APRIL 14, 1976

5030-22

REGIONAL OPERATIONS RESEARCH: DETAILED WORK PLAN

REGIONAL OPERATIONS RESEARCH FOR GEOTHERMAL DEVELOPMENT IN THE STATE OF CALIFORNIA

DETAILED WORK PLAN

MASTER

**Prepared for the
ENERGY RESEARCH AND
DEVELOPMENT ADMINISTRATION**

**JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA**

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April 14, 1976

**Prepared for
Energy Research and Development Administration
Division of Geothermal Energy, Planning Branch
Washington, D.C. 20545**

**JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
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REA

FOREWORD

The ERDA Division of Geothermal Energy (DGE) has the responsibility for coordinating the Federal Geothermal Program Planning and coordinating all activities by the Federal agencies in support of that program. The objective of the Federal program is to provide the Nation with viable options, which, if exercised, could lead to the rapid commercial development of geothermal energy. This is in consonance with the expressed intention of the Congress in passing the Geothermal Energy Research and Development Act of 1974, PL 93-410, which stated, in part, that "The federal government should encourage and assist private industry through federal assistance for the development and demonstration of practicable means to produce useful energy from geothermal resources with environmentally acceptable processes."

To fulfill its mandate, ERDA/DGE has recognized that geothermal energy is essentially a regional resource, and that the problems that confront geothermal development are, to a large extent, local or regional in nature. The Federal program, to be effective, must address these local and regional needs. At the same time the Federal program must be designed for maximum cost-effectiveness in terms of national power-on-line achievements per dollar expended.

To maximize the effectiveness of its program, the DGE is instituting a system of regional operations research activities through regional contractors which will formulate potential future development scenarios for geothermal energy in the various regions of the Nation, and will identify the public initiatives that will most effectively support the realization of that potential. These regional needs will be input to a National Operations Research Contractor (identified as Mitre Corp. for this effort) who will integrate the inputs from all regions, and support ERDA in the development of its plans. The regional operations research activities in California have been assigned to the Jet Propulsion Laboratory (JPL), Pasadena, California, and Stanford Research Institute (SRI), Menlo Park, California. JPL is termed the lead contractor, and SRI is termed the economic analysis contractor. This document outlines the specific efforts to be performed by JPL and the coordination and interfaces between JPL and SRI. This detailed work plan also supports the interests of the California Energy Resources Conservation and Development Commission (CERCDC) in the development of the geothermal resources in California.

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SECTION I

WORK PLAN

A. STATEMENT OF WORK

The Statement of Work identifies seven specific tasks:

- 1) Preparation of a detailed work plan.
- 2) Development of a Regional Operations Monitor for growth in geothermal energy utilization.
- 3) Development of a Preliminary Scenario for the Region.
- 4) Industry liaison.
- 5) Development of detailed scenarios for growth in geothermal energy utilization at specific sites in the region.
- 6) Support to ERDA/Division of Geothermal Energy.
- 7) Support to the California Energy Resources Conservation and Development Commission (CERCDC).

The ensuing paragraphs present the approaches proposed for accomplishing each of these tasks.

1. Task 1 - Detailed Work Plan

This document represents the response to Task 1 of the Statement of Work.

2. Task 2 - Regional Operations Monitor

Task 2, establishment of the Regional Operations Monitor, will consist of the following sub-tasks:

- 1) Review of existing data banks.
- 2) Development of a classification guide and format.

- 3) Coordination with ERDA, Mitre and CERCDC.
- 4) Assembly and classification of data already collected by JPL in prior geothermal activities in support of NASA, ERDA, and CERCDC.
- 5) Acquisition of additional data.
- 6) Reports.

