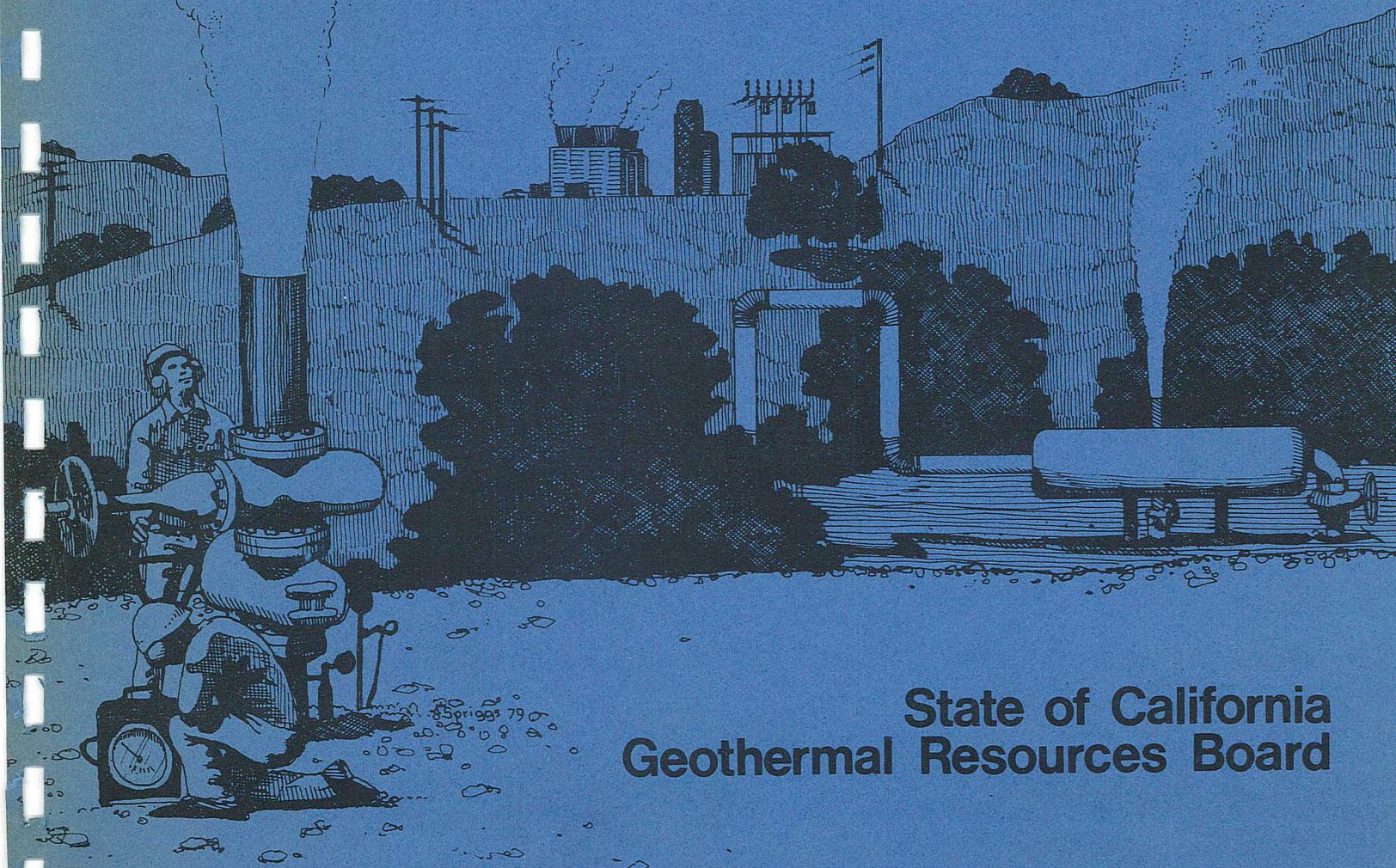


SIGNIFICANT PROBLEMS IN GEOTHERMAL DEVELOPMENT IN CALIFORNIA

FINAL REPORT ON FOUR WORKSHOPS
DECEMBER 1978 – MARCH 1979



State of California
Geothermal Resources Board

STATE OF CALIFORNIA
GEOHERMAL RESOURCES BOARD

Significant Problems in Geothermal Development in California

FINAL REPORT ON FOUR WORKSHOPS
DECEMBER 1978 - MARCH 1979

COUNTY PLANNING FOR GEOTHERMAL DEVELOPMENT
(DECEMBER 7 and 8, 1978)

FEDERAL LEASING AND ENVIRONMENTAL REVIEW PROCEDURES
(JANUARY 18 AND 19, 1979)

TRANSMISSION OF GEOTHERMAL GENERATED ELECTRICITY FROM REMOTE AREAS
(FEBRUARY 15 AND 16, 1979)

THE POTENTIALS FOR DIRECT GEOTHERMAL HEAT
UTILIZATION IN CALIFORNIA
(MARCH 8 AND 9, 1979)

SPONSORED BY THE CALIFORNIA
DEPARTMENT OF CONSERVATION
THROUGH A GRANT FROM THE
U.S. DEPARTMENT OF ENERGY

JULY 15, 1979

GEOTHERMAL RESOURCES BOARD 1416 Ninth Street, 13th Floor, Sacramento 95814 (916) 322-1080



July 15, 1979

A. C. Wilbur
Geothermal Energy Division
Department of Energy
133 Broadway
Oakland, California 94612

Dear Mr. Wilbur:

Pursuant to contract # ET-78-G-03-2099 with the United States Department of Energy, and as Principal Investigator for the grant, I am submitting 10 copies of the report on workshops concerning significant geothermal related problems in California.

The report identifies and recommends state actions that will expedite in selected areas the development of geothermal resources in this state. The Technical Advisory Committee and the Geothermal Resources Board will consider very seriously the recommendations in the report and take appropriate action.

Thank you for your assistance in making funds available for these workshops and the summary report.

Sincerely,

A handwritten signature in cursive script that reads "Priscilla C. Grew".

