F: Contr. 1077 8-2

PMED ~~para~~

~~SAN 1077-2~~

DOE/ET/12102--

MASTER

SUSANVILLE GEOTHERMAL ENERGY PROJECT

**QUARTERLY REPORT
JANUARY 8, 1976**

CITY OF SUSANVILLE

**PREPARED FOR THE U.S. ENERGY
RESEARCH AND DEVELOPMENT
ADMINISTRATION UNDER CONTRACT**

**AT(04-3)—1077
AC03-76ET12102**

1976 FEB 26 PM 12 03

RECEIVED
MAIL & RECORDS

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

SUSANVILLE GEOTHERMAL
ENERGY PROJECT

Quarterly Report

January 8, 1976

CITY OF SUSANVILLE

James C. Jeskey
City Clerk
Program Manager

Alfred B. Longyear
Principal Investigator

PREPARED FOR THE U. S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
UNDER CONTRACT NO. AT(04-3)-1077

AC03-76ET12102

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED
MGW

TABLE OF CONTENTS

INTRODUCTION	1
OVERVIEW	2
1.0 RESEARCH PLAN.	4
1.1 Requirements.	4
1.2 Resource.	14
1.3 Systems	21
1.4 Modeling.	27
2.0 INSTITUTIONAL PLAN.	30
3.0 UTILIZATION PLAN.	34
4.0 PROGRAM PLAN.	37

APPENDIX

SUSANVILLE GEOTHERMAL UTILITY SYSTEM CONCEPT

SUSANVILLE GEOTHERMAL ENERGY PROJECT POSTURE

INTRODUCTION

This is the second quarterly Report on the status of the Susanville Geothermal Energy Project, (SGEP). The report has been prepared as an aid in project management and contains only that technical information required for project direction. Technical Reports will be reserved for the Workshop Proceedings and special reports. This report is organized by task in accordance with the Work Plan in Contract AT-1077, except that Institutional Aspects have been raised to the full Plan level.

Each task in the Report includes a description of scope which is repeated from the first quarterly SAN-1077-1 except that the Institutional Plan write up has been condensed. Each task has a statement of status, and where appropriate, the identification of key results, problems, recommended solutions and future activities.

In this Report the Appendix contains a conceptual description of the utility system and a posture of the Project. It may be noted that task reports have been prepared by the task managers and hence, reflect an individuality in approach and content. Editing has been limited to establish uniform format, content and program management policy.

OVERVIEW

During this past quarter, the Requirements Definition effort, neared completion. The aforementioned delays in obtaining energy specific data on products and processes has delayed completion of the effort. Analyses of a number of generic industries are showing a significant economic potential through the use of geothermal energy for the Susanville area and similar areas in the West. The assessment of the Resource in the Susanville area is being completed with the drilling and testing of eleven temperature gradient holes in the anomalies. This is added effort in the BuRec Appraisal Study.

The success of the BuRec effort has resulted in planning and Federal legislation (HR 6669, dated December 16, 1975) authorizing the completion of the exploration effort. Based on data in hand, the Systems and Modeling effort was initiated but progressed slowly pending more specific guidance from Requirements and Resource. To expedite this effort, a conceptual system plan with alternatives was developed based upon socio-economic-environmental-institutional considerations pertinent to Susanville. This effort will be refined and used to focus the Resource planning, Systems, and Modeling and Institutional tasks. Systems work has been directed at definition of major cost elements and parameters. Energy conversion activities surveyed the state-of-the-art and conducted thermodynamic analysis of competing cycles, working fluid selection analyses, power systems modeling and surveyed component availability. The Modeling is oriented to establish an input/output model core with screening and engineering/cost sub-routines. In the Institutional area a key criteria was identified. It calls for local control of rates and revenue in order to cause and control economic development through use of local energy sources. Candidate administrative vehicle screening and evaluation are

being completed. A special agreement was negotiated between the City and industrial participants to document their mutual commitment of the resource for local community development.

Characteristics of Utilization Panel member communities has been slow in being received. Data collected in earlier surveys and visits will be used pending receipt of the balance of data. Planning was conducted in support of the resource exploration program and in the structuring of a candidate system concept and the development of the Posture of the Project. The Workshop has been tentatively scheduled for a joint conference with Lassen Community College in Susanville between July 14-16, 1976.

1.0 RESEARCH PLAN

1.1 Requirements

Task Manager: David A. Edson, VTN

Scope - Collect and analyze data relative to current and projected energy utilization as a function of the present industrial, agricultural, and forest industry requirements in the Susanville area.

Develop list of candidate job intensive industries as a function of sensitivity to varying levels of geothermal potential for use in a model to include Susanville. Investigate the feasibility of generating electrical power for local application and sale into a regional grid system. Collect and analyze land planning and economic data as a function of both current and projected need. Analyze the application of geothermal energy to the utility infrastructure.

Status

1.1.1 Industrial, Energy, and Physical Criteria

Local interviews have been generally completed as well as an assessment of the replies that were received from those segments of the Susanville industrial, agricultural, electrical power and fossil fuel segments of the community contacted. An overall combined service map of the electrical infrastructure was prepared depicting the service to the valley by C.P.U. and the Plumas Sierra Rural Cooperative.

Individual studies have been largely completed by Dr. Barmettler on likely candidate operations in the greenhouse, processed foods, forest industries, and livestock areas. (See Dr. Barmettler's report). This work has been expanded by the retention of Dr. Gordon Reistad of the Mechanical Engineering Faculty at Oregon State University to conduct a study and prepare a report on

potential energy-intensive applications in the forest product industries. Emphasis is directed at those processes that make use of chips and sawdust for the manufacture of chemicals. This report is nearing completion. In addition, a literature search has been undertaken in order to quantify energy intensiveness for at least a minimal array of products suitable for consideration as applied to Susanville and the replicable communities, and to create a rational base for subsequent use in the screening model. The hydrology report has been completed and has been made available for system design and modeling purposes.

Problem Areas

This effort has proven to be more formidable than anticipated due to our difficulty in locating integrated source data on this subject in the literature. However, through contacts with industrial firms and location of individual references, an adequate representation of candidate industries is beginning to emerge. It is also our understanding that NSF has retained Sandia Corporation to prepare a comprehensive study on energy utilization by product, however, it is unlikely that this effort will be completed in time to be of significant benefit to Susanville Geothermal Energy Project during this first phase.

1.1.2 Basic Agricultural Schema

Dr. Edwin Barmettler, University of Nevada, Reno

Five areas of investigation were commenced following the initial work on agricultural land use and farming operations analysis. The five areas undertaken are as follows:

1. Greenhouse Food Productions - Under Geothermal Environmental Control Systems.

2. Food Products Processing - Using Geothermal Energy (Heat) Resources.
3. Animal Agriculture - Geothermal Heat Energy Utilization.
4. Geothermal Energy Utilization with Forest Products.
5. Multiple Utility for Geothermal Energy - Including Environmental Modification - Extension of Growing Season, Single Cell Protein Production and others.

