations of disciplines within these broad fields. Each area of the Institute has research groups and staff specialists with qualifications that can be brought to bear on specialized portions of any proposed study.

SRI's research and consulting work has always been either problem or client oriented. This approach is conducive to working harmoniously with a client organization, understanding its problems, and structuring research in a flexible manner to provide realistic solutions to those problems.

SRI's research facilities in Menlo Park include more than 1 million square feet of office, laboratory, and conference space and incorporate the most advanced scientific equipment, including unique instrumentation developed by the staff. Since 1957, the bulk of SRI's facilities and most of the professional staff have been located at the Institute's 70-acre headquarters location at 333 Ravenswood Avenue in Menlo Park.

Facilities at SRI's main offices include extensive data processing, library, and laboratory support. Computer services are available for an on-site CDC 6400, a Burroughs B6700, and several other computer installations. Staff members also make use of several time-sharing computer services. SRI's extensive library services and those of the major universities in the area provide excellent research support for staff members.

Since its founding, SRI has completed more than 13,000 projects representing client investments of over \$1 billion, of which 70% has been performed for local, state, and federal government agencies, and the remainder for business, foundations, and other private clients. Currently, about 20% of Institute research is for international clients. More than 700 research projects are under way at any given time, with current volume of contract research of well over \$100 million per year.

For more than 25 years, SRI has been conducting energy-related research for governments and industrial clients throughout the world. To date, in energy economics alone, this work has amounted to more than \$30 million and has covered the full range of energy problems and utilized most of the hundreds of skills at the Institute's command. Projects vary from specific questions on an operation procedure, or the technical and economic feasibility of a new process, to broad assessments of socioeconomic trends and national strategies.

2) Organization

The overall organization of SRI is shown in Figure 2. The staff for the proposed ERDA research project will be drawn primarily from the Energy Center, part of the Office of Research Operations.

The Energy Center is composed of three departments: Energy Technology, Energy Economics, and Industrial and Utility Planning (see Figure 3). SRI staff for the proposed research project will be drawn from the Energy Economics and Energy Technology Departments. The members of the selected project team have directly applicable experience in geothermal energy.

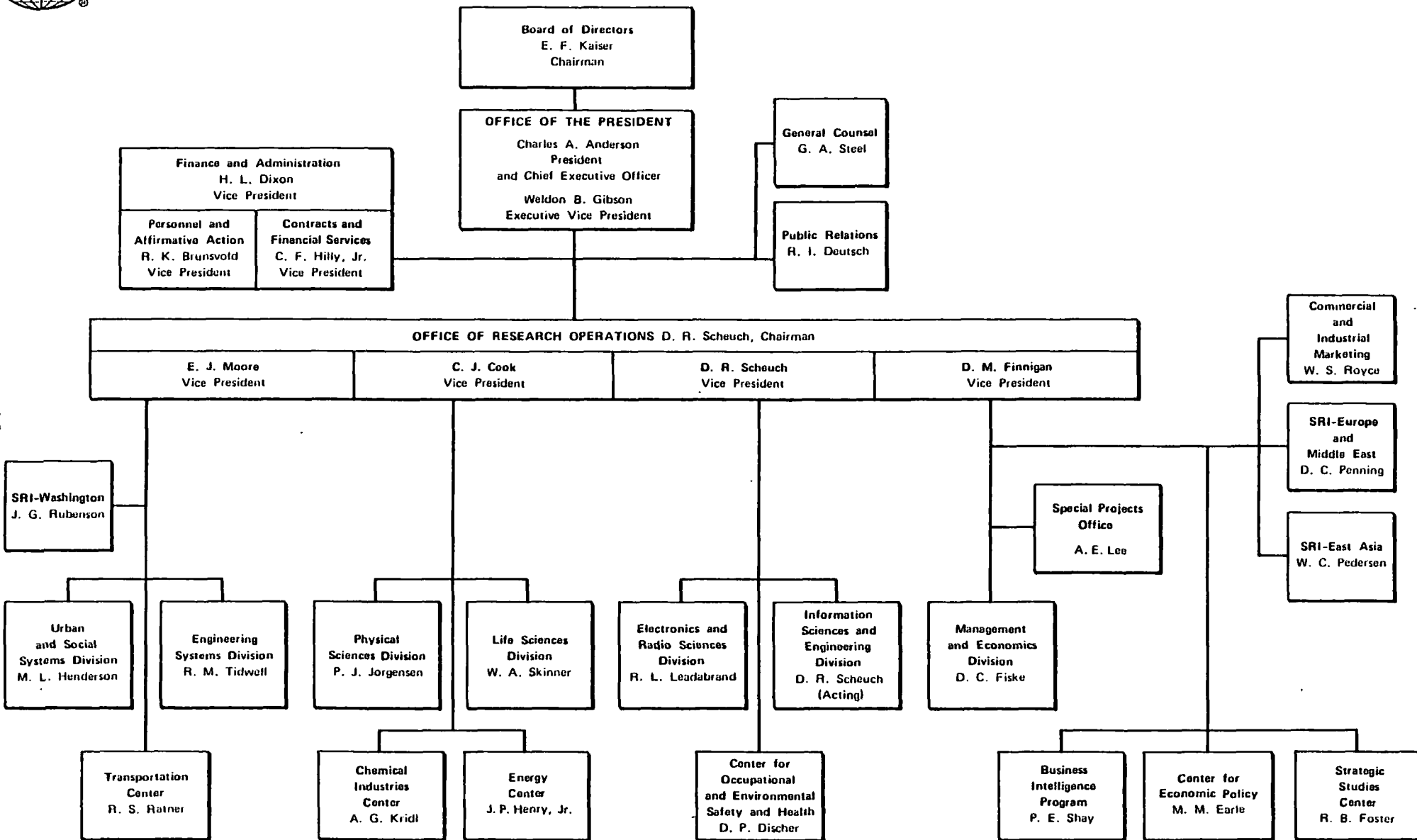
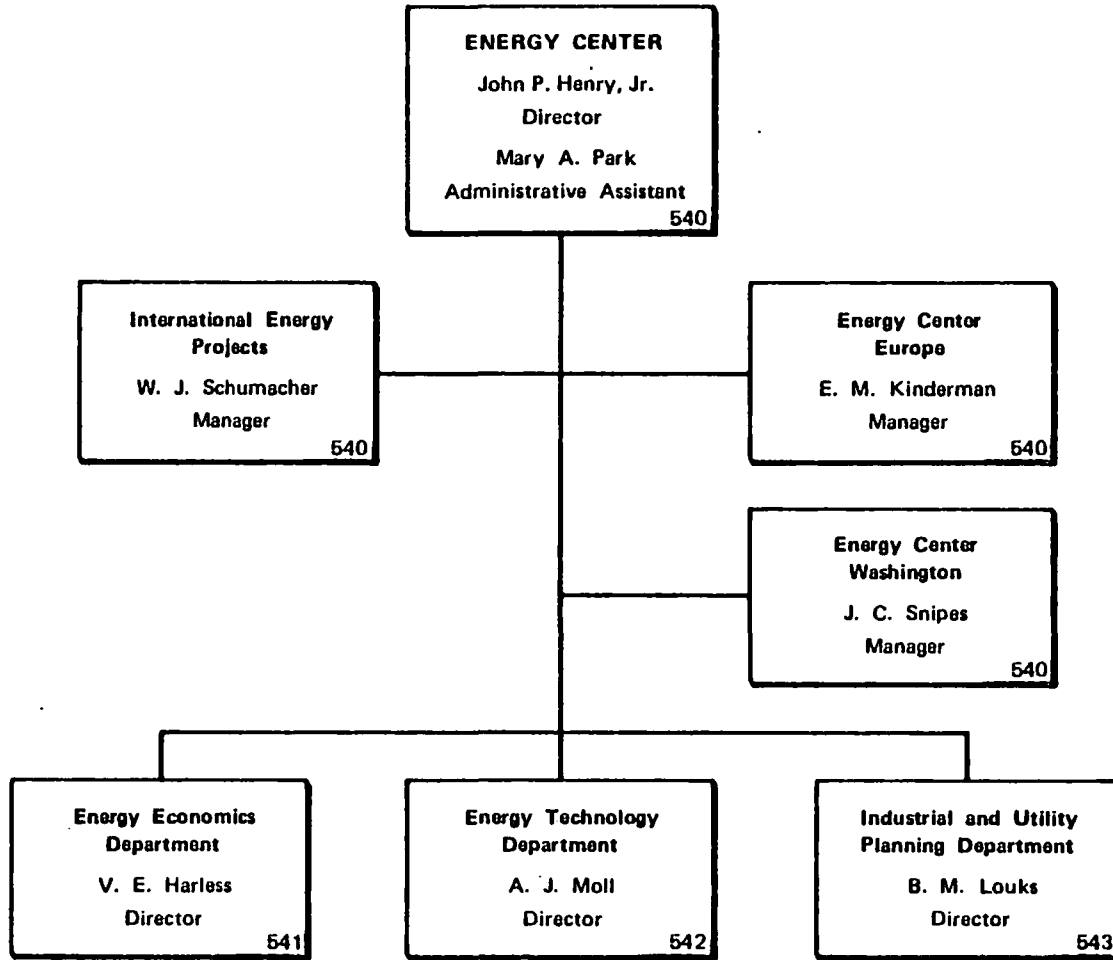