Priscilla C. Grew, Chairperson
Geothermal Resources Board
and
Director
Department of Conservation

cc: Division of Geothermal Energy
Department of Energy
20 Massachusetts Avenue
NW Washington, D.C. 20545
Attention: Donald Elmer

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INTRODUCTION

From November 1978 through March 1979 the California Geothermal Resources Board held four workshops on the following aspects of geothermal development in California: County Planning for Geothermal Development; Federal Leasing and Environmental Review Procedures; Transmission Corridor Planning; and Direct Heat Utilization. These four workshops followed the work of the Geothermal Resources Task Force by one year. The Geothermal Resources Task Force was created by the Legislature in 1976 to study geothermal development in California and to prepare a report on its findings for transmittal to the Governor and the Legislature. Their work was completed in December of 1977.

Some of the issues raised in the workshops are similar to the findings and recommendations of the Task Force and reemphasize the need for implementation. Other issues raised in the workshops will add to the recommendations of the Task Force.

One of the objectives of the workshops was to increase the number of people aware of geothermal resources and their uses. The workshops succeeded in meeting this objective. For example, of the total number of counties in California possessing geothermal resources, approximately two-thirds attended the *County Planning for Geothermal Development* workshop. The last workshop, *Potentials for Direct Heat Utilization in California*, also succeeded in introducing many new businesspersons to the uses of low temperature geothermal resources. Much of the benefit of these workshops is realized by the exposure of more people to the uses of geothermal resources as well as receiving the perspective of many local governments about their needs and

concerns with geothermal development.

Finally, a number of the issues raised in the workshops cannot be easily and quickly implemented; yet their eventual implementation will be critical to the development of California's geothermal resources. Some of these issues are not unique to geothermal development but relate to broad concerns such as the need to maximize energy development and environmental protection, and the need for interagency coordination for the review and approval of energy related projects.

This report is divided into two parts. Part I provides summaries of all the key information discussed in the workshops. For those people who were not able to attend, this part of the report will provide you with a capsule version of the workshop sessions.

Part II focuses on the key issues raised at the workshops which need to be acted upon to expedite geothermal resource development that is acceptable to local government and environmentally prudent. For the purpose of continuity, similar Geothermal Resources Task Force recommendations are identified. Those people who did attend the workshops, may wish to turn directly to Part II.

The report will be submitted to the Geothermal Resources Board (GRB) for their action on the issues and recommendations identified in Part II. If you wish to be notified of the action being taken by the GRB on any of these issues, please write to Dr. Priscilla C. Grew, Chairperson, GRB, Room 1320, 1416 Ninth Street, Sacramento, California 95814.

SUMMARY OF KEY RECOMMENDATIONS

Recommendations:

1. The State should provide a travelling team of assistants or contract consultants to help counties in the preparation of geothermal elements, and other related activities.

Related 1977 Geothermal Task Force Recommendation

Local jurisdictions should adopt zoning ordinances designating areas for geothermal development; funds for this effort should be provided by the state in areas of highest probability.

2. a. Specific terms used in the geothermal industry (e.g. "exploration", "proven resource", "unknown resource") should be defined by law.
- b. Better coordination at the state level which leads to expedited geothermal development should be implemented.

Related 1977 Geothermal Task Force Recommendation

The GRB should coordinate permit actions for geothermal projects.

3. The GRB should identify and implement specific actions needed to expedite federal geothermal land use decisions (e.g., resolution of the issue of local permit authority on federal lands relating to the environment, and resolution of the question of need for both U.S. Geological Survey (USGS) and U.S. Forest Service (USFS) involvement in the geothermal pre-lease stages).

Related 1977 Geothermal Task Force Recommendation

Government environmental documents should be prepared jointly.

4. One agency should take the lead role to coordinate the following activities of federal, state, and local agencies having jurisdiction over a geothermal project:
 - a. Environmental review.
 - b. Consolidated hearings.
 - c. Development of a single set of criteria for regulatory agency requirements.

Lead agency determination should be made on an individual project basis.

5. The GRB should initiate action to provide on a statewide basis a comprehensive transmission corridor plan.

Related 1977 Geothermal Task Force Recommendation

The Public Utilities Commission (PUC) should sponsor legislation giving common-carrier status to electric transmission facilities.

7. The GRB should:
 - a. In conjunction with local government, explore the concept of linking the development of low temperature geothermal resources with the development of industrial parks.
 - b. Explore the possibility of geothermal district heating legislation for California. Analyze the Oregon, New Mexico, and Utah experiences.

- c. Examine the taxing structure for low temperature geothermal wells and consider changes which would make development of this resource more attractive.
- d. Look into the concept of flexible lease size for direct heat projects.
- e. Consider supporting a redefinition of geothermal resources to exclude fluids susceptible to direct use.

Related 1977 Geothermal Task Force Recommendation

1. Establish a statewide policy to encourage the use of non-electric hot water geothermal resources for commercial and noncommercial uses where the development is consistent with environmental quality concerns.
2. Ask the Division of Oil and Gas to sponsor legislation to eliminate bonding requirements for the "life of the well" for low temperature geothermal wells which are not a threat to health, safety, or the environment.

PART I

WORKSHOP SUMMARIES

PREFACE TO PART I

Part I includes highlights of the major presentations from each workshop. For various reasons some of the presentations will be given in more detail here, than others. The appendices contain lists of some of the more lengthy material available at the workshops, as well as workshop agendas and lists of attendees.

To obtain more detailed information on the workshops than is presented here, tape recordings of most of the workshop sessions are available for your use by contacting the Department of Conservation. Those workshop sessions which were recommendation oriented will be reflected in Part II rather than Part I.

SECTION 1

WORKSHOP #1 - COUNTY PLANNING FOR GEOTHERMAL DEVELOPMENT

State Agencies Involvement in Geothermal Development

The Geothermal Resources Board Technical Advisory Committee (TAC) was established as an interagency forum at the state level for discussion of geothermal issues. All state agencies with involvement in geothermal development and resource protection are represented in this group. At the workshop, six of these agencies described their role with geothermal. (Appendix 1 contains a listing of all the member agencies of the TAC, contact persons and phone numbers.)

Geothermal Legislation

The Resources, Land Use, and Energy Committee of the State Assembly is responsible for review of policy issues related to geothermal. John White, a senior staff person for the committee, described the Legislature's interest in geothermal.

In 1976 Assemblyman Lawrence Kapiloff authored legislation creating the Geothermal Resources Task Force within the Resources Agency. The Task Force was instructed to identify those steps which need to be taken in state and local government to accelerate geothermal development. The later action by the Legislature to sustain the Energy Commission decision to not approve construction of the Sun Desert Nuclear power plant proposal added great significance to the work of the Task Force.