Key Results

1. Greenhouses: Construction costs were assumed at \$2.75 per sq. ft. in five acre production units in the model. Total operational costs were established at \$599,500.00 for five acres.
 - a. Annual labor required per acre was 6,200 hours, or \$25,000
 - b. Annual heating and cooling fuel cost were \$40,000 per acre, using fossil fuels.
 - c. At .40¢ per gallon for oil will require 100,188 gallons or 2,385 barrel, per acre equivalent.
2. Food Processing: Onions were used as the model product. Estimated model dehydrator capacity of 230,000 lbs. dry onion production per day, and a 150 day production season in the bare case.
 - a. Per hour Btu required: 42,500,000 - 7.23 bbls. oil
 - b. Per day Btu required: 1,000,000,000 Btu (170 bbls.)
 - c. Cost for fossil fuel per lb. of onions 4.16¢
3. Forest Products: Two activities were considered - Greenhouse Seedlings and lumber production. Seedlings cost range per 1,000 as follows: Greenhouse produced - \$58.40. Outside with soil heated - \$135.30, and outside natural

\$85.00. Some efficiencies still need to be worked out.

Timber and Lumber Production: Saw mills of two sizes were considered.

	<u>Small Mill</u>	<u>Intermediate Mill</u>
a. Annual production	20,800 M.b.f.	46,800 M.b.f.
b. Labor Required (man years)	64	121
c. Kiln fuel equivalents	22,885 bbls.	50,143 bbls.
d. Average per hour labor	\$7.50	\$7.50
e. Cost for fuel per b.f.	1.8¢	1.8¢

4. Single Cell Protein (SCP) Production: S.C.P. production for both human feed supplementation and livestock feeding was assumed. The following is given for comparative purposes, further refinement of data is required. Estimates are for producing 1,000 lb. protein.

	<u>Land Use (Acres)</u>	<u>Water Use</u>	<u>Cost Estimates</u>
a. Algae	.05	.20	\$200.
b. Alfalfa	1.00	3.00	250.
c. Soybeans	1.75	3.50	800.
d. Corn	4.00	8.00	850.

Processing data to produce pure protein needs still to be completed.

5. Animal Agriculture: Two types of considerations are being developed:

- a. Modification of animal environment
 - 1) Bedding grounds and buildings
 - 2) Media - Fish tanks and ponds
- b. Feed Processing:

- 1) Cooking - Garbage for pigs
- 2) System by product processing

Key Results/Conclusions

Selected energy and labor intensive agriculture products and food processes that can benefit significantly through the use of geothermal energy are being identified. Certain specific products within the five generic areas are economically compatible with the Susanville area and with similar areas in the western states.

Problems & Recommended Solutions

The lack of energy specifics for selected processes has complicated the analysis. In order to develop the input required for Systems and Modeling, the number and selection of candidate products and processes has had to be restricted.

Future Activities

1. The analysis of the five areas of investigation will be concluded.
2. A typical energy cascade with selected products and processes sized for application to the Susanville area will be developed.

1.1.3 Economics and Land Use Planning

L. Jackson

Scope - The scope of work relating to economics and land use is composed of two distinct phases. The first phase of work which has been completed and discussed in a working paper included the following assignments:

1. Collect and analyze existing socio-economic data on the study area including recent planning studies, census data, and other appropriate labor and migration pattern information.

2. Review and analyze the makeup of businesses and industries currently operating in the study area. Historical and recent trends as well as anticipated expansion plans are to be noted.
3. Analyze existing and projected transportation networks serving the local region including rail, airports and highways.
4. Determine land use requirements and restrictions in relation to industrial development utilizing geothermal resources.

Work on the second phase is well underway and includes the following elements:

1. Determine a methodology which will enable a community to screen industrial activities in order to discover which industries may be attracted to the area based on the availability of inexpensive geothermal energy.
2. Assess the potential economic and social impacts these new activities will have on the local economy in terms of basic and support employment, land use patterns, population growth and overall economic well being.
3. Document potential areas of concern where major environmental problems or conflicts may arise.

Status and Results to Date

Work during the second quarter dealt with completing working papers on the economy of the Susanville area and Lassen County as well as an overview of Land Use Planning in relation to Geothermal Development for the region.

The major elements of the first working paper are discussed below and were written to serve as a basic tool for Susanville and other replicable communities in assessing their economic strengths and weaknesses.

Economic Setting - In this discussion of Susanville's and Lassen County's economic setting, the general nature of the population, employment and income characteristics were described. The development of an overall economic setting for the region relates changes occurring in the area to those observed in California or the nation as a whole. This allows an observer to gain the perspective of how the region is prospering in relation to California and the United States.

Resources of the Study Area - The second element of this working paper dealt with the description of the resources which may serve to attract or support economic activity. Most important of these resources are human resources. A potential labor pool which has adequately demonstrated a propensity to work and learn can be a very strong selling point for an area. Second, natural resources of an area can be extremely valuable to a region. In this paper we focused on the potential of local geothermal energy to be tapped and utilized for industrial development. Finally, it was important to examine the existing industrial base of the area because it provides insight into the types of supplies that are available in the region and also reasons for existing activities to be located in the region.

Barriers to Economic Development - A discussion of barriers has been included in this working paper because it places the areas resources in a realistic perspective and indicates where local efforts could improve the attractiveness of the area for development. Some of the barriers, such as isolation of Susanville relative to major metropolitan centers, may not be readily responsive to corrective efforts and may restrict development

in some areas. On the other hand, measures taken to improve transportation and to provide assistance to new business may serve to markedly reduce a group of business related barriers. Major findings included in the Land Use Planning working paper include the following elements:

The combination formed by the locational requirements of the potential uses and the characteristics of the geothermal resource at its various locations will ultimately determine the implications of geothermal resource utilization upon land use planning in Susanville and the County. The General Plan policies of both the County and the City provide for:

1. Additional community development and corresponding population growth.
2. New development and corresponding growth in the industrial, commercial and agricultural sectors of the economy.

Sufficient land area is available to accommodate such new development (including residential, supportive commercial and public as well as employment producing industrial development). Thus, the principal of stimulating economic growth and physical development through the utilization of geothermal energy is not in conflict with the land use plans and policies of Lassen County or the City of Susanville. However, in actual practice, conflicts between planning and the final geographic configuration of geothermal energy-oriented development may arise.