Each sub-task is briefly discussed below.

a. Review of Existing Data Banks

To assure coordination with and maximum utilization of other data banks containing material related to development of geothermal energy in California, existing data banks will be reviewed to identify those with appropriate material, and to determine how those data banks might be most economically accessed in support of the present program. The data banks will be examined for data available, ongoing activities, and data classification, format and handling techniques. In particular, access to the Geothermal Research Information Data Center (GRID) of Lawrence Berkeley Laboratory of the University of California and to the Energy Information Data Base of the ERDA Technology Information Center, Oak Ridge, Tennessee, have been identified as potential major objectives of the regional monitor. While it is not anticipated that actual accessing of these data banks will be accomplished within the scope of the present effort, the mechanisms for providing such access shall be defined for later implementation.

b. Development of a Classification Guide and Format

A system will be developed to classify the data procured for the monitor so that it can readily be identified, stored and retrieved. Major classifications, sub-headings and nomenclature will be chosen to organize the material. A system compatible with use on automatic data processing equipment will be set up for data tabulation and retrieval. The generic types of data to be collected and classified are summarized in Table 1.

Table 1. Data types for inclusion in the Regional Operations Monitor*

Data Types	Data
Resource Base	<p>Location, properties, and expected size of all known geothermal resource areas (KGRAs) in the State.</p> <p>Location, expected properties, and expected size of all potential geothermal resource areas (PGRAs) in the State.</p> <p>Land ownership of all KGRAs and PGRAs (Federal, State, County, private).</p> <p>Leases presently applied for.</p> <p>Exploration/assessment activities in progress.</p> <p>Information available or inferrable on industry plans for exploration/assessment.</p>
Utilization of Resource	<p>Present usage and users.</p> <p>Present plans or on-going projects for new or expanded usage.</p> <p>Present projections for growth in energy consumption in the State through 2020, broken by location, type of consumption.</p> <p>Present projections of availability of alternate energy sources.</p> <p>Growth plans of prospective utility users.</p> <p>Prospective non-electric users – present energy sources and projected availability of those resources through 2020.</p>

* Whether data with broader applicability than just California may be incorporated in the National Data Bank to be developed by Mitre Corp. Details of this interface will be worked out in the near future.

Table 1 (Contd)

Data Types	Data
Legal and Institutional	<p>Existing laws which affect the development process – Federal, State, local.</p> <p>Regulatory bodies which impact geothermal enterprises, and their specific charters.</p> <p>Present policies of these bodies.</p> <p>Applicable environmental standards – Federal, State, local.</p> <p>Existing community attitudes.</p> <p>Existing land-use plans.</p> <p>Existing water-use plans/water availability.</p> <p>Socio-economic conditions at each prospective site.</p>
Economics of Resource Exploitation	<p>Major cost factors in exploration/assessment.</p> <p>Major cost factors in field development.</p> <p>Major cost factors in utilization (in industry).</p> <p>Tax policies – Federal, State, local.</p> <p>Capital costs – by industry.</p> <p>Capital amortization policies.</p>
Technology Development	<p>On-going federal and non-federal programs and target date for technology readiness.</p>
Industry Status	<p>Capital position – by industry.</p> <p>Manpower availability.</p> <p>Equipment availability.</p> <p>Production rates.</p>

c. Coordination with MITRE and CERCDC

The classification guide, format and nomenclature chosen during the sub-task discussed in b above will be coordinated with MITRE and CERCDC to assure compatibility with their requirements.

d. Assembly and Classification of Data Already Collected

Considerable material and data has been gathered at JPL during the course of recent geothermal studies conducted for ERDA and CERCDC. This material will be located, identified and titled, where necessary, and will then be assigned a classification and code number for identification in the regional monitor. Data cards will be prepared in the format agreed upon among JPL, ERDA, MITRE and the CERCDC.

e. Acquisition of Additional Data

New data developed or acquired as part of the current effort will be classified and assigned an identification number for the filing in the automated data retrieval system. As other appropriate data sources are identified the source will be contacted and the data acquired for classification, filing, and storage in the regional monitor.

f. Reports

During the second month of the program, a preliminary progress report will be prepared for mid-May delivery. A final report describing the development and operation of the regional operations monitor will be prepared during the last month of the program for delivery in mid-September.