Assemblymen Kapiloff and Goggin authored Assembly Bills 2644 (Goggin)

and 3707 (Kapiloff), which became law in 1979. The principal objective of these two new laws is to bring geothermal development along as quickly as possible with minimum disruption to the environment. The authors believed that geothermal energy needs to be treated differently in the regulatory process from other energy sources. Meaningful involvement by local government in the permitting process must be achieved while reducing, wherever possible, bureaucracy and red tape for the geothermal industry.

The current Legislature will closely monitor the interface between state and local government in the implementation of these new laws. If the desired results are not being achieved there may be further modifications of the legislation.

The Legislature may consider additional incentives for geothermal development in its effort to avoid the typical crisis to crisis approach that has characterized energy policy development in the past. The members believe it is important to involve local government early in energy decision making.

The lengthy discussions on the implementation of AB 2644 by the California Division of Oil and Gas (CDOG) will not be repeated here because their proposed process for carrying out AB 2644 has been modified since the time of the workshop. Refer to Appendix 1 for a graphical explanation of the process the CDOG is now using to meet AB 2644 requirements. The California Energy Commission's (CEC) regulations pertaining to geothermal power plant siting, and its procedures for certification of local governments as lead agencies for geothermal power plant siting are currently pending before the Commission for adoption. Inquiries should be made to the Commission for further developments.

Advance Planning for Geothermal

Development - Local Government Experience

The main points made by these speakers* were that:

- (1) Advance planning for geothermal is to the county's advantage, particularly in order to protect environmentally sensitive areas.
- (2) A county may wish to develop policies for all of their potential energy sources including wind, solar, biomass, and geothermal.
- (3) Harnessing geothermal energy can be a way to stimulate economic development for a county.
- (4) The issues involved in planning for geothermal development are as varied as the resource and natural surroundings.
- (5) Communication and cooperation among the resident population, county government, and developers is essential in reducing conflict.
- (6) Because of Proposition 13 constraints, counties need outside sources of funding to do geothermal planning.

County Geothermal Elements

Workshop participants discussed with staff from the Office of Planning and Research (OPR) various planning approaches for dealing with geothermal development.

*Dr. Martz, Napa County Board of Supervisors; Jim Chapman, Lassen County Board of Supervisors; Don Johnson, former Lake County Planning Director; Mary Jadiker, Lake County Planning Commission; Leonard Fabian, Imperial County Planning Department; Rollin Russell, McCulloch Geothermal.

Sources of information for a data base for a county geothermal element were identified. Some of them are: Bureau of Land Management's (BLM) prelease Environmental Assessment Reports; Science Applications Inc.'s (SAI) Direct Use Overview of Geothermal Resources and Utilization, which is available through the Department of Energy (DOE) and the California Energy Commission (CEC); Lawrence Livermore Laboratory's documents on geothermal development in The Geysers, Coso, Mono-Long Valley, and the Imperial Valley; VTN and Systems Development Corporation reports which identify the current status of geothermal resources, and exploration and development plans of the geothermal industry (call Jack DeAngelo at VTN for more information (714) 833-2450).

For those counties not sure of how to proceed with geothermal development, participants suggested that OPR develop a checklist of the issues which could be involved in developing a geothermal resource. An energy element to the general plan rather than a geothermal element was suggested. Other planning tools which can be used to guide geothermal development are: performance standards, overlay zones, inclusionary and exclusionary zoning. Other individuals viewed geothermal development as an industrial land use and a site planning problem for which a specific area plan could be developed. Imperial County's planning approach for geothermal has been to place an overlay zone on the area industry requests as the ultimate development boundary; then require conditional use permits for the production plans. Since 1971 industry has been allowed to explore for geothermal resources in any zone by conditional use permit. However, this permit does not automatically allow industry to develop the resource.

OPR volunteered to assist any county by conducting a workshop involving elected officials or planning commissioners on geothermal policy development.

SECTION 2

WORKSHOP #2 - FEDERAL LEASING AND ENVIRONMENTAL REVIEW PROCEDURES

State/Federal Leasing Processes

State Lands Commission

Don Hoagland, representing the State Lands Commission, discussed the effects of SB 1027 (Roberti - 1978) on geothermal development and state lands. In essence SB 1027 gives the Commission an active role in promoting geothermal development on state lands. Specifically:

- (1) SB 1027 eliminates the State's KGRA (Known Geothermal Resources Area) concept. The State Lands Commission now can lease any state lands without regard to KGRA designations.
- (2) SB 1027 allows surface exploration and temperature hole drilling without the expense of large-scale environmental impact reporting through a nonexclusive exploration permit.
- (3) Under certain circumstances SB 1027 provides for a negotiated lease.
- (4) SB 1027 provides for low temperature geothermal development.

Bureau of Land Management

John Moon, representing the Bureau of Land Management, focused on the two new federal actions which encourage closer cooperation between the federal government and local government. These actions are contained in new Council on Environmental Quality (CEQ) guidelines, and Executive Order 12088. The CEQ guidelines stress cooperative planning and are designed to structure and facilitate interagency planning such as common planning, shared hearings, and joint environmental statements. Important issues in environ-

mental statements are to be identified and then addressed through an initial "scoping" effort. Executive Order 12088 requires federal compliance with applicable pollution control standards. In addition, the Order requires federal agencies to coordinate with the Environmental Protection Agency (EPA), state, interstate, and local agencies on the prevention, control, and abatement of environmental pollution.

U.S. Geological Survey

Both the U.S. Geological Survey and the Bureau of Land Management have major roles in the Department of Interior's geothermal leasing program. BLM is responsible for issuing mineral leases and licenses and is the office of record in leasing matters. The Geological Survey is responsible for all geologic, engineering, economic value determinations, and supervision of lessee operations. (Refer to Appendix 2 for detailed information on the role of the USGS in geothermal development.)

U.S. Forest Service

Bob Rice, Forest Supervisor of Inyo National Forest, described how geothermal resources were incorporated into the planning for various land uses in the Mammoth-Mono Planning Unit of Inyo National Forest. His comments were as follows:

"I present a different viewpoint to this panel, that of a National Forest administrator with a rather prominent hydrothermal system called Mono-Long Valley KGRA.

"Interest in developing the resource rises and falls almost as abruptly as the Eastern Sierra Escarpment adjacent to it, as do the opinions of those that have examined this resource.