Potential Problems - Land use planning to ensure orderly development of industrial activities is essential to alleviate potential land use related problems in the study area. Although specific areas of such conflict, if any, cannot be adequately determined

until more comprehensive data on the nature and location of the geothermal resource are available, possible problem areas of non-conformity between existing land use plans and potential geothermally-oriented land use patterns have been identified. Two potential conflicts are discussed below:

1. Agriculture is a major component of the County-wide economy whose welfare is tied very closely to the physical properties inherent in the land. Honey Lake Valley in which the geothermal study area is situated encompasses the majority of prime agricultural land in the County. Of particular significance is the fact that the highest quality soils in the County are distributed in a pattern which partially overlaps the general boundaries of two of the five geothermal resource fields located in the study area. Recognizing the importance of this crop land as a valuable, and relatively scarce resource, both the City and County General Plans recommend land use controls to preserve and protect agricultural crop lands from encroachment by competitive urban land uses.

At present, the City of Susanville and County of Lassen General Plans provide for urban development to be concentrated in and around Susanville. Ample space for residential, commercial and industrial uses are provided and adequate separation of potentially incompatible uses is maintained. Industrially planned and zoned land, in particular, is well sited in relation to road and rail access as well as known geothermal energy could be easily accommodated in the Susanville area without conflicting with existing and planned land use patterns nor encroaching upon valuable crop lands. It should be noted,

however, that the possibility exists that one or more of the other known geothermal fields could prove to be better suited for the establishment of urban uses (Note: for the purposes of this analysis, it is assumed that the development of urban land uses in the outlying geothermal fields would be largely limited to industry and that any major residential or commercial development would occur only in association with industrial development in order to provide residences and commercial goods and services for the industry's employees). Should this prove to be the case, conflict with existing land use plans and policies may occur involving urban development pressures on presently undeveloped agricultural lands or on existing small rural communities in the vicinity of the fields.

2. The development of uses based on the application of geothermal energy could possibly introduce undesirable factors which would make present land use designations incompatible with surrounding community development. This is a particular area of concern where, as in the case of Susanville, residential land uses are planned for development in relatively close proximity to industrial land areas. Some industrial and agricultural processes which could utilize geothermal energy (i.e., cattle feed lots, food processing plants, etc.) may produce noise, odors, lighting glare and/or other conditions which infringe upon other land uses. Depending on the specific nature of the resource, geothermal water itself can present a problem in terms of obnoxious hydrogen sulfide odors. These potential factors will need to be considered when sites for such industrial and agricultural activities are selected.

Future Activities - Work is underway to develop an economic model which can approximate the existing state of the Susanville area economy and estimate changes to the economy as a result of geothermal industrial activities. Input-output analysis is thought to be the most appropriate tool to utilize in this endeavor and it is hoped that extensive use of the Lassen County model developed by the University of California, Berkely will be possible. The results of these efforts will lead to the quantification of jobs created and dollar volume of economic activity generated in the region.

It is hoped that specific recommendations for land use planning will be possible based on the location and quantity of geothermal resources found in the area. In addition, federal and local environmental guidelines will be noted to ensure that extraction of geothermal resources and all industrial activities conform to N.E.P.A. and C.E.Q.A. guidelines.

Future work in Requirements will be directed to:

1. Assimilate the characteristics of Utilization Panel member communities in order to establish proper Requirements input to Systems and Modeling tasks.
2. Additional requirements data collection and analysis will be wrapped-up early in the next period. Additional requirements activity will be in direct support of Systems and Modeling and reported under those tasks.

1.2 Resource

Task Manager: George Zebal, consultant to VTN

Scope - The resource assessment task will combine original geological and geophysical work to be accomplished by the Bureau of Reclamation with

existing governmental and private information to evaluate the presence and physical characteristics of potential geothermal resources within the Honey Lake Valley and adjacent to the City of Susanville. A cost-effective flow of exploration activities will be developed for future utilization as follows:

1. Literature search for pertinent structural, stratigraphic and geothermal information; surface geological mapping; scanning infrared photometry; and theoretical geochemical thermometry.
2. Regional electrical resistivity survey to discover and establish the boundaries of geothermal anomalies.
3. Series of shallow thermal gradient holes to identify specific sites of abnormally high heat flow.
4. Deep exploratory drilling to establish the depths to potential reservoirs, reservoir and production characteristics, and the potential temperature and geochemistry of geothermal fluids.

Integration and cost accounting procedures as well as the sequence of exploration activities will be utilized for future economic modeling.

Status - During this past quarter, four significant activities have occurred as follows:

1. Completion of an internal final report on reconnaissance electrical resistivity surveys and geochemical thermometry conducted by the Bureau of Reclamation.
2. Eleven thermal gradient holes were drilled on the Susanville and mid-valley anomalies.
3. Integration of Gulf Mineral Resources Co. data covering the Wendel and Amedee anomalies into SGEP surveys conducted by the Bureau of Reclamation.
4. Exploration planning meeting held at Lawrence Berkeley Laboratory

to define the specific scope of future exploration activities.

The resource assessment task has been a very cost-effective reconnaissance survey of the overall geothermal potential of that part of the Honey Lake Valley lying within the boundaries of the SGEP. Prior to the implementation of this task, three geothermal anomalies were indicated in the valley: Susanville, Wendel, and Amedee. During the course of the work, these and additional areas in the mid-valley were evaluated. It must be noted that assessment work to date has been of a reconnaissance nature and a great deal of geophysical surveying and drilling remains to be accomplished before the total geothermal potential of the valley can be evaluated. The extent of future planned resource assessment work will be discussed under "Future Activities".

Additional data have been collected and abstracted from the geothermal literature and private sources for the purposes of adding to a data bank for assessing the resource of replicable communities and for modeling purposes. These data concern existing surface temperatures, potential subsurface temperatures, potential area of resource, distance of resource from communities, probable status of geothermal resource in terms of hot water or steam, and character of probable reservoir strata (fractured volcanic rocks versus sedimentary sands and gravels).

The internal report covering theoretical geochemical thermometry of geothermal manifestations exhibited by selected water wells in the Honey Lake Valley and the interpretation of reconnaissance resistivity surveys was issued by the Bureau of Reclamation as an internal document. The report by Rick A. Schimschal, Research Geophysicist, confirmed data discussed at the October Quarterly Review. Currently, Mr. Schimschal has access to the data supplied by Gulf Mineral Resources Co. in order to more thoroughly understand the geophysics in the Wendel and Amedee

areas.

During the months of November and December, under adverse weather conditions, Bureau of Reclamation drilling crews drilled eleven thermal gradient holes varying in depth from 45 feet to over 150 feet to obtain bottom hole temperatures and thermal gradient data within anomalies discovered by reconnaissance electrical resistivity surveys. Temperature data will be obtained during the next quarter after the holes have undergone temperature stabilization.

The exploration planning meeting held at the Lawrence Berkeley Laboratory on October 29, 1975, to define the scope of future exploration activities was attended by 14 participants from the City, VTN-CSL, BuRec, USGS, ERDA, H. F. Swift & Co. and LBL.

The meeting was conducted in two parts: first, a review of exploration conducted by Bureau of Reclamation for the SGEP, and second, a definition of a specific plan for future exploration to evaluate the extent of the geothermal resources of the Honey Lake Valle.