FIGURE 2 ORGANIZATION CHART OF SRI

APPROVED
Charles A. Anderson
 Charles A. Anderson 8-17-76



14

FIGURE 3 ORGANIZATION OF THE ENERGY CENTER

APPROVED: *[Signature]* 12/12
 DATE: 12/12/76
 BY: J. Cook
 INSTITUTE: R.K. Brumfield

a) Energy Technology Department

The Energy Technology Department evaluates the technology and economics of existing and emerging energy processes. The departmental staff specializes in developing in-depth as well as preliminary assessments of synthetic processes for making oil and gas from coal, oil shale, and tar sands. Flue gas desulfurization and other environmental processes related to electric power generation are also evaluated by senior engineers in the department. Petroleum refinery modeling studies are another important area of activity.

The staff also engages in planning analyses--for industry and the government--on long-term energy technologies. These include solar energy, advanced nuclear power schemes, in situ solid-fuel conversion, and studies using geothermal, wind, tidal, biomass, solid waste, and hydrogen energy sources. Staff members of this department have extensive experience with energy companies and universities. The personnel of this department also have principal responsibility for conducting the "Energy Technology Economics Program," a continuing international multiclient study.

b) Energy Economics Department

The Energy Economics Department prepares energy-oriented studies on a national, regional, and worldwide basis for government and private clients. These studies are used by governments in establishing domestic or international policies and by private companies to formulate future development plans. Analyses and forecasts consider pertinent demographic, economic, energy, financial, and sociopolitical factors, utilizing a combination of judgmental and analytical modeling techniques. Many sociopolitical decisions are not amenable to mathematical analysis, especially during periods of rapid changes in one or more of the above factors. Models express the mathematical relationships among many variables that are carefully considered to ensure that they depict the physical reality of real-world activities. These models can be used to examine and test various alternative strategies as well as different environmental, conservation, and national energy policy considerations.

Staff members in this department have extensive academic and industry experience in all phases of national and international energy relationships, including the use of sophisticated modeling techniques. This expertise is being utilized currently in carrying out a major multiclient world energy study.