"I was on the Inyo National Forest in 1957 - 58 when the Casa Diablo springs and surrounding area was first seriously

explored and tested for hydrothermal. I returned 19 years later to a grandfathered area and renewed interest (based on the 1972 - 73 exploration) and controversy on whether or not development should be pursued. Some said the eastern half of the caldera was the most attractive. As recently as last fall this has been reversed and it is now believed that the western 60% has the major potential.

"The Inyo National Forest ranks in the top five nationally in recreation visitor-days use. It is among the top forests in California in fish and wildlife productivity. From its slopes comes a large percent of the water supply for the City of Los Angeles. It has the largest Jeffrey pine forest in the world. It ranks second of all national forests in California in forage production and livestock use and contains a multitude of archaeological sites.

"The caldera, as described in a 1978 Geological Survey publication, could not have been more perfectly placed to be controversial. It lies squarely beneath the land where all these resources come together. Taking a clue from the 1970 Steam Act, the Forest Service began, in 1974, an environment assessment procedure to lease some 30 million acres of National Forest land for the purpose of harnessing natural heat energy and the generation of electric power. Admittedly, the financial support of this endeavor was weak as was the information base of the many environmental factors present. When one visualizes the many impacts of the Santa Rosa development and mentally transposes it to Mono-Long Valley area, questions pop up faster than they can be answered.

"Underfinanced and understaffed, and with a shaky data base, I halted the process in 1976 and readdressed it. The net result was two choices:

1. We could do an environmental statement for every major resource impact in the Mammoth/Mono area: winter sports, timber planning, geothermal development.
2. We could examine issues and evolve a land and resource management plan through environmental statement procedures.

"The latter offered us a favorable cost/benefit; gave us a chance to allocate land to resources; to analyze conflicts between resources and to entertain public involvement. That's how I went, being responsive to both the Geothermal Steam Act and NEPA.

"The management alternative we chose out of the six developed, allocates suitable lands for geothermal development

commensurate with maintaining other resource values, and identifies the extent of the geothermal resource within the KGRA commensurate with maintaining other resource values.

"In the total assessment area, we will continue to allow under special use permits: (1) airborne surveys; (2) topographic and geological mapping; (3) geophysical and geochemical investigations; and, (4) seismic and temperature measurements made by the use of shallow drill holes (depths of about 500 feet).

"The area approximating the grandfathered area will be subject to lease under the Geothermal Steam Act of 1970, within the constraints of certain protective laws identified in the land management plan. This is the area that studies to date indicate have the most promising potential. We are, however, still proceeding with caution because of the sensitivity of the area and conflicting resource demands. We will stipulate 'staged leasing' or 'conditional development leasing' which will allow for separation of exploration and development. We've received correspondence between Agriculture and Interior on this possibility and feel it offers the best of two worlds.

"Following the release of the Mammoth-Mono Plan Final Environmental Statement and the 30-day waiting period by law (February 1979) competitive leasing procedures of the Geothermal Steam Act will be followed. Essentially that means we will be coordinating with BLM and USGS to lease and administer the exploratory operations in accordance with the lease stipulations we have identified in the Environmental Analysis. At this time, we envision block leasing of 2,560 acres each, over the area not withdrawn because of the presence of sensitive environmental factors."

Interagency Efforts to Expedite Environmental
Review and Leasing for Geothermal

NCPA/Shell Project at The Geysers (Sonoma, Lake, Mendocino, and Napa Counties)

Matt Brady, CEC

Joel Verner, BLM, Ukiah

The NCPA/Shell Project at The Geysers is an excellent example of state and federal interagency cooperation as mandated by the new CEQ guidelines. Previously, each agency involved, USGS, BLM, CEC, and DOE would have done separate environmental statements. Now, they are working together under a memorandum of understanding (MOU) to prepare one document. Each agency is responsible for completing specific segments of the document. CEC has assumed lead agency status on this project. Major results of this approach are: (1) eliminating duplication of effort and cost; and (2) streamlining the process. Under an MOU approach, the environmental document will take one year to prepare. The minimum time for BLM to prepare a separate environmental statement is about 18 months.

Coso (Inyo County)

Syd Willard, CEC

Tom Dodson, US Navy

Coso is an example of both formal and informal cooperation between the various governmental entities involved. The area involved lies primarily on Navy land; the Navy and BLM have different responsibilities in the environmental statement and leasing process. The two federal agencies have worked out a formal MOU, determining non-duplicating responsibilities.

While the State does not have specific jurisdiction over the land, several state agencies have varying concerns about geothermal development in the area. In order to provide state input in an expedient and organized manner, the Coso Geothermal Advisory Committee was formed at the request of the Governor. This committee is an informal body with membership consisting of concerned state agency representatives. Its function consists of providing a forum for early issue identification and follow-up cooperation in dealing with specified problems. One unique sign of the committee's success has been to mount a Washington lobbying effort on behalf of BLM to obtain the necessary funds for completing the environmental statement.

East Mesa (Imperial County)

Dick Mitchell, Imperial County

Roger Haskins, BLM, Riverside

Only one of the Imperial County's four viable KGRA's is on federal land. Development of the resource to date has relied upon close coordination and cooperation between Imperial County and BLM. Impetus for the County's participation has come from a desire to see geothermal development on federal land while at the same time assuming protection of the area's valuable agricultural base. The former has been accomplished by authorizing experimental geothermal plants on federal land without requiring rezoning or the issuance of conditional use permits. The latter has been authorized by requesting that the federal government consider Imperial County's general plan in developing its environmental impact statement. As a result of these efforts, a single environmental document is being written. Imperial County representatives believe that local governments must become

involved in geothermal development at the earliest possible stage. The County would like to see legislative action which would assign total responsibility for geothermal development to the local level.

California Leasing Paper and
Federal Streamlining Task Force Report

The following is: (1) a summary of the background of the Geothermal Resources Board Technical Advisory Committee federal leasing paper; and, (2) a brief description of the workshop panel critique of the efforts of the Federal Geothermal Streamlining Task Force.

Background on the California Leasing Paper

At the April 1978 meeting of the Technical Advisory Committee of the California Geothermal Resources Board, it was noted that the Federal Geothermal Streamlining Task Force of the Inter-Governmental Geothermal Coordinating Council would be holding hearings in California the following month on the subject of federal leasing. It was also noted that the Department of Conservation had applied for a Department of Energy grant to conduct a series of geothermal workshops, one of which would deal with federal leasing policies, and it would be useful to have a working paper for the Federal Task Force hearings. Such a paper could also serve as a springboard for discussions at the upcoming GRB workshops.