Key Results - Most of the results of the resource assessment program were discussed in the October Quarterly Report. In this report, a warning was issued. New geothermal anomalies were evaluated by means of original work by the Bureau of Reclamation. This information is being kept confidential pending a decision regarding the best method of exploiting the geothermal energy for the economic benefit of the community. This factor prevents issuing a complete report on the key results of the resource assessment task until the workshop.

Despite the reconnaissance nature of the results of this task, tentative boundaries have been assigned to all of the geothermal anomalies and this information has been relayed to the City of Susanville.

Eleven shallow thermal gradient holes have been drilled within the

areas of three anomalies. These holes are currently undergoing temperature stabilization for a period of at least one month before any meaningful temperature logging can be undertaken. When the holes are logged, the complete resource assessment task for the SGEP program will have been completed for this phase of the project.

Future Activities - The original work accomplished by the Bureau of Reclamation successfully confirmed the presence of geothermal anomalies that were previously known and disclosed potential new areas. Additional information about the Susanville, Wendel, and Amedee anomalies was provided by Bureau of Reclamation reconnaissance electrical resistivity surveys and data interpretation and through the cooperation of the Gulf Mineral Resource Co. These positive factors developed a need to propose a follow-on exploration program to completely evaluate the extent of the geothermal resources within the SGEP area of interest. These factors, therefore, led to the meeting at Lawrence Berkeley Laboratory to plan a proposed follow-on exploration program. A skeleton plan had been defined by Bureau of Reclamation and VTN-CSL task managers; this plan was presented to LBL and BuRec geophysicist and modified as follows:

The plan consists of a series of geophysical surveys leading to the location of a series of deep regional heat flow and geothermal gradient test holes. The final step includes drilling a 5,000-foot deep geothermal well at the site having the best thermal gradient. The program is scheduled for an 18-month time span at an approximate cost of one million dollars. The plan is also based on the following assumptions:

1. Environmental and geological factors negate exploitation of Susanville anomaly for generating electricity; therefore, thermal energy will be planned for light industrial and space heating use.

2. Deep thermal gradient holes (1,500 feet deep) can be utilized as injection wells for productivity test purpose.

Planned subtasks include the following:

1. Surface mapping, Susanville anomaly:

This subtask involves detailed mapping of the volcanic rocks in the vicinity of Susanville in order to specifically locate fault lines that can be projected into the alluvium covering the Susanville geothermal anomaly.

2. Environmental assessment, all anomalies:

This assessment will dictate the use and degree of exploitation that can take place on or in the vicinity of each anomaly.

3. Reflection seismic survey; all anomalies excepting Wendel:

This survey will utilize "thumper" equipment (mechanical rather than explosive source of energy) to survey preplanned lines across anomalies to determine:

- a. Location and dip of fault plane on fault lines concealed by alluvium.
- b. Depth to and structure of basement rocks and lakebed sediment-volcanic rock interface.

4. Deep dipole-dipole electrical resistivity surveys, all anomalies exception Wendel (already covered by Gulf data).

These surveys coupled to the seismic surveys will denote:

- a. Depth, area extent, structural relationships (relation of geothermal reservoir to faults and basement rocks), and apparent porosity of reservoir.
- b. Designate best locations for deep thermal gradient holes.

5. Passive microearthquake seismic monitoring, all anomalies excepting Wendel (already covered by Gulf data).

Microearthquake monitoring is a seismic tool that defines the existence of fault lines by means of microearthquake activity. In this sense, it is a valuable adjunct to sharpen the results of the reflection seismic and deep electrical resistivity surveys.

6. Geochemical thermometry, all anomalies:

During the course of analyzing geochemical data from water wells and springs, it was noted that both temperature and water chemistry values were not consistent because of differing methods of obtaining and analyzing the waters. Therefore, a new geochemical program wherein all water would be field sampled in an identical manner and analyzed by a single laboratory was recommended.

When all of the geophysical and geochemical data has been interpreted, an exploration drilling program will commence. This program will consist of discreet phases commencing with the Susanville anomaly as follows:

1. Locate and drill two 1,500-foot test wells on the Susanville anomaly; complete and test both wells for temperature and productivity by injecting one into the other following temperature stabilization for the pilot thermal use project.
2. Locate and drill a regional heat flow hole to 500 feet in depth; this hole should lie outside of any geothermal anomaly.
3. Locate and drill single 1,500-foot thermal gradient test holes on all anomalies excepting Wendel (already drilled by Gulf); this will involve a total of three holes.
4. Select the site of the maximum thermal gradient as a site for a deep exploratory well; if the exploratory well is successful, it can be tested by injecting spent geothermal water into an adjacent 1,500-foot deep thermal gradient hole to provide data for design of a thermal-electric facility.

At the conclusion of the well test phase of the Susanville anomaly, the design of the pilot thermal project can commence. If funding becomes available, this could occur as early as the fall of 1976. Similarly, at the conclusion of the well testing program for the deep discovery well to 5,000 feet, parameters for the design of a thermal-electric facility will be available. These are the most important milestones in the planned exploration follow-on program.

Analysis of geothermal data being furnished by Utilization Panel members communities for resources in their areas will be conducted during the next quarter. In addition, consultation will be furnished the City of Susanville to support their planning for the utilization of the resources in the SGEP area.

1.3 Systems

Task Manager: David A. Edson, VTN

Scope - Analysis and definition of system design shall be conducted for the production, control, conversion and distribution of thermal and electric geothermal energy. This effort is primarily parametric in nature with emphasis on that design effort required to prepared parametric costs for the Economic Modeling. The mix of thermal vs. electric energy needs shall be analyzed in support of the subsystem and system parametric design. The requirements for system integration into the community infrastructure (existing utilities) shall be defined. Life maintenance and operational considerations shall be evaluated for economic influence on the modeling.

1.3.1 Overall Systems Analyses

Status - Towards the end of this quarter sufficient Requirements data had been accumulated and socio-economic factors identified with the City staff to allow preliminary designation of potentially

attractive system concept design options. An overlay map is being developed depicting one candidate integrated system involving the establishing of a thermal plant and an interconnected thermal and electric plant with geothermal water mains and local distribution systems throughout the valley. Alternate sites, transmission systems and distribution systems are also being identified. These concept layouts are being structured in order to guide the system parametric analysis. The design logic employed will be to cascade geothermal energy from its highest economically feasible temperature employment (for electrical generation, if economically practical) through declining grades of effective usage as a function of temperature. After the lowest temperature usage the conceptual system will reinject the residual fluid into the vicinity of a suitable geothermal reservoir. Alternate disposition of geothermal fluids is a site specific detailed design and economic trade study that should only have second order impact on the economic modeling.