3) Relevant Experience

This section describes current or recent SRI projects of relevance to the proposed ERDA research project.

a) An Assessment of the Economic Feasibility of a Geothermal Exploration Program

Prepared for a client considering a substantial investment in a geothermal exploration program, this study involved an analysis of the economic feasibility of electricity generation from the hydrothermal resources at the Roosevelt Hot Springs site in Utah. Based on a preliminary analysis, this site appeared to be the most favorable fluid-dominated hydrothermal resource in the western United States for competitive electricity generation. Estimates and projections were prepared of the generating costs of electricity from new base load alternatives (coal, nuclear, conventional oil, and combined-cycle oil) in the Pacific and Mountain regions, and in the service territory of Utah Power & Light. The power plant capital investment for a hydrothermal generating facility at Roosevelt was determined and translated into fixed charges and operating and maintenance costs per kilowatt-hour generated, based on assumptions about capital recovery requirements and the load factor that could be achieved. The resource price (fuel cost to the utility) required by a successful field developer to achieve a specified discounted cash flow rate of return on investment was calculated using a computerized economic model for three constant-dollar rates of return on investment to the resource developer. The important reservoir performance parameters affecting potentially competitive electric power generation were obtained. This information included well flow rates, steam fraction of well flow, detailed geochemical analyses of total dissolved solids content of well fluid, noncondensable gas content of well fluid, well depths, drilling costs, bottom hole temperatures and pressures, and well head temperatures and pressures. This information was obtained for several of the producing wells in the Roosevelt field. The analysis also considered the effects of potentially applicable tax incentives to the resource developer (expensing of intangible drilling costs, and percentage depletion on gross income) on the resource price required by the developer to justify major investment in the proposed project. Also considered were the differential costs of transmitting power output from a hydrothermal plant to local and distant load centers under a variety of assumptions as compared with these costs for new base load plants using conventional fuels.

Dates: 1/77 - 4/77

Contract Amount: Confidential

Type of Contract: FP

Client Private

b) Economic Analyses of Geothermal Energy Development

SRI's Energy Center recently assisted the Energy Research and Development Administration and the California Energy Resources Conservation and Development Commission in economic analyses of geothermal energy development in California. Some of the subject areas included in the analyses were projections of energy and electric rates, identification of major power load centers, estimation of the probable contribution of geothermal electric power and geothermal direct heat cost, comparison of geothermal direct heat cost with the cost of alternative energy sources, and cost/benefit analyses of government program alternatives.

Dates: 3/76 - 3-77

Contract Amount: \$205,000

Type of Contract: CPFF

Contract Number: E(04-3)-115-P.A. 108

Contracting Officer: George A. Maki

Address: Energy Research and Development
Administration
1333 Broadway
Oakland, California 94612

c) Consulting Services in Support of Geothermal
Loan Guarantee Program

To facilitate the development of U.S. geothermal energy resources and aid the client in developing a loan guarantee program for new geothermal projects, evaluations of proposed projects are essential. SRI will provide consulting services for such evaluations, including the areas of proposed energy product marketability, project financing, and project management.

Dates: 3/1/77 - 3/1/78

Contract Amount: Negotiated for each task

Type of Contract: FP

Contract Number: EG-77-C-03-0351

Contracting Officer: David J. Tenca

Address: Energy Research and Development
Administration
1333 Broadway
Oakland, California

d) Environmental Analysis for Geothermal Energy Development in the Geysers Region

This study was to assist the California Energy Resources Conservation and Development Commission in the determination of decision criteria for the approval or disapproval of further geothermal development in the Geysers/Calistoga known geothermal resource area (KGRA). The study had three distinct components: (1) preparation of a master environmental assessment (MEA) for application throughout the KGRA, (2) definition of the hydrogen sulfide emission levels and recommended abatement technology, and (3) definition of the air quality data and analysis required to assess local impacts of hydrogen sulfide emissions.

Air quality data, gathered from a network of nine ground-based stations and supplemented with meteorological data, is the basis for a study of the relationship of emissions to air quality at ground level. The data needed by air pollution control authorities were defined, and a program was proposed to provide the data and to analyze and apply it in future siting cases.

Dates: 7/76 - 2/77

Contract Amount: \$123,000

Type of Contract: FP

Contract Number: 4-0133

Contracting Officer: L. H. Forrest

Address: California Energy Resources Conservation
and Development Commission
1111 Howe Avenue
Sacramento, California

e) Corrosion Chemistry of Geothermal Brines

The objective of this study is to improve our understanding of the mechanisms of metal corrosion in the hot (up to 300°C) geothermal brines of the Imperial Valley, California. With this, we hope to: (1) explain why brines taken from different wells (but from the same reservoir) can differ markedly in corrosivity, (2) recommend corrosion control methods, and (3) predict corrosivity of a brine from its chemical composition. Our study includes field tests at two sites in the Imperial Valley (one low-salinity and one high-salinity brine) and laboratory tests using unflashed brines collected from the two field test sites. Ten alloys will be tested, ranging from carbon-steel and austenitic stainless steel to titanium alloys and high-nickel alloys. Corrosion products and siliceous scales will be identified and correlated with brine composition and alloy composition. Electrochemical measurements made at 250-300°C will be incorporated into experimental

potential-pH diagrams, and these diagrams will be compared with those constructed from thermodynamic data available in the literature.

Dates: 4/1-76 - 9/30/77

Contract Amount: \$142,900

Type of Contract: Grant

Grant Number: AER-76-00713

Contracting Officer: William B. Cole, Jr.

Address: National Science Foundation
Washington, D. C. 20550

f) Energy Technology Economics Program (Multiclient Study)

As part of its private multiclient Energy Technology Economics Program, SRI is currently evaluating the worldwide prospects for geothermal energy. This study includes technical and economic evaluations of the various geothermal conversion processes in use and those that are in the development stages. Processes covered are applicable both to dry-steam and fluid-dominated systems. The geological and reservoir characteristics are being examined for a variety of hydrothermal sites on a worldwide basis. In conducting this study, the project staff is visiting many developing geothermal sites, including those in Japan, New Zealand, the Philippines, Mexico, and the United States.

b. Southwestern Exploration Associates

Southwestern Exploration Associates (SEA) is a geologic consulting firm specializing in geothermal and mineral exploration and development. Associates of SEA have conducted detailed studies and drilling projects in the Geysers dry steam field, the Imperial Valley, and the Roosevelt area in Utah, as well as in several other resource regions in the western United States. SEA, as consultants to SRI, will provide geologic, geophysical, geochemical, and hydrologic services to the proposed research program.

The Associates of SEA have a broad background in hydrothermal systems, which is coupled with more than 10 years of direct experience in geothermal exploration and development.