3. Task 3 – Preliminary Scenario Development

The development of the preliminary regional scenario for the State of California will be an iterative process of scenario formulation; interaction with affected counties and communities, industry, and involved Federal and State agencies; analysis; and modification. It will be approached on a subregional basis, by dividing the State into five geothermal subregions as shown in Fig. 1. A subregion representative will be assigned to each subregion, with responsibility for generating the scenario for that subregion. A large number of variables will affect the growth rate of geothermal energy utilization. For the preliminary scenarios the approach taken will be to consider first the development of the reservoir to its full capacity at a pace limited only by the perceptions of the counties and communities of the rate of growth they would allow; then in successive iterations analyze the manner in which this growth rate will be modified by the imposition of additional restrictions. The process of scenario development is schematically depicted in Fig. 2. This process is described below.

a. Data Assembly

The State Status Survey document will be reviewed and all data concerning each subregion will be extracted. Data will include county and community attitudes, socio-economic data, resource data and guesstimates of probable size and characteristics of the resource, present use of geothermal energy, and any planned future development.

b. Initial Scenario Formulation

Using this data base a projection of geothermal growth in the various subregions through 2020 will be made, drawing heavily upon present JPL experience and on available information of present industry plans. The scenario will consist of:

Fig. 1. Geothermal subregions in California

Fig. 2. Flow diagram for preliminary scenario development

- 1) A graph of megawatts electric of generating capacity on line as a function of time between 1976 and 2020.
- 2) A graph of non-electric utilization in terms of quads (10^{15} BTUs) per year as a function of time between 1976 and 2020.
- 3) A list of the specific assumptions made in arriving at the projected figures.

The scenarios so developed will be used for initial interaction with the counties/communities.

c. First Iteration Scenarios

After the initial scenarios have been generated, contact will be made with the County Planning Offices of the fourteen counties in California which have been identified by the USGS as being potential geothermal resource areas. Contacts will also be made with local communities and action groups. Most of these contacts will be with individuals previously contacted in the course of JPL's prior geothermal activities. In these meetings ranges of alternative futures and the assumptions associated with those ranges (high, nominal, low) will be explored.

On the basis of these meetings, a first iteration scenario will be prepared incorporating our best judgment of the development projection considering the various opinions expressed. These scenarios will be the first input to the analysis team.

d. Analysis of First Iteration Scenarios

The analysis will cover the following:

- 1) Comparison Against Supply/Demand (SRI). Identification on a subregion by subregion basis of the fraction of the potentially available market that the scenario shows geothermal energy capturing; and the identification of the assumptions that are most inhibiting and of the most promising areas for market penetration.

- 2) Comparison Against the Resource Base (JPL). Identification on a resource by resource basis of the fraction of the identified resource base being utilized as a function of time. This analysis will also identify the implied requirements on the rate of identification of undiscovered but assumed resources necessary to support the scenario, and will critically evaluate these requirements. Checks will be made with the exploration industry, the BLM, the Forest Service, and the USGS, as appropriate for each subregion.
- 3) Application Analysis (JPL). Identification and critical evaluation of technology availability needs and of time-lines for development. Utilities and other potential users will be consulted in developing the application alternatives, as well as ERDA for R&D schedules.
- 4) Environmental Impact Analysis (JPL). Evaluation of the environmental impact of the proposed scenario, against all known Federal, State, and local environmental criteria. Checks will be made with EPA, ARB, and other involved Federal and State agencies.
- 5) Legal and Institutional Analysis (JPL). Evaluation of the legal and institutional environment in which the development will be carried out, identifying the assumptions that are sensitive to potential federal or state policy actions and evaluation of both the sensitivity and the probability of such actions, and their probable effects.

On the basis of this analysis, the scenarios will be appropriately modified, to form the second iteration scenarios.

e. Second Review Cycle

The Second Iteration scenarios will be again circulated to the counties/communities for review, with explanation of why they differ from the First Iteration scenarios. If there is obvious and unanimous disagreement, there will be further modification at once; however, it is anticipated that there will more likely be hesitations and disclaimers that will be specifically noted.

The Second Iteration scenario will also be circulated to selected members of industry and the involved federal agencies for comment. Final modifications to the scenarios or qualifications to the assumptions will then be made.

f. Documentation

Documentation of the preliminary scenarios will include:

- 1) A summary graph of geothermal energy utilization for electric power production versus time for the entire State, showing high, nominal, and low projections.
- 2) A summary graph of geothermal energy utilization for non-electric applications versus time for the entire State, showing high, nominal, and low projections.
- 3) Graphs for each subregion, giving the same information as above.
- 4) A detailed listing of the assumptions leading to the high, nominal, and low projections for each subregion.
- 5) A preliminary listing of potential public sector actions which could influence the probability of whether high, nominal, or low projections will be realized.
- 6) A listing of all specific comments of the counties and communities on the realizability of the scenarios.