In the current concept, geothermal water will be delivered to industrial parks and individual agricultural and industrial sites at temperatures consistent with the applications involved. The end project will be presented in generalized model system format to enable application to alternate sites and other areas including the Utilization Panel member communities. The systems effort is primarily directed to establish the basis for energy costing in the Economic Model. Work is now beginning to establish generalized relationships regarding optimum electric-thermal "mix", ranges in this "mix", temperatures, piping systems,

economically feasible transmission runs, pumping station characteristics, metering and control systems, surge and storage installations and other physical variables. In addition, one or more candidate system will be selected for "site specific" study of the incorporation of the system into existing utility infrastructure in the SGEP study area.

Key Results - Socio-economic, geologic and environmental factors when interrelated, have tended to cause the system concepts to focus on a multi-source system with interconnecting transmission/distribution systems. However, further study should cause either the reinforcing of this concept or the separation of sites into non-connected, individual modules of a "system".

Problems & Recommended Solutions - The difficulty in obtaining energy specifics on products and processes has delayed significant systems parametric analysis. Enough data are in hand to effectively continue the systems task.

Future Activities

1. System concept layouts and alternates will be completed and cost sensitive parametrics will be identified and quantified for Susanville and the Utilization Panel member communities.
2. Those trade studies and parametric analysis that have a first order impact on energy cost will be conducted.

1.3.2 Energy Conversion Systems

Task Manager: Barry Beindel, Aerojet Energy Conversion Company

Scope - Perform the studies associated with the conversion of geothermal energy to useful power. Candidate electrical generating systems will be modeled parametrically, considering a range of possible geothermal water resource characteristics,

cooling water features, hot water distribution system requirements and community energy needs. The existing state-of-the-art in energy conversion hardware forms the basis for the study. A mathematical model will be used to determine the capital and operating costs of applicable geothermal electrical generating power plants. The output from this model will be used in conjunction with the overall geothermal system model to determine the optimum mix between direct thermal energy utilization and electrical power generation. This will contribute to establishing the most economically beneficial approach to applying the geothermal resources in a community typified by the City of Susanville.

A candidate energy conversion subsystem will be selected in consort with the overall requirements. This subsystem will be used for program planning for the demonstration phase.

Status - Energy conversion system activities commenced in the early part of this reporting quarter. Work effort was progressive in the area of geothermal state-of-the-art assessment, preliminary thermodynamic cycle analysis, working fluid selection, power system modeling, and component availability. Major emphasis was directed towards contacting geothermal groups at Energy Research and Development Administration (ERDA) national laboratories, including, Lawrence Berkeley Laboratory, Lawrence Livermore Laboratory, Idaho National Engineering Laboratory, Sandia, Battelle Northwest Laboratory and Holifield National Laboratory, as well as industrial organizations. The objective is to assess and build upon existing technology, as applicable, for the Susanville energy conversion system study. Cooperation from ERDA has been

excellent and proper utilization of results will avoid duplication of effort and enhance new system trade-off studies.

Preliminary thermodynamic analyses were performed for double flash steam systems and isobutane organic Rankine power conversion systems.. Output power was fixed at 10 MW but geothermal resource and heat rejection temperatures were varied parametrically.

Output power variations will be accommodated in subsequent analyses. A comparison of early results indicates that capital costs are lower with the flashed steam system although utilization of the geothermal resource energy is superior with the organic system. The latter implies the need for lower water flow with resultant savings in production well and water distribution costs. This type of trade-off would be a subject for the total community system model. Other organic working fluids are also being considered for more optimum binary system selection. A review of the Susanville region hydrological report indicates that surface water is not available in sufficient quantities for direct condenser cooling. This is probably characteristic of most other potential sites in semi-arid areas. In the Susanville area, however, there should be adequate makeup water to operate wet cooling towers. Assessment of the temperature, flow and environmental impact of use of ground water could alter the above conclusion.

Under environmental considerations, the most significant impact that can be hypothesized at this time is associated with excessive loss of organic working fluid inventory. From previous work, contact with OSHA has indicated that such closed systems of readily available air breathing equipment for personnel protection.

Further consideration of the environment effects associated with use of cooling water will be continued after additional resolution of probable cooling concepts.

Key Results/Conclusions

- ° Technology state-of-the-art assessment has included contact with key ERDA Laboratories.
- ° Initial communication with technology centers has been completed and evaluation of state-of-the-art is in progress.
- ° Pending additional definition of ground water availability, wet cooling towers would be needed for condenser cooling water.
- ° Adequate surface water is available for make-up.
- ° Availability of adequate supplies of cooling water can become a major if not the major deciding factor on the economic feasibility of electric power generation for many potential geothermal sites in the predominantly semi-arid West.

Problems and Recommended Solutions - In order to minimize power plant costs, direct condenser cooling with ground water is desirable to eliminate the need for wet cooling towers. It is recommended that the Susanville hydrological report be supplemented with added data on ground water resource and flow characteristics. This should be followed by an economic trade-off study comparing wet cooling tower systems with surface ground water make-up versus direct condenser cooling and versus other concepts.

Future Activities - Energy conversion system emphasis will be directed towards the following:

1. Completion of state-of-the-art assessment with decisions on availability of advanced technologies under current development;
2. Screening and selection of candidate thermodynamic cycles and working fluids;
3. Parametric system modeling and selected trade-off studies;
4. Definition of hardware availability; and
5. Participation in program mid-point review.

1.4 Modeling

Task Manager : David A. Edson,

Scope - An overall economic model and appropriate submodels will be developed to evaluate the overall economic advantages and disadvantages of a community utilizing geothermal energy to build an economic base. The system and subsystem modeling will be conducted to define economic sensitivity parameters such as impacts on cost of sales, employment and revenue. The range of input parameters will be selected to accommodate the requirements and projected resource capabilities of the communities whose representatives form the Utilization Panel.

Status - During November work commenced on the Economic Modeling task. Initial effort was aimed at developing a methodology for estimating potential economic impacts on the Susanville area (as the example community) based upon geothermal energy-related industrial development including the generation of electricity. Throughout this initial phase of the analysis it has been the intention to develop a generalized model using Susanville specifics to establish practicality and yet assure that the model can be readily adopted to other replicable communities. Through analysis of the characteristics of Utilization Panel member communities, selection of parameters and their range

will be defined to assure specific compatability with the model and sub-routines.

Current thinking indicates that an input/output technique should be the most appropriate for evaluating total employment, salaries and revenues associated with the geothermal energy related economic development. It should be noted that extensive work on a Lassen County input/output model has been developed by the University of California. Similar models using identical methodology have been developed for four other counties. This effort can be used and can assure replicability for other specific economic areas.

As applied to the analysis of the Susanville area, a conventional input/output model will show, for a base period such as 1976, the dollar value of the total transactions of each local industry with respect to one another and with respect to each of the exogenous industries. The proportions of direct input requirements from the various industries will be calculated for each local sector. Then this coefficient matrix is used as the basis for calculating the values of total direct and indirect output created within the area per dollar of revenue. The multiplier effect on each local industry, as well as the entire economy of the area, can be shown. Addition to the industrial base of the area (resulting from geothermal related economic development) can then be estimated based on the coefficients previously developed.