The geothermal services and experience of SEA include:

- Exploration Program Design and Management
This includes some or all of the activities listed below.
- Regional Studies
 - Literature research and acquisition.
 - Regional geologic and lineament tectonic analysis using LANDSAT (ERTS), Skylab, shadow relief maps, SLAR, ultra-high-altitude aircraft imagery, geologic maps.
- Prospect Evaluation
 - Geologic evaluation. Detailed geologic mapping on aerial photographs of the geothermal prospect; structural analysis; stratigraphy; petrology of volcanic, plutonic, sedimentary, and metamorphic rocks; modeling of the prospect, including the reservoir and heat source; hydrology; hydrothermal alteration and mineralization studies; photo-geology; graphic depiction of geologic data.
 - Geochemistry. Trace element geochemistry of rock and soil samples; geochemical profiling and mapping.
 - Geophysics. Interpretation of data; temperature gradient measurements and heat flow; gravimetry; magnetics.
 - Geothermal drilling. Supervision of geothermal well drilling, including rotary rigs, truck-mounted rotary rigs and diamond drilling; preparation of well programs; lithologic logging; interpretation of electric logs and other down-hole logs.
 - Geothermal reservoir modeling. Preparation of geologic models of geothermal reservoirs to assist reservoir engineering studies.

SEA currently is assisting clients with projects at The Geysers, in the Imperial Valley, and at Roosevelt Hot Springs. At The Geysers, several projects completed or under way include property evaluations and exploration; reservoir modeling and evaluation is currently in progress for two reservoirs. In 1976 SEA assisted a client in drilling one of the most successful wells yet encountered in the Roosevelt Hot Springs field.

Geothermal exploration projects are currently being conducted for clients in California, Oregon, Washington, Idaho, and Utah. These are target areas selected by SEA for the clients involved, and several show a very promising potential.

c. Ramey, Miller, & Brigham

Ramey, Miller, & Brigham is an affiliation of Stanford University professors in the Department of Petroleum Engineering who have established a worldwide reputation in the fields of petroleum and geothermal engineering. This consulting affiliation has followed and been active in geothermal-fluid reservoir engineering for a number of years. The firm consults regularly for Pacific Gas & Electric at The Geysers and has carried on a worldwide practice with other clients. The Department of Petroleum Engineering at Stanford was awarded National Science Foundation geothermal research contracts extending over a period of three years, largely based on the recognized expertise of these three men. This work was subsequently transferred to ERDA. Ramey, Miller, & Brigham is now awaiting ERDA signatures on the most recent contract. Most of this research is a part of the highly regarded Stanford Geothermal Program.

Dr. Frank Miller, as a consultant to SRI, will provide reservoir engineering services to the proposed research program.

2. Project Staffing and Organization

The project will be managed in the Energy Economics Department of SRI's Energy Center. The Center's Director, Dr. John P. Henry, Jr., will actively review the progress and conclusions of the study. Presented below are the formal project organizational and staffing plans, with responsibilities and qualifications of key staff members briefly summarized. Their biographies follow these descriptions.

Project Supervisor--V. Eugene Harless

The project supervisor will ensure that the work will be completed in a timely fashion, within budget, and with high standards of quality. He will be available to consult with the ERDA Program Manager at any time concerning any difficulties that may arise in the course of the study. The final work product will be directly reviewed and approved by him. The selected supervisor, Eugene Harless, Director of SRI's Energy Economics Department, has guided numerous energy studies at SRI for a broad range of clients. In addition to supervision of SRI's recent study of the economic feasibility of electric power generation from the hydrothermal resources at Roosevelt Hot Springs, other projects supervised by Mr. Harless include the current major multiclient project on world energy; an analysis of the overall demand/supply/price energy balance within each state and province of the United States and Canada, and a study for the Electric Power Research Institute that projects regional prices of competing fuels used for U.S. electric power generation.

Project Leader--Joseph E. Peline

The project leader is responsible for the day-to-day operations of the project. He organizes the research effort--planning and scheduling individual tasks and assigning personnel to them. He will maintain frequent contact with the ERDA Program Manager or designated ERDA staff members. He will also contribute significantly to the research effort itself. The designated project leader, Joseph Peline, Manager, Energy Resources, Energy Economics Department, is a veteran geologist and resource analyst, with more than 20 years of industry experience, who has successfully led many other major SRI projects. During a long career with EXXON Company, U.S.A., most recently as Division Manager of Analysis and Evaluation, he developed close familiarity with U.S. sedimentary basin geological and operating characteristics. During his tenure at EXXON he developed a screening procedure to evaluate the economics of proposed geothermal energy ventures in the western United States. He also prepared economic analyses of producing geothermal properties at The Geysers, California, for an acquisition study.

The following key supporting staff members have been selected to assist in carrying on the research.

Mark P. Sweeney, Energy Economist. Mr. Sweeney was project leader on a recently completed study of the economic feasibility of a geothermal exploration program for the exploration division of a major domestic oil company. In carrying out this study, he was able to obtain proprietary data from the results of drilling operations in the Roosevelt Hot Springs KGRA, including well flow rates on the seven producing wells in the Roosevelt field, detailed geochemical analyses of the well fluids from several of the producing wells, the measured steam fraction of the well flow from the single well to which a steam separator has been connected, well depths and drilling costs, bottom hole and well head temperatures for several successful wells, and reservoir and well head pressure readings under a variety of flow rates. He is also participating in the preparation of the report, "Geothermal Energy", currently being prepared under SRI's ongoing Energy Technology and Economics Program (ETEP).

G. (Ram) Ramachandran, Engineer-Economist. Mr. Ramachandran has extensive experience in geothermal energy. He is now completing--as project leader--an interdisciplinary study entitled "Economic Analyses of Geothermal Energy Development in California" for ERDA/DGE. This study includes a detailed examination of the costs of producing geothermal power from several hydrothermal resource areas in California. He is also currently preparing a technology review of the potential of geothermal energy as a part of SRI's ETEP. Before joining SRI, Mr. Ramachandran participated in geothermal work at Bechtel Corporation, where he obtained extensive experience in the technoeconomic evaluation of conceptual energy systems.