An example of a subregional scenario and a description of its major features is given in Attachment B.

4. Task 4 - Industry Liaison

Industry liaison, as well as liaison with other Federal and State agencies, counties, and communities, and civic action groups, will be undertaken as a continuing part of the efforts described under Tasks 3 and 5.

5. Task 5 - Detailed Scenario Preparation

Preparation of the detailed scenarios will begin as soon as direction is received from the Contract Officer on the subregions to be addressed by the detailed scenarios. It is anticipated that this will be received with one week after the submission of the preliminary scenarios. The process will again be an iterative one, and is depicted in Fig. 3 and described below. This process will be applied at as many sites as the resources available will allow. Criteria for prioritizing the order in which sites will be addressed will be developed in conjunction with ERDA/DGE, and ERDA/DGE will make the final selection of the priorities.

a. Preliminary Scenario Breakdown

The specific sites in the subregion which contribute to the subregional scenario will be identified, and the growth projections will be allocated among the sites, together with any aggregated constraints (such as total impact on air quality or water quality, total cooling water consumption, total impact on indigenous vegetation and wildlife, or other criteria that may become apparent, during the preparation of the preliminary scenarios). The assumptions in the preliminary scenarios will be reexamined and appropriately modified as they apply to each site. The specific sites will then be prioritized in conjunction with ERDA for detailed analysis.

b. Potential Customer Identification

At each site, potential customers and potential applications that could foreseeably be moved into the area will be identified through detailed surveys of state energy consumption patterns, and by direct contact with present users of alternative energy sources (such as those facing cutbacks in their natural gas supplies). Assumptions that make each identified user a potential customer will be listed. Where access to actual industry planning is not available, best judgment will be used.

Fig. 3. Flow diagram for detailed scenario development

c. Customer/Constraint Matching

The constraints at each site will be compared against the requirements of each potential customer for the site, and the set (or sets) of customers that appear to be most effectively using the site without violating the constraints will be selected.

d. First Commercial Development

A first commercial development for each site will be timed, selecting the most probable first customer, and starting with existing conditions at the site, and existing attitudes of leaseholders, developers, and potential users. Each assumption that goes into the timeline will be specified and the sensitivity of the timeline to that assumption will be estimated. Where government actions are assumed, it will be noted whether these assumptions are consistent with present policy and planning, are an extension of present policy and planning, or require a change in present policy or planning. An example of such a timeline is shown in Attachment C.

e. Scenario Synthesis

The outputs of c and d above, at each site, will be combined to arrive at one or more alternate scenarios for that site. Each scenario will have high, nominal, and low projections. It will include the list of potential customers, the time each is expected to become involved, and all assumptions made in developing the scenario.

f. Initial Analysis

The scenarios for the specific sites will be summed to form a subregional scenario, which will be analyzed for its implications on capital demand, equipment and skilled labor demand, socio-economic impact on the subregion and demands on public agencies. Gross inconsistencies between implications and known or projected availability of such items as drill rigs, or skilled manpower, will be identified and resolved.

g. Initial Documentation

The scenario will be documented including:

- 1) A graph of projected geothermal development for the subregion.
- 2) Graphs of projected geothermal development at each site.
- 3) Timelines for first commercial application at each site.
- 4) Listing of all assumptions in each scenario and timeline.
- 5) Listing of sensitivity of composite scenario to major assumptions.
- 6) Listing of all implications of the scenarios.