A subcommittee composed of representatives of TAC member agencies along with the Bureau of Land Management and U.S. Geological Survey was formed to prepare the issue paper. Two meetings of this state-federal group were held to establish priorities, identify areas of potential development,

outline present state and federal leasing procedures and make recommendations on needed changes in the federal leasing procedures and policies.

At the conclusion of the second session, during which a consensus was reached on these issues, three members, Syd Willard of the California Energy Commission, Jack Lahr of the Bureau of Land Management, and Don Hoagland of the California State Lands Commission were charged with the task of writing the report.

A draft was prepared and circulated to the GRB, TAC, and federal agencies. Comments from this circulation resulted in modification of the paper which was adopted by the TAC and then presented by the authors as testimony at the Streamlining Task Force hearing June 21, 1978 in Sacramento.

Workshop Critique of Federal Geothermal Streamlining Task Force Report

Authors (identified above) of the state leasing working paper compared the Federal Geothermal Streamlining Task Force Report recommendations with those recommended by the state group. It quickly became apparent that the Streamlining Task Force had paid very little heed to the recommendations from California. Some were deemed not to be within the jurisdiction of the Task Force charge, others were indicated to be already in force (although this was not accurate in some cases), while others were ignored. One of the major recommendations of the state--the so-called de-coupling concept or separating, for the purpose of environmental impact documentation, the exploratory from the full field phase--was virtually ignored. Other suggestions such as that which recommended that the Secretary of Agriculture should make a determination that energy resource development was at least as important as wilderness so that the Forest Service could proceed with

geothermal leasing received similar treatment.

At the time of this writing it is not clear what actions the Inter-governmental Geothermal Coordinating Committee will be taking on the recommendations which they accepted.

Federal and State Lease Areas

Geothermal Leasing Schedule
BLM - California
April 1979

<u>Study Area</u>	<u>Status</u>	<u>Leaseable Acres</u>	<u>Lease</u>	<u>Comments</u>
North Salton Sea	N/C	640	May 1979	Cleared by District
Randsburg	KGRA	3,200	July 1979	Potential WSA conflicts
	N/C	11,000	May 1979	" " "
East Mesa	KGRA	18,000+	May 1979	Reoffer sale
Yuha	N/C	30,000	October 1979	Preliminary DEAR 5/79
East Mesa	N/C	90,000	November 1979	Field work started
Beckworth (FS)	KGRA		March 1980	
Geysers (MRL-2)	KGRA	4,000	April 1980	Field work started
Glamis-Dunes	KGRA		Late 1980	Field work started
Coso	KGRA		December 1980	Work in progress
	N/C		January 1981	
Sand Hills	N/C	10,000	-	Probably rejected
San Felipe Wash	N/C	8,000	Early 1981	Work in progress
Knoxville	KGRA	14,000	January 1981	-
Geysers (MRL-3)	KGRA	5,000	June 1981	-

California State Lands Commission Geothermal Development Status

Donald L. Hoagland, Program Coordinator, Energy and Mineral Resources
Development

Geothermal Resources Leases

<u>County</u>	<u>Lessee</u>	<u>Acreage Under Lease</u>
Imperial	Imperial Thermal Products	535
Lake and Sonoma	Union Oil Company	3988
Lake	Natomas Company	130
Sonoma	Wildhorse Development Company	434
		<u>5087</u>

Geothermal Prospecting Permits

<u>County</u>	<u>Permittee</u>	<u>Acreage Under Permit</u>
Sonoma	Aminoil U.S.A., Inc.	200
Imperial	QB Resources International	640
Lake	Geothermal Kinetics, Inc.	1785
		<u>2625</u>

Pursuant to the provisions of Senate Bill 1027 of 1978 (Public Resources Code Section 1139), the State Lands Commission may now designate any State-owned lands for leasing by competitive bidding. Accordingly, the Commission has designated approximately 4931 acres within The Geysers KGRA in Lake, Sonoma and Mendocino Counties.

These parcels are divided into eight lease tracts and the first sales are now tentatively scheduled for the latter part of 1979. Lease sales will be scheduled on a regular basis as soon as environmental impact documents on the tracts are completed.

BLM Wilderness Assessment

Jack Lahr, Bureau of Land Management, identified the potential conflicts between geothermal development and national wilderness study areas in California. One of the workshop sessions was devoted to the discussion of this topic. A summary of that discussion follows.

Phase I of the national wilderness assessment effort included an inventory of all potential wilderness areas. Phase II involves designating for further study the areas found to meet specified wilderness criteria. The purpose of Phase II is to determine the value of existing resources so that alternative land uses can be evaluated and determined. BLM plans to complete its study of wilderness areas in the California Desert Conservation Area by 1982. There is no time limit for Congress to make the final determination.

The process poses two difficult issues for those concerned with geothermal development.

First, while the designation of wilderness study areas is designed to evaluate all resources in a selected location, geothermal resources exploration may be limited. This effect may be caused by the fact that most exploration is presently carried out by private operators who demand a fair return. Potential reasonable returns are impeded by the wilderness study designation in two ways: 1) no permanent structures are allowed in the designated area during the study period and until Congress takes final action; and, 2) if economic geothermal resources were found, there still is no guarantee that Congress will decide to allow geothermal development. Given these two factors, geothermal exploration may be limited, leading

to valuable geothermal resources not receiving proper evaluation.

One possible solution to the above problem proposed in the workshop was to relax federal policy regarding geothermal exploration and leasing in designated wilderness areas. Another solution suggested was that USGS undertake the necessary geothermal exploration.

Second, designation of wilderness study areas places severe limits on the location of transmission corridors. This was specifically seen as an issue in Imperial County. A point was made that existing highway and rail corridors should be used for transmission corridors as an alternative to constructing lines across more pristine areas. Some compromise might be reached in widening the existing corridors. BLM feels it might be worthwhile to bring developers, environmentalists, and appropriate government representatives together to discuss this possibility.

SECTION 3

WORKSHOP #3 - TRANSMISSION OF GEOTHERMAL GENERATED ELECTRICITY FROM REMOTE AREAS

Interconnection and Wheeling Service

Bill Foley, with the Legal Division of the California Public Utilities Commission (PUC), gave an overview on interconnection and wheeling legislation.