Richard K. Miller, Energy Resource Analyst. Mr. Miller has made significant contributions to each of the major geothermal energy development projects conducted at SRI. His work has involved mostly evaluation of geothermal exploration programs and preliminary reservoir dynamics analysis. Among other pertinent academic work, Mr. Miller authored an honors thesis on geothermal resource characteristics and exploration techniques. For the forthcoming ETEP geothermal report, he has recently completed several chapters, entitled "Geological Environments of Geothermal Systems," "Specific Characteristics of Geothermal Resources," "Description of World Geothermal Resources," and "General Geothermal Exploration Techniques." These chapters cover the characteristics of dry-steam, wet-steam, and fluid-dominated hydrothermal resources on a worldwide scope.

Principal Consultants

Eugene V. Ciancanelli, Consulting Geologist. Mr. Ciancanelli, an Associate of Southwestern Exploration Associates, is a Registered Geologist who has spent the last 12 years specializing in geothermal exploration. Mr. Ciancanelli was one of the first industrial geothermal explorationists in the business and has broad experience in known geothermal zones, including the Roosevelt Hot Springs field, and The Geysers in California. In December 1976, Mr. Ciancanelli brought in what may

be one of the most successful wet-steam wells drilled to date. This well, in the Roosevelt field, was drilled by a joint venture of the Natomas Company and O'Brien Gold Mines, Ltd., of Canada. Mr. Ciancanelli was geothermal consultant for the joint venture and selected the well location. Mr. Ciancanelli brings to the project direct and successful experience in the Roosevelt Hot Springs area, coupled with a detailed knowledge of the geology and geophysics of the area.

Dr. Frank G. Miller, Emeritus Professor in the Petroleum Engineering Department, Stanford University. Dr. Miller, former Chairman of the Department of Petroleum Engineering, is a world-recognized authority in the areas of petroleum and geothermal reservoir engineering. During the current academic year, Dr. Miller has been working as a coprincipal investigator on two U.S. government contracts awarded to the Stanford University Geothermal Program. One relates to well testing work and steam recovery from some of the geothermal fluid reservoirs in the Larderello area of Italy. The other relates to the effect of hydraulic injection-production doublets in shielding California coastal aquifers from brine intrusion. He has also recently performed geothermal reservoir engineering work at the Cerro Prieto hydrothermal field in Mexico.

Resumes of the SRI project team and the principal consultants follow.

V. EUGENE HARLESS

Director
Energy Economics Department
Energy Center

SPECIALIZED PROFESSIONAL COMPETENCE

Technical and economic analyses used for long-range business planning and investment decisions

REPRESENTATIVE RESEARCH ASSIGNMENTS AT SRI

Project supervisor for single and multiclient energy-related studies such as a multiclient world energy study, future opportunities for the offshore construction industry, projected world requirements for large diameter line pipe, and the feasibility of constructing an export refinery in Scotland

Project manager of a study for a Middle Eastern country analyzing factors influencing current and future hydrocarbon policies (energy demand, price, and supply cases were prepared covering the major countries and regions of the world from 1950 to 2000)

Project manager of a study for a European country to assist it in formulating petroleum exploration policies

Participated in both short- and long-term multiclient energy studies for North America

OTHER PROFESSIONAL EXPERIENCE

Atlantic Richfield Company:

Corporate Planning Director: performed studies of all phases of company's business, with primary emphasis on gas and oil producing operations; participated in planning major company merger

Manager of international planning: supervised preparation of studies used to determine location and size of foreign exploration, producing, and marketing operations

Manager of technical planning for synthetic crude operations: supervised group evaluating technology for producing gas and liquid hydrocarbons from coal, oil shale, and tar sands; assisted in the acquisition of coal, oil shale, and tar sands holdings

Manager of mineral operations: supervised sulfur production and uranium exploration operations

Texaco Inc.:

Petroleum engineering assignments, including drilling, production, and reservoir studies in Rocky Mountain area

District Petroleum Engineer and Assistant District Superintendent for Texas Petroleum Co. in Venezuela

Acting Chief Petroleum Engineer for Texas Petroleum Co. in New York

District Petroleum Engineer for American Overseas Petroleum Ltd. in Indonesia, with a brief assignment in Libya

ACADEMIC BACKGROUND

B.S. in mechanical engineering (1948), University of Colorado

JOHN P. HENRY, JR.

Director
Energy Center

SPECIALIZED PROFESSIONAL COMPETENCE

International energy economics; energy technology planning and application; technical, economic, and market research on the petroleum and petrochemicals industries

REPRESENTATIVE RESEARCH ASSIGNMENTS AT SRI (since 1965)

Impact analyses of international energy problems
Energy perspective for proposed government research
Comparative technoeconomic evaluation of processes to produce liquid and gaseous hydrocarbons from solid fossil fuels
Market research in South America to determine the feasibility of a polymer-oriented petrochemical complex for Bolivia
Technical and economic feasibility studies for high temperature (plasma) chemical processing
Market research and planning on environmental control systems (air and water)
Technical and economic examination of oil gasification processes
Corporate diversification, acquisition, and planning studies

OTHER PROFESSIONAL EXPERIENCE

Research chemical engineer, Chevron Research Corporation (Standard Oil Company of California): responsible for pilot plant design and operation in petrochemical process development studies and the process design of major petroleum (hydrocracking and catalyst manufacture) processes

ACADEMIC BACKGROUND

B.S. in chemical engineering (1957), Gonzaga University (Spokane, Washington); M.S. in chemical engineering (1959), Northwestern University (Evanston, Illinois); Ph.D. in chemical engineering (1963), Ohio State University (Columbus)

PUBLICATIONS

Papers on international energy economics, solid fuel conversion, and mass transfer applications to heterogeneous catalysts

PROFESSIONAL ASSOCIATIONS, HONORS, AND AWARDS

Registered professional engineer (chemical), California and Ohio; American Institute of Chemical Engineers; Federal Power Commission, Natural Gas Survey, Technical Advisory Task Force
Alpha Sigma Nu; Phi Lambda Upsilon; Dow Chemical Company fellowship; Eastman Kodak fellowship; Standard Oil Company of California scholarship; Bituminous Coal Research, Inc. Award (1971); listed in American Men of Science

RICHARD K. MILLER

Energy Resource Analyst
Energy Technology Department
Energy Center

SPECIALIZED PROFESSIONAL COMPETENCE

Mineral economics, especially of geothermal energy, hydrocarbon resources, uranium, and coal resources; also analysis of mineral resource development policies including mineral leasing policies, technical feasibility studies, and investment risk analysis

REPRESENTATIVE RESEARCH ASSIGNMENTS AT SRI

Economic analysis of geothermal energy development in California
Estimation of world oil resources and their development impact in regard to world operations
Estimation of world coal resources and reserves
Technoeconomic analysis of world coal mining techniques related to geologic parameters
Technoeconomic analysis of world geothermal resource development

OTHER PROFESSIONAL EXPERIENCE

Scientific intern with New York State Legislative Commission on Energy
Teaching Associate in geology, St. Lawrence University (Canton, N.Y.)