Key Results & Conclusions - At this time the modeling effort is directed at being documented in a manual format. Care will be exercised to not preclude adoption for computerization. However, emphasis will be placed upon development of modeling that can be most readily used through manual operations.

Future Activities

1. Development of the input/output model, energy costing, screening and other-sub routines will continue.
2. Characteristics of Utilization Panel member communities will be evaluated as they become available.

2.0 INSTITUTIONAL PLAN

Task Managers: Jerome Garza, City of Susanville

Donald P. Cady, City of Susanville

Scope - An administrative vehicle that is appropriate for a community to cause and control the development and utilization of geothermal energy to build an economic base will be characterized. Emphasis is being focused on establishing the vehicle required to support the ERDA funded prototype demonstration effort in Susanville. The characterization of the administrative vehicle will be constrained by state code and financial opportunities for development and construction of the systems. Local legislation for the protection of the environment, the community way of life and the geothermal resource will be developed. Under consideration of the environment, potential environmental problems and recommended approaches to solutions will be defined.

Status- During this quarter, the identification and evaluation of administrative vehicle options has been the principal effort. Legal counsel experienced in municipal development, including utility systems, has been retained. Through input from the consulting counsel, the City Attorney, the Executive Director of LAFCo, and data collected from Utilization Panel members, eight candidate vehicle concepts have been selected and preliminarily screened. The candidate administrative vehicles are:

- ° City Power Department
- ° City and Private Entity Agreement
- ° Private Utility
- ° Joint Powers Agency
- ° Economic Development Corporation (E.D.C.)
- ° E.D.C. - Private Entity Joint Venture

- ° Municipal Utility, Public Utility, or Irrigation District
- ° Community Development Commission

It is expected that the preliminary evaluation will be completed early in the next quarter. Screening to date will eliminate about half of the candidates. Through discussion with the Utilization Panel members and evaluation of other communities successful in economic development, it is apparent that a fundamental criteria must be met in order to cause and control local economic development through the development and use of an energy source. It may be stated as follows:

In order to cause and control local economic development through use of a local energy source the governing body must control the energy rate structure and/or be able to cause the flow of revenue from the sale of the energy back into the general fund to be used in local economic development.

Without such control, significant economic development will not be under local government control. In addition to the characterization of administrative vehicles a means of limited control of local energy resources was developed. A special agreement was structured and negotiated between the City and all of the private industry contractors and participants in the SGEP. This agreement commits the geothermal resources in the area of the project for the economic development of the community. The key elements of this agreement are fundamental to other projects wherein local government entities develop energy resources for local benefit and wherein this development occurs in conjunction with industry and especially wherein public funds are used for resource definition.

Environmental considerations are reported in appropriate tasks.

Key Results & Conclusions

1. Local economic development through low-cost, local energy sources requires local control of rates and/or revenue from the sale of the energy.
2. Steps must be taken to protect and commit local geothermal resources for local economic development. The normal routine of commitment of geothermal resources for export to the grid for consumption in distant areas precludes their use for local economic development.
3. HR 6669 establishes the authorization and hence charter in a qualified agency for the resource assessment for local communities.

Problems and Recommended Solutions

1. The agreement between the City and participating industrial entities documents the protection of the resources only between members of the team that is already committed to local economic development. It does not protect the resources for local use from entities outside of the Project. There is no immediately apparent solution to this problem. It is recommended that a means be established, through Federal legislation if necessary, to protect resource assessment data as proprietary to the Project, irrespective of whether public or private funds are used for this effort.
2. Funding is not yet available to implement HR 6669. This is not serious at this time except for the prototype Susanville Project. Until the economics are established through the SGEP and related prototype projects, communities are not in a position to commit their share of their public funds for such unproven projects.

Future Activities

1. The administrative vehicle characterization and selection will be completed and at least provisionally selected for Susanville.
2. During the second half, local legislation for protection of the resource will be developed.
3. As system and resource efforts progress, environmental considerations will be developed.

3.0 UTILIZATION PLAN

Task Manager: Alfred B. Longyear, CSL

Scope - The Utilization Plan will be implemented to assure timely transfer of the technical and institutional findings of the Project to other interested communities and to assure that the scope of the parameters used in the prototype Susanville Model are broad enough to be of use to other similar communities. If system optimization can be made to reflect applicability to a large number of communities, the engineering and development costs can be spread over a broader market for the hardware.

A Utilization Panel shall be formed with representatives outside of Lassen County, California. This Panel will exchange data on community and resource characteristics with the Project. A newsletter shall be prepared for distribution to interested local governments after each quarterly meeting.

Evaluation and planning will be conducted to determine the value of establishing a geothermal laboratory for use by industry to evaluate the economics of use of geothermal energy.

A Workshop shall be held at the end of the 12 month study. All task managers shall present papers covering their scope of effort. The Proceedings, containing these papers shall be published in lieu of a final technical report. The Utilization Panel will be convened to describe and discuss their participation in the Project. After the Workshop, a Summary Report covering conclusions drawn from the Workshop and final administrative information shall be published.

Status - Criteria for characterization of communities and their geothermal resources was prepared and mailed to the Utilization Panel member communities. Subsequently, a tour was made of all of the

communities:

Fillmore, Utah

Boise, Idaho

Union County, (La Grande), Oregon

Skamania County (Stevenson), Washington

Carson River Basin COG, Nevada

Fallon, Nevada

Yerington, Nevada

Carson City, Nevada

Lakeport, California

Since that time characterizations have been received from Fillmore, Union County and Skamania County. Pending receipt of additional responses the original survey material and material collected on the tour will have to be used for structuring of the systems and modeling. The communities range in size from less than a thousand population in the municipal area to over 250,000 population in the economic area. Based on surficial and published resource data the estimated energy resources range from less than 200°F. to exploration wells producing 250,000 lbs./hr. of 450°F. wet steam. All have economic development activities ranging from the planning and organizational stage up through multiple industrial parks. It was noted that each community had one or more key municipal officials at least committed if not actively pursuing economic and community development activities.

Discussions have been held with Lassen Community College and California State University at Chico regarding the Institutional Park Laboratory. The concept of a regional laboratory with field installations located throughout the Lahontan Basin is scheduled for discussion between Lassen, Chico and the University of Nevada, Reno. The workshop has

been tentatively scheduled for July 14-16, 1976 in Susanville. A concurrent symposium is being scheduled by Lassen College.

Key Results and Conclusions

1. The selected member communities represent a good spectrum in characteristics.
2. All of the communities have a positive position and need for economic development.
3. All of the communities have at least reasonable thermal resources in their county and some may have the potential of electric generation.

Problems and Recommended Solutions - Limited, over-committed staffing in some of the communities has delayed the preparation of the Community Characterization. Pending the receipt of the balance of data, information collected previously will have to be use for the Systems and Modeling tasks.