Several years ago amendments were added to the California Public Utilities Code (Section 2801-2816) which permit "private energy producers", as defined in the Code, to file an application with the PUC to have interconnection and wheeling provided by order. Wheeling was limited by these amendments to service from producer-owned facilities to their own facilities located elsewhere in the State. Thus, the initial application of this law pertained to a fairly large industrial firm wanting power wheeled to itself. Last year these sections were amended to allow any public agency or other private energy producer, as defined, also to file with the PUC to secure interconnection and wheeling service. The law applies only to electricity produced from nonconventional fuels (any fuel other than nuclear or fossil fuels).

The PUC can order and set the terms for interconnection and wheeling service under certain circumstances, assuming that subject areas have not been preempted by federal authority. There are conditions in the statutes that require capacity to be available in the transmission system, and an applicant must be willing to pay reasonable costs for the service, etc. (see Public Utility Code Sections 2811, 2812.5 and 2813.)

The Federal Power Act of the 1930's was amended by the National Energy Act to provide some wheeling relief for public utilities and publicly-owned utilities. Two new categories of energy producers were established; small (80 MW or less) energy producers using biomass, waste materials, or renewable sources for production of electricity and cogenerators. It is not clear whether geothermal qualifies within the first category. These qualifying producers can file with the Federal Energy Regulatory Commission and request FERC to require a privately-owned utility to provide inter-connection of their production facilities with the utility's system. These amendments to the Federal Power Act are set forth in Title II of the Public Utility Regulatory Policy Act (PURPA). Regulations will be issued later in 1979 which should clarify the federal-state relationship in this area.

There was disagreement among the public utilities at the workshop about "wheeling" as a problem for geothermal. Since most publicly-owned utilities are involved in negotiations over wheeling, there is difficulty in determining the extent of the problem. Should negotiations break down, regulatory agencies may wish to become involved in dealing with the issue.

SECTION 4

WORKSHOP #4 - THE POTENTIALS FOR DIRECT

GEOHERMAL HEAT UTILIZATION IN CALIFORNIA

Overview of Low and Moderate Temperature Resources in California

Dr. Priscilla C. Grew, Director, California Department of Conservation

Low to moderate temperature geothermal resources (less than 150 degrees centigrade) are found in many parts of the world and often are used for direct application purposes. Countries like Hungary, Iceland, Italy, and New Zealand already use considerable geothermal resources for such purposes. Over half the homes in Iceland are heated by geothermal energy, while in Italy, in addition to electrical generation, geothermal energy is being used to heat greenhouses, offices, public buildings, and homes. In other countries such as the Phillipines, Turkey, and Mexico, there also are increasing uses of direct applications of geothermal.

Some of the commercial uses of low temperature fluids include fish farming, mushroom growing, greenhouses, space heating, drying organic materials, drying seaweed and vegetables, washing and drying wool, drying and curing light aggregate cement, refining sugar, drying farm products, food canning, drying fish meal, and drying timber.

It has been estimated in the United States that the medium temperatures (90 to 150 degrees centigrade) and the low temperature geothermal resources (50 to 90 degrees centigrade) contain about four to five times as much recoverable heat as the high temperature resources in the geothermal systems (above 150 degrees centigrade).

In many cases, the direct applications of hydrothermal energy are straight forward extensions of today's technology. The failure to take advantage of this resource has been more a matter of people not being aware of the geothermal potential than the adequacy of the "know how" to make it work.

Still there are some key problems and barriers needing to be addressed to increase the use of these resources. Some of these are: environmental impacts of geothermal development, difficulty in generalizing economics, limits to the

availability of personnel experienced in working with direct application of geothermal, a lack of low temperature process equipment vendors, and a general lack of public knowledge about the feasibility of these low temperature geothermal resources.

Roger Martin, California Department of Conservation, Division of Mines and Geology

Attention to low temperature geothermal resources is relatively new in California. Many areas of the State are suspected of having such resources, mainly on the basis of nearby hot springs activity. In most cases little is known about the underground extent of the resources, the temperatures or total energy available.

The California Division of Mines and Geology (CDMG) is involved in a direct heat geothermal resources assessment program, one of 13 Western States working under a Cooperative Direct Heat Geothermal Program of the U.S. Department of Energy. In this program attention is being focused on the lesser known geothermal areas rather than the six major areas (The Geysers, Imperial Valley, Coso, Long Valley, and Surprise Valley) where commercial interest in developing geothermal electric energy has been keen.

Low temperatures as well as the high temperature resources have been slow to develop because of the abundance of cheap petroleum-based energy. Now we are at the crossroads where costs of different energy sources are changing. Hence, DOE has entered the picture with programs to encourage alternatives such as geothermal. DOE's philosophy, based upon industry's experience, is that the major barrier to geothermal development is reservoir uncertainty.

Useful data sources

1. U.S. Geological Survey Circular 790 - Assessment of Geothermal Resources of the United States - 1978. This document is an update of their Circular 726 published in 1974. It contains a map of the Western States showing the approximate geographical distribution of geothermal waters in California, as determined by USGS and California Division of Mines and Geology staff.
2. The California Division of Mines and Geology's Fault Map of California by Charles Jennings, showing hot springs, geothermal wells and volcanoes at 1:750,000, provides a more useful scale for locating local geothermal phenomena.

3. The GEOTHERM Computer bank of the USGS contains the largest single collection of geothermal data for the U.S., including California. It contains temperature, depth, chemical data, and location parameters for virtually all known geothermal waters in California, and it is growing as USGS, CDMG, and other investigators continue geothermal studies.
4. Coming next year will be a 1:750,000 scale geothermal map of California currently being prepared by the CDMG. This will be a relatively non-technical map intended for the general public.

Location of Thermal Areas in California

Slide presentation of map showing:

Surprise Valley
Kelley Hot Springs
Susanville
Sierra Valley

Lovelady - Wilbur Hot Springs
Geysers/Calistoga
Bridgeport
Mono Lake

Note: Presentation of a set of slides actually showing most of these places was given in Workshop #1 by Bacon and Olmstead, staff of the Department of Conservation.