ACADEMIC BACKGROUND

B.S. in geology (with honors, 1975), St. Lawrence University (Canton, New York); studies in mineral economics and geopolitics (1976), Mackay School of Mines, University of Nevada (Reno); seminar-course in the economics of international mineral exploration and development (1977), Colorado School of Mines (Golden, Colorado)

PUBLICATIONS

Author, "The Energy Crisis in Nevada--Governmental Measures in the Light of New Problems," in Energy in Nevada (Bureau of Governmental Research, University of Nevada, 1976)
Author, "Estimation of Natural Gas Resources Underlying the New York State Jurisdiction of Lake Erie," New York State Legislative Commission on Energy (1975)

PROFESSIONAL ASSOCIATIONS AND HONORS

American Institute of Mining, Metallurgical, and Petroleum Engineers;
Geological Society of America; Society of Mining Engineering
Degree of Honor, National Forensic League

JOSEPH E. PELLINE

Manager, Energy Resources
Energy Economics Department
Energy Center

SPECIALIZED PROFESSIONAL COMPETENCE

New venture investment planning; petroleum and natural gas operations, including feasibility studies and cost projections; appraisal of hydrocarbon fuel supply sources; economic modeling; risk analysis

REPRESENTATIVE RESEARCH ASSIGNMENTS AT SRI (since 1975)

Demand and supply projections for South Alaska natural gas
Future developments in the world offshore petroleum industry
Construction cost projections for offshore platforms
Assessment of future oil and gas resources in the United States and the world
Oil and gas resource availability as a function of price

OTHER PROFESSIONAL EXPERIENCE

Exxon Company, U.S.A.

Division manager of Analysis and Evaluation: initiated preparation of economic screening studies for all proposed exploration ventures; reviewed existing projects for achievement of satisfactory profit levels

Supervisor, Analysis Section: conducted varied economic studies emphasizing competitive lease sale analyses involving geological assessment, preparation of complex economic models, and detailed risk analysis; prepared economic analyses of historical profitability, by geographic location or type of venture of individual oil companies or entire industry

Staff geologist: assessed oil and gas reserve potential of undeveloped areas, especially offshore Pacific basins; forecasted future oil and gas development programs, including annual estimated expenditures and production of oil and gas, for proposed exploration/production projects; engaged in a program of acquiring independently-owned marginally producing oil properties of California with secondary recovery potential

Basin geologist, Exploration, Central California: integrated seismic and subsurface geological data for preparation of oil and gas prospect maps; well-site geological analysis

ACADEMIC BACKGROUND

B.S. in engineering (1945), University of Minnesota; M.A. in geology (1953), University of California (Los Angeles)

PROFESSIONAL ASSOCIATIONS

Registered Professional Geologist, California

G. (RAM) RAMACHANDRAN

Engineer-Economist
Energy Technology Department
Energy Center

SPECIALIZED PROFESSIONAL COMPETENCE

Technoeconomic evaluation; cost engineering; project engineering; plant design; construction engineering functions related to the energy industries

REPRESENTATIVE RESEARCH ASSIGNMENTS AT SRI (since 1975)

Leadership of an interdisciplinary project for ERDA to evaluate geothermal loan guarantee applications
Technoeconomic evaluation of geothermal energy for the multiclient-sponsored Energy Technology Economics Program
Leadership of an interdisciplinary study performed for ERDA to determine the economic competitiveness of geothermal power in California
Application and evaluation of solvent refined coal process
Technoeconomic evaluation of commercially proven processes to manufacture low/intermediate Btu gas from coal
Technoeconomic evaluation of processes for extraction of shale oil and upgrading to syncrude

OTHER PROFESSIONAL EXPERIENCE

Senior cost engineer, Bechtel Corporation: conceptual cost study for a power plant utilizing geothermal energy; conceptual cost study of coal gasification processes; cost studies of a synthetic crude plant from tar sands; computer applications related to project cost control
Project engineer, Engineers India Ltd.: design and engineering of a marine loading facility; engineering, construction, and start-up of a petroleum refinery unit
Office engineer, Stone and Webster India Corporation: plant design and engineering related to a multimillion dollar petrochemical complex

EXPERT TESTIMONY

Testimony before the California Energy Resources Conservation and Development Commission on economic competitiveness of geothermal steam

ACADEMIC BACKGROUND

B.S. in chemical engineering (1965), University of Madras (India); M.S. in chemical engineering (1972), University of Idaho

PROFESSIONAL ASSOCIATION

American Institute of Chemical Engineers

MARK P. SWEENEY

Energy Economist
Energy Economics Department
Energy Center

SPECIALIZED PROFESSIONAL COMPETENCE

Economic and public policy analysis applied to business and public sector decision making; the impact of public law on energy supply, demand, and price; the effect of domestic and international political processes on energy industries; fiscal impact analysis, cost/benefit analysis, environmental economics, regional economic analysis; OPEC and international oil prices; constitutional, regulatory, and environmental law; economics of geothermal electricity generation; energy conservation