Future Activities

1. Data collection from the remaining Utilization Panel members will continue.
2. A composite characterization will be established to designate ranges in appropriate parameters in Systems and Modeling.
3. Definition and justifications for a geothermal laboratory will be evaluated.
4. Planning for the Workshop will be initiated.

4.0 PROGRAM PLAN

Task Manager: Alfred B. Longyear, CSL

Scope - Planning will be conducted so that, through the application of appropriate resources, the tasks of the Project and their inter-related efforts will be accomplished according to the SGEP Work Plan. Through coordination with the BuRec Appraisal Study, planning shall be conducted to assure timely exchange of data between the two projects. Planning for the development/demonstration phase will be conducted based upon a candidate geothermal energy utility system selected from the Research Plan. This planning will include a definition of the system, a work plan including program schedule and a funding plan. The funding plan shall include definition of funding sources evaluated and selected. Both private and public funds sources shall be evaluated.

Status - The Work Plan schedule has been brought up to date. Quarterly reviews and the end of the effort remain fixed. The previously unscheduled Workshop has recently been tentatively scheduled for July 14-16, 1976. It will be held on the Lassen College campus in conjunction with a related program being scheduled by the College. The Requirements effort is essentially completed with only some wrap up of the past work and the provision of updating to incorporate new data. The characterization of Utilization Panel member communities must be completed during the next quarter in order to make use of their data. Significant planning effort has been directed at defining the completion of Resource Exploration in the SGEP area. The results of the excellent BuRec effort plus the planning was the basis for the Federal legislation (HR 6669) which authorizes completion of the exploration as described under 1.2 Resource.

In order to focus the balance of effort a total system concept and

demonstration unit has been developed. This concept is preliminary and should be considered only for focusing the effort. It is most probable that the concept will evolve or change as the Systems, Modeling and Institutional tasks progress. The socio-economic-environmental-institutional factors considered in structuring the concept are fundamental to the success of the SGEP. They reflect the site-specific situation in Susanville. However, the rational and fundamental issues should be applicable to and be considered by other communities contemplating similar projects.

The "Susanville Geothermal Utility System and Demonstration Modules Preliminary Concept" is described in the Appendix.

The future Posture of the SGEP and its interface with supporting economic development activities has been prepared and is presented in summary in the Appendix.

Key Results and Conclusions

1. Through certain tasks have had to be extended in schedule, the overall contracted effort can meet the Workshop scheduled milepost.
2. Assuming the resource is as currently estimated, based on limited data, it is believed that at least the thermal energy will be an economically viable asset to local economic development.

Problems and Recommended Solutions

Delays in acquisition of energy specific data have in turn delayed the development of numerically-backed conclusions on direction of the Systems and Modeling tasks. These delays have, in turn, delayed the more specific definition of candidate systems and hence have limited the depth of definition of the Posture. In order to focus the balance of effort a candidate conceptual system has been developed based upon the data currently available for Resource and

7/7/75

SUSANVILLE GEOTHERMAL ENERGY PROJECT WORK PLAN

Revised 1/8/76

Requirements and structured in accordance with socio-economic-environmental-institutional factors pertinent to Susanville.

Future Activities

1. The BuRec planning for completion of resource exploration will continue to be supported.
2. Definition of the candidate systems and alternatives will be continued. Program planning for the development and demonstration phase will be conducted.
3. In cooperation with Lassen College, Chico University and other educational institutions, planning for the laboratory will be conducted.
4. In cooperation with Lassen College the Workshop will be planned during the next quarter for discussion at the third Quarterly Review.

APPENDIX

- Susanville Geothermal Utility System Concept
- Susanville Geothermal Energy Project Posture

SUSANVILLE GEOTHERMAL UTILITY SYSTEM CONCEPT

Introduction

This preliminary concept description has been prepared as an aid to focus the system design parametric studies, to evaluate and define the scope and range of modeling, and to focus the resource exploration activities. In selecting the concept, a range of alternative concepts have been evaluated and reviewed by the City's project staff, Project technical personnel and the Community Development Committee of the City Council. Concepts evaluated included:

1. A thermal utility system for delivering thermal energy to agricultural/industrial consumers in an industrial park in the industrial area of the City of Susanville with an option for additional utilization through residential and commercial space heating.
2. A thermal utility system to supply thermal energy for space heating in residential and commercial buildings.
3. A geothermal electric conversion plant in or near the City of Susanville.
4. A thermal and electrical conversion composite system in the Honey Lake Valley.
5. Individual well-head electric conversion power supply units of hundreds of KW to less than 10 MW capacity for individual ranch or industry installations.
6. A thermal subsystem near the City (Concept No. 1) connected to a thermal and electric subsystem in the Valley (Concept No. 4).

The No. 6 Concept has been selected as having the greatest opportunity to produce the most measurable economic impact with the minimum cost and to

have the greatest degree of environmental and social acceptance.

Summary

The Susanville Geothermal Utility System is projected to be comprised of subsystem modules located in or near Susanville, Litchfield, Wendel, Amedee and the Honey Lake Valley east of Bald Mountain. These subsystem modules will be interconnected with a transmission and distribution network for the delivery of thermal and electric energy to agricultural, industrial, commercial, institutional and residential consumers. Surplus electric power will be transmitted to customers out of the area through connections with the existing transmission grid in the region. Through the administrative vehicle that will control the development, construction and operation of the system, rates will be structured to cause competitive industrial expansion in the Susanville-Honey Lake Valley area and to generate revenue to be used for the economic development of the community.

The Susanville Geothermal Utility System Demonstration Unit will be located at the Susanville-Honey Lake Site. The Demonstration Unit will be composed of the following system elements:

- ° A thermal energy module and electric distribution system located at the southern edge of the City of Susanville.
- ° A combination thermal and electric generating module located east of Bald Mountain in Honey Lake Valley.
- ° A transmission and distribution system that interties the two modules and distributes thermal and electric energy to consumers located between and around the two modules. This system would be designed to permit intertieing with other modules as they are developed for the full operational system.

Discussion

The geology and geophysics of the area indicate that it is improbable that the hydrothermal resources in the immediate vicinity of the City of Susanville will exceed 150°C (300°F) in temperature. Further, the blowing down of steam wells in the immediate vicinity of the City would probably be unacceptable for social and ecological reasons.

However, significant economic development in the area points to the need for additional sources of more economic electric power. Further, results of the Requirements Definition effort point to the agriculture, agricultural process and food process industries as the most pertinent for economic development through use of hydrothermal energy. These industries require large amounts of heat and cooling/freezing energy as well as competitively priced electric energy for shaft and lighting power. This spectrum of useful energy requires abundant quantities of $\geq 300^{\circ}\text{F}$ water as well as an abundant quantity of heat sink for efficient electric power generation. Energy consumption in the economic area is spread from Susanville on the west to Herlong on the east. Principal growth trends occur along Highways 36 and 395 between Susanville, Johnsonville and Janesville. Principal agricultural development occurs in Susanville-Johnsonville-Standis area. Three-quarters of the trade in the County of Lassen occurs in Susanville. Westwood (west of Susanville), Susanville and Herlong make up over 90% of the population of the County.