This documentation will form the basis for public and private sector discussion, and will also be supplied to SRI for starting the decision analysis and cost/benefit analysis activities. It will of course be made available to ERDA and the CERCDC.

h. Interaction and the Public/Private Sectors

The documentation developed under g above will be submitted for review by both public and private sector. In particular, a critical review of the assumptions and the sensitivities is needed. Contacts will include, as minimum:

- 1) Federal Agencies - BLM, USGS, USFS, Fish and Wildlife, EPA, BuRec.
- 2) State Agencies - State Lands Office, ARB, CDWR, DOG, SWRB, Fish and Game, PUC, OPR GRB.
- 3) County Agencies - Various APCD's, planning offices of Lake, NAPA, Sonoma, Mendocino, Imperial, Regional Water Quality Control Boards.
- 4) Action Groups - Sierra Club, Growers Associations.
- 5) Utilities - SDG&E, SCE, PG&E, NCPA, IID, Burbank, EPRI.
- 6) Exploration Co.'s - Union, Chevron, Burmah, Magma, Republic.
- 7) A&E - Ben Holt, Bechtel, Rogers.

i. Iteration

The review of the public and private sectors can be anticipated to produce many diverging opinions. All comments and critiques will be assembled, and steps a through f will be iterated to produce a revised scenario. A second review with industry and the public sector will then be conducted to explain, and hopefully obtain concurrence in, the reasons individual comments or critiques were not incorporated in the revised scenarios.

j. Identification of Public Assistance Options

At each stage of the scenario development, assumptions on the probable actions of public and private sector entities will have been made. Associated with each assumption there will be terms and conditions on which the assumption is based. A number of alternatives for public assistance to meet the terms and conditions will be identified. These alternatives will be assembled and examined to determine what if any government actions would be appropriate to address them.

k. Government Action Analysis

Many of the government actions identified in j above may have applicability to more than one set of terms and conditions. The actions will be assembled and prioritized according to their probable impact on the total scenario. The prioritized listing of government actions will then be supplied to SRI for cost/benefit analysis of each action alternative.

l. Final Documentation

The final documentation will include all the items listed under Initial Documentation, appropriately updated to reflect the results of the analysis and interaction activities. In addition, it will include all the terms and conditions associated with each of the assumptions, the prioritized listing of the public sector action alternatives, and the analysis supporting the prioritization.

6. Tasks 6 and 7 Support to ERDA and the CERCDC

These tasks cover the provision of support to ERDA and the CERCDC on an AD HOC basis when their needs require it. While no detailed work plan for such support can be prepared, some provision for such support is included in the resource allocation chart under the function titled "Liaison."

B. TASK SCHEDULES

The proposed schedules for the tasks are given in Fig. 4.

Fig. 4. Task schedules - Tasks 2, 3, and 5

SECTION II

PROJECT MANAGEMENT

A. RESPONSIBILITIES

The ERDA Division of Geothermal Energy (DGE) has the overall responsibility for coordinating the Federal Geothermal Program and will have primary responsibility for monitoring and directing the JPL contract for "Regional Operations Research and Systems Analysis for Geothermal Energy Development." This task is oriented uniquely to the California geothermal region. In implementing its responsibilities, ERDA will use its San Francisco Operations Office to convey technical direction and to exercise administrative control over the JPL contract.

Management of the "Regional Operations Research and Systems Analysis for Geothermal Energy Development" project is the responsibility of the "Lead Contractor," JPL, supported by the Economic Analyses Contractor, "Stanford Research Institute (SRI).

The specific responsibilities of JPL as lead contractor include:

- 1) Technical coordination of the regional operations research activities in California.
- 2) Development of regional geothermal utilization growth scenarios.
- 3) Engineering analysis of geothermal utilization systems.
- 4) Identification of legal and institutional impediments facing the materialization of the aspired scenarios.
- 5) Formulating, maintaining, and updating a regional program operations monitor.
- 6) Performing regional needs analyses to identify needed Federal and State measures for the scenarios to materialize.
- 7) Proposing program and policy measures for consideration by the Federal and the State governments.
- 8) Performing regional impact analyses of Federal, ERDA, and State programs.

B. JPL ORGANIZATIONAL STRUCTURE

Project management, on a detailed and daily basis, of the "Regional Operations Research for Geothermal Energy and Development" is the responsibility of the Assistant Manager for Geothermal Energy as shown in the overall skeleton organization chart for the JPL Civil Systems effort, Fig. 5.

C. PROJECT ORGANIZATIONAL STRUCTURE

In addition, to accommodate California Energy Resources Conservation and Development Commission interests, to incorporate advice from government and industry, and to coordinate the joint activities of JPL and SRI a tentative operational organizational structure has been identified and is shown in Fig. 6.