REPRESENTATIVE RESEARCH ASSIGNMENTS AT SRI

Analysis of factors affecting continued OPEC control over world oil prices
Project leader of a study to evaluate the economic feasibility of electricity generation from hydrothermal resources in the Western United States
Participated in the formulation of a state energy conservation plan for Iowa
Analyzed the elasticities and cross elasticities of demand for alternative residential space-heating fuels
Conducted a study of coal reserves, production, mining technology, and applicable public policies and environmental laws in major coal producing nations of the world
Developed estimates of future natural gas production in the offshore regions of the Persian Gulf

OTHER PROFESSIONAL EXPERIENCE

Research associate, Urbanomics Research Associates: preparation of reports and studies, applying social science and economics research techniques to practical policy problems in the public and private sectors; research experience in the methodology of economic and public policy analysis, the economics of energy, national energy policy issues, the economics of environmental problems, fiscal cost/revenue impact analysis, legal (antitrust) economics, regional economic analysis, land use analysis, market and economic feasibility studies; preparation of environmental impact statements
Consultant, General Research Corporation: research and analysis of the judicial, legislative, administrative, and regulatory processes, constitutional law, criminal law, and court systems

ACADEMIC BACKGROUND

B.A. in government and economics (1969), Pomona College; M.A. in political science (1975), University of California, Santa Barbara. Completed course work requirements for a Ph.D. in political science specializing in international relations, international economics, and public and constitutional law

PUBLICATIONS

Coauthor: The Economics of Energy and the Environment (in preparation for publication); The Economics of Energy, prepared for Southern California Edison (1976); Economics and the Environment, prepared for Southern California Edison (1976)

EUGENE V. CIANCANELLI
Geothermal & Mining Geologist
12352 Escala Drive, Rancho Bernardo
San Diego, California 92128
(714) 487-3506

Registered Geologist #357, State of California

Education: M.Sc (1965) and B.Sc (1963) College of Mines,
University of Arizona, Tucson, Arizona

Experience:

May 1975 to present: Consulting geologist in geothermal and mining geology providing advice and services in exploration and development. Specialties include: geologic mapping, property evaluations, supervision of drilling programs and field parties, photo geology, petrography, lithologic well logging, analysis of surface and subsurface geologic data, planning exploration programs and budgets, preparation of technical reports and advising clients on the feasibility and economic risk of projects.

May 1973 - May 1975: Geologist and vice president of Canada Geothermal Oil Ltd., Calgary, Alberta. Designed and managed a joint venture geothermal exploration program for eight companies. The exploration program continues and encouraging information has been developed for several of the prospects. Approximately 4500 acres were leased in the Geysers - Clear Lake geothermal area. The leases were sold to another company with Canada Geothermal retaining a royalty interest. A reconnaissance geothermal survey of Guatemala was carried out to define exploration targets.

August 1968 - May 1973: Chief geologist for Geothermal Resources International, Inc., Marina del Rey, California. A geologic evaluation of the company's 1100 acre geothermal lease at the Geysers helped to establish the value of the property which was sold for 9.5 million dollars and a 10% royalty. Recommended and evaluated other properties at the Geysers; Long Valley, California and Klamath Falls, Oregon. These properties are all now in joint venture with Standard Oil Company of California or the Natomas Company. A property at the Geysers was sold to Getty Oil Company with Geothermal Resources retaining a royalty position. Mercury, coal and a salt deposit were evaluated for the company. Two properties were recommended for acquisition, but the company did not act on the recommendations. The two mines eventually returned a profit to their subsequent purchasers.

June 1966 - July 1968: Exploration Geologist, Phelps Dodge Corporation, Douglas, Arizona. Involved in an exploration program for porphyry copper, massive sulfide, base and precious metals. The major area of exploration was in Arizona with some exploration in Wyoming and California. One property, which was located during reconnaissance mapping was acquired and tested. Phelps Dodge has retained the property since I located it in 1967. Studies accomplished for Phelps Dodge included mapping eight 7½ minute quadrangles, reconnaissance mapping of twenty eight 7½ minute quadrangles, mapping one geophysical anomaly, examination of twenty three mining prospects, reconnaissance geochemical sampling and drilling project supervision.

April - Sept. 1965: Exploration Geologist, Umont Mining Company. Salt Lake City, Utah. Supervised a drilling project for copper and molybdenum in central Nevada. Recognized a critical jasperoid zone that eventually resulted in the delineation of 9.5 million tons of copper-molybdenum mineralization.

Summer 1962, 1963, and 1964: Employed several summers as a geologist by U.S. Steel Corporation, Provo, Utah. Two seasons were spent in Alaska doing assessment work on ultramafic magnetite iron deposits and limestone flux deposits. As a result of this work all claims were approved for patent. One summer's work was in Colorado blocking out coal reserves.

Resume Update

Consulting

May 1975 - Present

Established consulting practice specializing in geothermal and mining geology

Following the resignation from Canada Geothermal Oil Ltd. I was retained by that firm to manage their geothermal operations which included approximately 4,500 acres of leases in the Geysers - Clear Lake area and the operation of a joint venture exploration program with seven other Canadian companies. California Geothermal, Inc., the wholly owned U.S. subsidiary of Canada Geothermal Oil Ltd., is the operator for the group of companies. The group has geothermal lease applications pending on about 300,000 acres of Federal lands, which I recommended they acquire in California, Oregon, Washington and Idaho. As a consultant to the group, I prepare and file the necessary documents to maintain good title to the groups lease applications and I conduct a geologic exploration program.

Retained by Collins Securities Corporation to evaluate some geothermal lands in the Geysers area prior to a joint venture with Earth Energy, Inc. Prior to beginning this evaluation it was explained to Collins Securities that it did not appear to be a property worthy of consideration. Collins Securities requested that I nevertheless evaluate the property, and this was done. The property had clear title to only 71 acres and the geology was not entirely favorable. Collins Securities requested I change my evaluation of the property so the report would be favorable to their venture and this would facilitate the raising of money for the project. I would not change my evaluation and Collins Securities never paid for the study.

Phillips Petroleum Company requested the preparation of a geologic map for their Borax Lake project at the Geysers. The map was prepared and accepted by Phillips. I continue to advise them concerning geology in the Geysers - Clear Lake area and I have been instructing their geologists in the local geology.