Future economic growth will most likely occur principally in agriculture, agricultural processes, food processes and wood products. Some of these processes are not best located near centers of population. Such industries as controlled environment animal agriculture, meat packing, fertilizer processing and certain food processing are best located in more remote, less population-dense areas. Certain of these industries that can

interrelate should be located in close proximity to each other. Such interrelation occurs when a by-product of one industry can become a feed stock for another.

The geological and geophysical effort to date in the economic area tends to indicate that the best potential sources for energy conversion to electricity, chilling/refrigeration and for higher energy heat are most probably located in the eastern end of the Susanville-Honey Lake Site. This location includes the Wendel-Amedee KGRA.

Energy conversion on an economic scale will probably be in the range of 40 MW or more for binary cycle conversion of 300°F water. With a county peak demand under 30 MW, an initial module of 40 MW is a reasonable size for the area. However, the residual thermal energy available for cascading from a 40 MW plant most probably exceeds the needs of consumers in immediately surrounding agro-industrial parks. Hence economic transmission to additional consumption centers should be considered in order to minimize the cost of electric conversion.

All of the above factors have been considered in structuring the concept for the Susanville Geothermal Utility System and for structuring the most economic demonstration system. It must be recognized that the purpose of this latter system is to demonstrate how a hydrothermal resource can be used to cause a measurable economic impact. It is the application of technology to cause economic growth rather than the advancement of energy technology per se. The new technology being developed on this Project is energy economics.

POSTURE OF THE SUSANVILLE GEOTHERMAL ENERGY PROJECT AND ITS INTERFACE
WITH THE OPERATIONAL SUSANVILLE GEOTHERMAL UTILITY SYSTEMS.

Introduction - In accordance with contractual requirements, the Posture of the SGEP is to be structured and discussed at the Mid-Point Review. The Posture is structured, based upon data in-hand at this time, in order to be available for use in ERDA and other Federal and State Agency budget and program planning efforts.

Assumptions and Criteria - In accordance with contractual guidelines, the ERDA-funded development of an economic model of a community utilizing geothermal energy to build an economic base assumes that there is a geothermal resource, that it is adequate in quality and quantity to be used in a utility system for economic development. Further this effort also assumes that needed technology will be in-hand for the development and use of the utility system. However, in order to assure the development of a useful, proven model that will be accepted by local government entities, realness in terms of site-specific data must be used in the development and testing of the model.

Based upon existing usage of previously established wells in Susanville, the BuRec data covering the Valley, the Gulf Minerals Co. wells and data and prior geologic work by industry, it is assumed that thermal energy of less than 300° F. temperature will be available in the Susanville anomaly and that at least thermal energy of over 200° F. will be available from at least four other anomalies in the SGEP area and that energy in excess of 300° F. temperature with adequate flow rates for electric generation will be available from at least one anomaly in the Valley.

A fundamental criteria must be accepted and used to guide the Project effort in order to "use geothermal energy to build an economic base". This

fundamental criteria is that the local elected governing body must either directly or indirectly control the energy system rate structure and/or cause flow of a significant portion of the revenues (from energy sales) into the general fund of the governing body. These revenues must then be dedicated to cause economic and community development.

Therefore, it is assumed that the City government will elect to establish a municipal power department, and will enter into agreement with industry to at least distribute power to the local inhabitants and will enter into agreements with public and/or private entities for the acquisition, control and conversion, and transmission of thermal and electric energy to industrial, commercial, institutional and residential consumers in the SGEP area. It is assumed that surplus electric power, if available, will be transmitted to consumers outside the area through existing transmission networks.

Overall Concept - The Susanville Geothermal Utility System and the Demonstration Unit, in candidate conceptual form, is described in an accompanying document. In essence, the total system is composed of a thermal energy module in the Susanville anomaly. A (probable) thermal energy module and a (possible) thermal-electric module in the mid-Valley area and one or more thermal-electric modules in the Wendel-Amedee KGRA. All of the modules are intertied for the transmission of thermal and electric energy to all module sites. Distribution networks then distribute thermal and electric energy to agricultural and industrial facilities throughout Susanville and the Honey Lake Valley, and the communities therein. Agro-industrial parks are adjacent to each thermal module (including those that distribute thermal energy to and from an electric conversion facility). The Demonstration Unit is a "dog bone" shaped installation of a thermal module in Susanville and a thermal-electric module in the eastern part

of the SGEP. These modules are intertied in order to make maximum use of the thermal energy cascading from the electric facility and hence assure minimum electric power costs. The initial industrial utilization will occur in the Susanville Industrial Park being planned for an initial 20 acres with a growth potential of 115 acres and with an ultimate potential of several hundred acres in a currently industrial zoned area. This park is contiguous with a private industrial park currently under development. Current industry in and immediately around this area include two saw mills, a moulding plant, a greenhouse operation, heavy equipment construction company, a paving company and a finishing mill. An industrial park laboratory will be developed either either adjacent to or within the industrial park. Primary use of this facility will be to permit industry to test and evaluate the economics of the use of geothermal energy for their products and processes and to furnish supporting technical assistance for the development of full scale facilities and processes in the industrial park. Additional field test facilities will be located throughout the valley and the Lahontan Basin.

Program Concept

The resource exploration program, per HR 6669 and as described in section 1.2 Resource, SGEP Quarterly Report SAN-1077-2, dated January 8, 1976, can be initiated in the spring of 1976. By the fall of 1976, (7 months), geoscientific effort and two 1,500-foot tested wells will be completed in the Susanville anomaly. Testing of the wells will produce data required for the design of the thermal module in or near the industrial park. Preliminary design, environmental and siting effort can be initiated as early as summer 1976. Geoscientific and drilling efforts (per HR 6669) will continue out in the valley in parallel with the work on the Susanville anomaly. This effort will culminate with the testing of a 5,000-foot exploration well in a site selected for a thermal-electric module. Design

data for that module will be generated from the testing by fall of 1977. Construction of the Susanville anomaly thermal module and the thermal unit of the thermal-electric module can commence after design. The electric conversion facility will probably require application of recent technology and hence may be somewhat developmental in nature. Hence, it is premature to even conceptually define program plans until the degree of developmental effort is further defined.

Project Funding - In basic concept, it is planned that funding will occur from both public and private sources. Preliminary informal discussions and responsible comment indicate a strong interest for private participation. Therefore, in principle, the prototypic and other high risk aspects of the program should be public (Federal, State, and Local) funded and the more conventional aspects of the project should be private funded. More detailed breakdown, at least by major elements of effort, will be defined during the next two quarters. A definitive program plan including funding and funding sources will be presented at the Workshop.