The Government Advisory Panel and the Industry Advisory Panel shown in Fig. 6 will be constituted during April, 1976. A list of potential panel members will be supplied to ERDA/DGE and the CERCDC for concurrence by April 17. After concurrence by ERDA and the CERCDC, potential panelists will be contacted, and a first meeting of the panels will be scheduled for early May.

D. RESOURCE ALLOCATIONS

Table 2 presents a preliminary breakdown of the project resources by activity type.

Fig. 5. JPL organizational structure

Fig. 6. Proposed project organizational structure

Table 2. Resource allocations (man-months/mo)

Activity/Mos. from Start	1	2	3	4	5	6	Total
Project Management	1	1	1	1	1	1	6
Work Plan	3						3
Regional Operations	1	1	1	1	1	1	6
Preliminary Scenarios	3	6					9
Detailed Scenarios			7.5	7.5	8.5	8.5	32
Liaison	1	1	1	1	1	1	6
Total	9	9	10.5	10.5	11.5	11.5	62

E. PERSONNEL ASSIGNMENTS

The following personnel assignments have been made for the initial phases of the program. They are provided here to expedite contract between ERDA/CERCDC personnel and the JPL personnel cognizant over specific work areas:

- 1) Project Manager - Mr. Casper F. Mohl
- 2) Task Team Leader - Mr. Daniel J. Kerrisk
- 3) Subregion Representatives -

<u>Subregion</u>	<u>Counties</u>	<u>Representatives</u>
Imperial	Imperial, San Bernardino, & Riverside Counties	Mr. Calvin Davis
Geysers	Napa, Sonoma, Mendocino, Lake, and Colusa	Dr. Lewis Leibowitz
Central Coastal	Ventura, Santa Clara	
Eastern Sierra	Inyo, Mono	Mr. Ken Tang
Northeast	Tehama, Plumas, Lassen, Modoc, Siskiyou	

Technical Analysts

Technology and Applications	Mr. James R. Womack
Legal, Institutional, and Environmental Resource	Mr. Ronald K. Granit
	Mr. Charles D. Fredrickson
<u>Operations Monitor Development</u>	Mr. Ben Schulkin
<u>SRI Interface Coordination</u>	Dr. Richard O'Toole

SECTION III

REPORTING SCHEDULES

A. MONTHLY LETTER REPORTS

Letter reports briefly summarizing the activities of the past month, and the anticipated activities of the coming month, will be submitted approximately the 15th of each month starting one month after the start of the contract.

B. BIMONTHLY REVIEWS AND CONFERENCES

At the discretion of ERDA and the CERCDC, bimonthly reviews will be held. These reviews should coincide with major project milestones. Suggested dates are:

- 1) May 17 (approx) - Presentation of Preliminary Scenarios
- 2) July 20 (approx) - Presentation of Initial Cost/Benefit
Analysis and of Initial Detailed Scenarios
- 3) Sept 15 (approx) - Presentation of Final Detailed Scenarios

C. DELIVERABLES

Deliverables on this effort shall include:

- 1) Progress Report on Regional Operations Monitor - May 17
- 2) Documentation of Preliminary Scenarios as specified in
Task 3, Item 7 - May 17
- 3) Final Report on the Regional Operations Monitor, as
specified in Task 2, Item 7 - Sept 15
- 4) Documentation of Final Detailed Scenarios as specified
in Task 5, Item 12 - Oct 7

ATTACHMENT A
JPL-SRI INTERFACE PLAN

A. INTERFACES BETWEEN JPL AND SRI

The areas of general responsibility for this study are as follows: JPL will provide data and analysis for the technical, institutional, and legal issues along with the geothermal development scenarios. SRI will be responsible for market and cost data, economic analysis, cost/benefit evaluations, and decision analysis. Anticipated interfaces between JPL and SRI are outlined below, and summarized in Fig. A-1.