Republic Geothermal, Inc. requested supervision of a temperature gradient hole drilling project at Howard Hot Springs in the Geysers - Clear Lake area. The drilling phase of the project was completed under budget and a report on the property was prepared. Republic Geothermal

retained my services to identify some unusual rock samples from a deep temperature gradient hole in Long Valley caldera. Currently I am assisting Republic with planning a geothermal exploration program at the Geysers, which I may eventually conduct.

O'Brien Mines Ltd., who have a large land position adjoining Phillips Petroleum Company's recent geothermal discovery in Utah, have retained my services to evaluate these holdings and advise them concerning several offers they have received for these leases. The initial phase of this study is completed and a report is being prepared. O'Brien Mines have advised that they will be retaining my services to assist them with the evaluation and sale of a gold deposit which they have discovered in Ontario, Canada.

ENI Corporation required a geologic evaluation of the Howard Hot Springs property of Republic Geothermal, Inc. This report was prepared after informing ENI on my consulting relationship with Republic Geothermal on the property and after obtaining clearance from Republic Geothermal.

The Hindsdale Corporation retains my services to advise them concerning geologic matters. I have assisted them in geothermal, coal and gold.

FRANK G. MILLER
BIOGRAPHICAL SKETCH

ADDRESS: Department of Petroleum Engineering
Stanford University
Stanford, California 94305

TELEPHONE: (415) 497-2938

EDUCATION: BS - Pet. Engr., Univ. of Calif., Berkeley, 1933
MS - Mech. Engr., Univ. of Calif., Berkeley, 1939
PhD - Mech. Engr., Univ. of Calif., Berkeley, 1950

EMPLOYMENT: 1953 - present, Professor and Chairman, Department of
Petroleum Engineering, Stanford University
1945-53, Assistant Supervising Engineer, US Bureau of
Mines, San Francisco
1941-45, Major, US Army Ordnance
1939-41, Engineer, US Bureau of Mines
1937-39, Graduate Student, Univ. of Calif., Berkeley
1937, Engineer, US Bureau of Mines
1933-36, Laboratory Technician, Analytical Chemist,
and Oil Field Worker, Union Oil Co. of California

RESEARCH
EXPERIENCE: He has published many technical papers. Special interests
include natural gas and oil reservoir engineering, oil re-
covery by fluid injection, geothermal steam production,
rock compressibility and compaction, land subsidence,
computer simulation of oil reservoirs, and pressure tran-
sient analysis. He is an international consultant to many
major oil companies. His consulting work has resulted in
extended assignments in Alaska, California, Texas, Chile,
Germany, Venezuela, Mexico, and New Zealand.

HONORS: He has held many offices in the Society of Petroleum
Engineers (SPE) of AIME including Chairman and Director
of the Golden Gate Section in San Francisco; co-Chairman
of Program Committee, California Regional Meeting, 1969,
SPE of AIME; SPE Education Committee of AIME (National);
Member of many committees on Production Technology,
Fluid Injection, and Core Analysis and Well Logging,
American Petroleum Institute; Inspector of Curriculum,
Engineers Council for Professional Development; Member
of many honor societies: Sigma Xi, Pi Mu Epsilon, etc.

PROFESSIONAL
MEMBERSHIPS: Society of Petroleum Engineers of AIME, American
Petroleum Institute

3. Operational Plan and Scope

The proposed program is designed to facilitate preparation, by both ERDA's Division of Geothermal Energy and participating developers, of plans for the orderly and successful exploitation of the geothermal resources within the selected study area. It consists of two separate phases.

Phase I will be an integrated geological and reservoir engineering study, based on existing data within the public domain and any nonproprietary existing data that are not yet in the public domain, that will provide guidelines for optimal resource development. The objective is to develop information that will minimize the private sector investment necessary to successfully develop the resource. SRI already has in its possession much valuable proprietary data concerning resource characteristics and reservoir performance. If agreements can be reached with regard to public dissemination of this information, it will be formally presented in the final report proposed for the Phase I effort. If it cannot be made publicly available, we will use it in analyzing the relationship between the data collected and known reservoir performance.

If initiated, Phase II would consist of a substantial upgrading of the Phase I product by the addition of detailed currently proprietary, subsurface geological and reservoir data not yet publicly available. Performance of the Phase II effort would be contingent on SRI's ability to gain access to these data with the understanding that it would be made available for public dissemination. The detailed proprietary data referred to are primarily in the possession of Phillips Petroleum Company.

It is recognized that the Phase I effort may necessarily contain much speculative material, but it will serve to establish the framework within which the study can be pursued and will provide an orderly array of data so that critical deficiencies and omissions can be readily identified.

Not all the sought-after data necessary for the performance of Phase II may be available for publication within the 3-year time frame specified by ERDA, although a survey conducted by SRI staff members supports the belief that much valuable information developed from Phillips' exploration and drilling program can be obtained with the understanding that it will be publicly disclosed within the three-year time period. It is expected that SRI will know specifically what currently proprietary data can be made available to SRI and ERDA--and when it can be publicly released--within 3 months of the date of this proposal. The performance of Phase II of the proposed research program is entirely contingent on our ability to ensure that this information can be obtained and made publicly available.

4. Business and Technical Contacts

The following individuals are authorized to conduct negotiations on behalf of the Institute:

Technical Matters: J.E. Peline, Manager, Energy Resources
Telephone: (415) 326-6200, extension 4709

Contractual Matters: J.R. Ribera, Supervising Contract Administrator
Telephone: (415) 326-6200, extension 2483

The following individuals can contractually bind the Institute:

C.F. Hilly, Jr., Vice President
Contracts and Financial Services
Telephone: (415) 326-6200, extension 2481

Philip J. O'Donnell, Manager
Contract Administration
Telephone: (415) 326-6200, extension 2482

These individuals are located at the Institute's main headquarters, 333 Ravenswood Avenue, Menlo Park, California, 94025.

5. General Contract Provisions

The section "General Contract Provisions" as attached to the RFP is acceptable to SRI as a basis for contract negotiations.

6. Program Technical Scope

The "Program Technical Scope" set forth in the RFP has been reviewed, and SRI agrees that all data that will be furnished pursuant to a contract may be published.