Methodology in Resource Assessment

The CDMG's resource assessment program consists of two overlapping phases. Phase I consists of preliminary site geologic studies and an inventory of existing data on low and moderate temperature geothermal resources. Temperature, location, and chemical data on hot springs and thermal wells have been computer coded for the USGS Geothermal data bank. Preliminary site studies involve study of the ground water regime based upon literature search, public well log records, field studies, and analysis of air photos or remotely sensed imagery, and interviews with well drillers and property owners with wells having higher than normal temperatures. Available chemical analyses are scrutinized for thermometric indicators of deep-seated temperatures. This information is synthesized to determine if the candidate site is worthy of more detailed geophysical study.

The more detailed, site specific studies constitute Phase II investigations. Gravity and magnetic studies are employed to locate concealed faults which may act as ground water barriers or conduits for upwelling hot waters. They also may indicate basement rock configurations bounding the local ground water basin, or anomolous buried features of recent volcanic origin. Deep resistivity is employed as a more direct sensor of hot or unusually saline water at depth. The most intensive part of the Phase II investigation is the heat flow study, which involves drilling

a pattern of small diameter holes 300 to 500 feet deep. Rock cores are taken at intervals during drilling for laboratory determination of heat conductivity. Thermal gradients are measured in the drill holes and geothermal heat flows computed. Maps are prepared showing variations in heat flow and thermal gradients as indications of unusually high subsurface thermal zones. Where financial resources permit, a sufficiently deep hole may be drilled into a suspected geothermal reservoir to validate its existence, temperature, and other physical properties.

Commercial Users of Direct Geothermal Heat

Rollin Russell, McCulloch Geothermal

Most of the major geothermal developers are involved in The Geysers, Imperial County, other areas in the United States, or abroad in such places as the Phillipines. Only one company (actually three) seems to be making profits from geothermal. The list is long of those companies still on the negative side. Exploration is very expensive but must continue if returns are to be realized. It is one of those necessary expenses in which one must participate to keep abreast of the game.

McCulloch has just drilled a hot water well, 13,000 feet deep, in the Brawley area. The Company drilled a deep well in The Geysers that cost over \$3 million. This is no game for anyone with a faint heart. You've got to get into it with both feet.

Most of the major companies have not yet gone into low temperature applications, and there are good reasons. One problem is hydrogen sulfide abatement. This is a key problem which must be resolved.

The same government restrictions exist for low and high temperature resources. There has been too much limiting legislation and the industry and other interested parties should closely follow the progress of new legislative and regulatory proposals. Programs like the federal wilderness inventory and its affect on the industry for both low and high temperature resources should be closely reviewed.

The costs of geothermal energy must be kept down and cascading may be a good way to go. It doesn't waste a single BTU.

McCulloch uses a systems approach to low temperature geothermal energy. For the last year the Company has been exploring the possibility of going into the geothermal farm

business. (Note: In the oil business there are integrated oil companies and there are independent oil companies. An integrated oil company is one that transports, markets, produces, and explores.) McCulloch is thinking of integration as far as the geothermal farm. The farm will grow food, raise hogs, raise rabbits, and use the waste material from them, basically for generation of methane. Methane will produce the electricity that is needed for mass freezing processes and excess products will be used internally. The project is located in Utah. There appears to be no reason why it couldn't be done in California. Once the system is proven, it is exportable to anywhere geothermal energy is available. The key is getting a balanced system, and this is what McCulloch is in the process of doing. Finally, as far as geothermal is concerned, it is a reliable, low-cost source of energy. Government regulations must be kept at a minimum. Geothermal development is a good example of free enterprise really moving. It can be an excellent way of utilizing this very important source of energy.

Ken Boren, GeoProducts,

"Quite often geothermal development is related some way or other to the oil companies, and that is natural because the geothermal business is very similar to the oil business, and oil companies are leaders in using geothermal energy for electrical generation. We're in the geothermal business and our philosophy is somewhat different from that of the oil companies. Our basic philosophy is to utilize the geothermal resource for whatever it is good for commercially. In the Wendel area it appeared like maybe the best thing to start with was a hydroponic vegetable operation. We studied the vegetable industry for a year or so, and looked at all the marketing results. We looked at the systems available for hydroponic growing of vegetables. We did this while we were studying the field's geology and deciding how best to produce the wells. About a year ago, we went to a program of building geothermally heated, hydroponic vegetable greenhouses. We now have thirty of these greenhouses. Each one is about 3,720 square feet. It is a sizeable hydroponic operation growing tomatoes and cucumbers, and the heat is supplied totally by geothermal energy. That's all we do with the geothermal water. It is not used as irrigant water.

"We are a commercial venture with no funding from the government so far. The money we have in it was raised from a limited partnership offering. We intend to enlarge our operation up to 205 greenhouses in the Wendel location.

It will be by far the largest hydroponic vegetable operation in the United States. The largest now is around 100 greenhouses. We market through the largest produce broker in California, C.L. Stoalton and Son in Los Angeles.

"We're about 19 air miles east of Susanville in Lassen County. We have about 11,000 acres under lease in this area. In our area we have natural hot springs of about 206 degrees, which is boiling at that elevation, 4000 feet. We also have two wells, one of which we drilled and one of which Magma drilled about 10 years ago. We thought that we were going to get cold water in the well we drilled and we got hot water instead. We are using the Magma well as the main heat supply for our greenhouses. It is equipped with a 40 hp turbine pump. Three to five hundred gallons per minute of boiling water are produced by the natural hot springs. As a back-up heat source we are equipped to pipe water from the springs to heat our greenhouses. We've got enough water there to heat entirely the present group of greenhouses. Instead, however, we've gone north along the fault line and are using the old well that Magma drilled to 627 feet. In that well we have about 220 degree water at 100 feet. This provides an ample supply of heat for the greenhouses. We've also drilled a cold water well to provide irrigation water for the project. The irrigation well produces about 100 gpm of water at 68 degrees from a depth of 100 feet.

"The maximum heating load for each greenhouse requires about 10 gpm of geothermal water. We have a 4 inch transite pipe that runs underground from the geothermal supply well to our greenhouses. This pipe is not insulated. It is buried 36 inches below surface and we're getting ample heat at the heaters. The heaters were designed for 190 degrees and I think that we're getting close to 200 degrees into the heaters, so we're slightly over designed.

"Elevation at the project site is about 4,000 feet, so the air is very dry. There is only about 5 or 6 inches of precipitation per year, some of which is snow. In the summer, when the temperature gets up around 100 degrees or so, the evaporative cooling system that is a part of each greenhouse is especially efficient. The greenhouses have tubular steel in the frames. They are covered by Monsanto 6 mill film designed especially for greenhouses. Two layers of the film are on each house, separated by about 4 or 5 inches of air space which is maintained at a slight little bit of pressure by an air blower.