1. JPL Interface Responsibilities

<u>Item</u>	<u>Date Needed by SRI</u>
● JPL Utility Cost Model	4/2/76
● JPL Geothermal Cost Model	4/2/76
● Preliminary Scenarios	4/12/76
● Preliminary Policy Options	5/10/76
● Hypothetical Site Specific Scenarios	6/15 or 6/22
● Detailed Policy Options (Preliminary)	7/15/76
● Refined Site Specific Scenarios	9/15/76

Fig. A-1. Project interfaces

2. SRI Interface Responsibilities

<u>Item</u>	<u>Date Needed by JPL</u>
● Preliminary Supply/Demand Analysis	4/12/76
● Preliminary Geothermal Cost Analysis	4/23/76
● Preliminary Market Contribution Analysis	4/23/76
● Evaluation of Preliminary Scenarios	4/26/76
● Preliminary Economic Analysis	5/17/76
● Review Selection of Detailed Scenarios	5/17/76
● Review of Sites for Detailed Scenarios	7/4/76
● Preliminary Economic Analysis for Detailed Scenarios	7/15/76
● Final Economic Analysis for Detailed Scenarios	9/15/76
● Cost/Benefit Analysis of Policy Options	10/15/76
● Decision Analysis	10/15/76

B. PLANS FOR COORDINATION OF JPL AND SRI

One JPL staff member and SRI staff member will be designated as the interface contact for their respective organizations. Telephone contact will be maintained on a weekly basis to guarantee the early identification of any problems in meeting the anticipated interface requirements. More frequent contacts will be made as necessary. Meetings will be held as necessary to effectively coordinate the project. By the assignment of one person to manage the interface task, JPL and SRI expect to accomplish the following goals:

- 1) Provide a clear and defined line of communication between JPL and SRI.
- 2) Insure early identification and definition of any delays in interface tasks.
- 3) Avoid redundant contacts between JPL and SRI.
- 4) Provide for the orderly transfer of information
- 5) Avoid duplication of effort.
- 6) Insure that project schedules, deadlines, and milestones are met.

ATTACHMENT B

PRELIMINARY SCENARIO

EXAMPLE

As an example, a preliminary scenario of Subregion A is shown in Fig. B-1. The numbers on the example identify the keys which are described below:

- ① Present low estimate of the resource base economically exploitable with current technology.
- ② Present high estimate of the resource base economically exploitable with current technology.
- ③ Commercial availability date for advanced technology expanding the resource base economically exploitable.
- ④ ⑤ Present low and high estimates of resource base economically exploitable with advanced technology.
- ⑥ Present growth rate - limited by timelines.
- ⑦ Inflection point - assumptions on exploration rate:
 - Demonstration of Economics.
 - Resolution of environmental concerns
- ⑧ Future growth rate - assumptions on:
 - Capital availability.
 - Energy demand.
 - Cost of alternative energy sources.
 - Environmental concerns.
 - Socio-Economic impacts.
 - Leasing rates.
 - Regulatory system loads.
 - Service industry capacity.
 - Exploration investment.
- ⑨ Other limitations - assumptions on:
 - Cooling water availability.
 - Land use conflicts.

- Aggregated environmental impacts.
 - Socio-political constraints.
- ⑩ Modified growth past limit - assumptions on alternate technologies to ameliorate problems; e.g., improved dry cooling towers, wellhead conversion to eliminate gathering system, and improved environmental abatement technology.
 - ⑪ Hypothesized date for commercial availability of newer, cheaper, better energy resource; e.g. fusion, breeder.
 - ⑫ Transition point; e.g., from a service industry capacity limited growth rate, to an exploration investment limited growth rate.

Figure B-2 shows the government action analysis and Fig. B-3 is a tree showing the development of policy alternatives.

Fig. B-1. Preliminary scenario example, Subregion A

Fig. B-2. Government action analysis

Fig. B-3. Development of policy alternatives

ATTACHMENT C

**EXAMPLE OF FIRST COMMERCIAL
DEVELOPMENT-TIMELINE**

An example of the first commercial development-timeline (Clear Lake) is depicted in Fig. C-1. The input data are as follows:

1) Input data - Site specific:

- a) Knowledge of resource - None.
- b) Status of leasing - Federal land sales scheduled Sept. 1976 and Sept. 1977.
- c) Customer interest - PG&E, possibly NPCA, CDWR.
- d) County attitude - Very favorable to development, but wants strong environmental safeguards.

2) Input data - General:

- a) State regulatory process.
- b) Technology status.
- c) Economic parameter sensitivities.
- d) On-going R&D programs.

Fig. C-1. First commercial development-timeline