"No problems either with corrosion or scaling have been encountered with the geothermal fluid. It's a very

mild, geothermal water and when it exits the house, flows by gravity into the same stream bed where the geothermal waters flow from natural hot springs.

"So far we've only tried tomatoes and a special European cucumber. We've had good results with both. It is possible that you could grow lettuce, flowers and a number of other things like bell peppers. We'll probably experiment with them. Our crops are rotated on a planned rotation schedule, so that we'll have crops throughout the year, not just in the summer and not just in the winter. Our produce is going to the Los Angeles market.

"Hydroponic greenhouse systems such as this produce a different kind of product that must be sold on a quality basis. For instance, when row crop tomatoes are 79 cents in the store during the winter, ours are going to cost about 99¢. There's always a differential between row crop and greenhouse produce. Row crop cucumbers are now about 29¢ each. Ours will cost any where from 89 cents to \$1.09 each. The higher price is justified only by higher quality. When you taste a greenhouse cucumber it is not the same and it cannot be grown anywhere except in greenhouses. The basis of our sales has to be superior quality, because we can't match the row crop price. Greenhouse cucumbers last a long time on the shelves. The tomatoes do too because they are grown under near-ideal conditions. There is essentially no spoilage in hydroponic tomatoes in a vegetable market.

"Our logo is Honey Lake Farms. We have a label that we put on each cucumber and a different label that we put on each tomato. Our products are very marketable. We have boxes designated with our own logo. We have a refrigeration unit on the complex. We keep the produce refrigerated until we have enough to send by truck. It is trucked directly from the complex to the retail markets as designated by our produce broker."

Questions and Answers

Question: Is your refrigeration geothermally fueled?

Answer: Right now, it's not. It's a regular refrigeration unit with an electric compressor. We have an absorption refrigeration system planned with geothermal. We have ample geothermal for expansion of our operations. We think the production technique can be expanded into as many as a hundred, two-hundred, three-hundred, four-hundred units in one or two phases without any problems. You do have labor

problems in getting somebody good enough to run a large operation. There are not that many hydroponic people around. Basically, however, you can solve that kind of problem. Then it becomes primarily a marketing problem. Right now, we don't see any limits on marketing. We're going to ease into it and be looking to see how our market moves.

Question: How many employees do you have in your operation at the moment?

Answer: We have about 28 employees for our 30 greenhouses, and as we get larger, probably with a hundred greenhouses, we'll probably figure about 80 employees. Not quite one person per greenhouse. Some are maintenance people, some are managers, and some work in the packing shed.

Question: You say you're making money. Is your rate of return high enough to attract commercial capital?

Answer: I didn't say we were making money. We're just about on the verge of breaking even right now. We should start making money with this spring's crop. We have raised our capital from limited partnerships, and we hope to raise the rest of it through a loan.

Question: When are you going to go public?

Answer: We're not going public with our offering. The limited partnership is a private partnership. It's a very lucrative thing to get into geothermal ventures if you can leverage your money with proper financing.

Question: How much fresh water does your operation consume?

Answer: Fresh water is used only in our irrigation. We have one well that's capable of about 100 gpm. We figure that we need, for 205 units, about 70 to 75 gpm. It's a very low water user. It uses about one-tenth as much water as irrigated row crops.

Leo Ray, Catfish Farms of America

Introduction

"Fish Breeders of Idaho, Inc. has been raising channel catfish (*Ictalurus punctatus*) in high density concrete raceways for six years. The water is supplied by artesian geothermal wells. The total flow is 6,000 gpm at 90°F. Cold water from springs and streams is used to cool the hot

water to 80 to 85°F., the ideal production temperature.

"The quality of channel catfish produced in the clean water is far superior to any other catfish on the market. A fish is like a sponge; it tastes like the water in which it is raised. The geothermal water produces a quality that has allowed Fish Breeders to introduce catfish into the gourmet markets and obtain high prices for catfish.

Facilities

"Fish Breeders is located in the Snake River Canyon near Buhl, Idaho. The elevation is 3,000 feet. Yearly temperatures are from -10°F. to 105°F. Ambient water temperature seldom exceeds 75°F. The climate is too cold and the growing season too short to grow catfish commercially without hot water. Geothermal water changes a non-commercial area to a 365 day optimum growing season.

"The fish farm is located on a hill. Approximately 80 feet of elevation is used in the farm. This is very important in aerating and reusing water.

"The production facilities are concrete. Each section is 24 feet long, 10 feet wide and 4 feet deep. The space utilized by the fish is 770 cubic feet. The sections are arranged four in a series with a 2 foot drop between each section. The raceways are in pairs with a common center wall. The water passes through four sets of raceways, each raceway having four sections (16 section total), from the top of the hill to the bottom. The upper end of the farm is used for catfish production. The lower end of the farm is used for Tilapia production.

Water Supply

"Four artesian geothermal wells supply 6,000 gpm of 90°F. water. This water is mixed with cold water that varies from 32°F. to 74°F. to obtain a temperature of 80 to 85°F. The geothermal water is used direct. No heat exchangers are utilized. The wells were all drilled by Fish Breeders and are approximately 700 feet deep. The water flows through each raceway at 1,500 to 2,000 gpm.

Stocking Rate

"There are two densities to consider in producing catfish; pounds per cubic foot of space and pounds per second foot of water. Both are interrelated, but the degree of interrelationship is unknown. They will be considered separately in this report. The pounds per cubic foot of space

is primarily limited by social factors. The pounds per second foot of water is primarily limited by water quality.

"Channel catfish are social animals. In their natural environment they tend to congregate in groups. Eggs are laid in a mass. Sac fry congregate after hatching. Fingerlings, and even adults, spend much of their time in schools. They do not establish individual territories like shrimp or lobster. This is one major factor that makes them ideal for high density production. Channel catfish do establish a social pecking order. Stocking at high densities appears to interfere with this pecking order and reduces fighting.

"Normal stocking densities are from 5 to 10 pounds of fish per cubic foot of space. Lower densities are used for small fish. Densities up to 20 pounds per cubic foot of space have been tested, but at this time are not recommended for commercial production. The pounds of fish that can be produced per second foot of lowing water is limited by water quality. Water analysis of the water entering the raceway, compared to water analysis of the same water leaving the raceway, tells what the fish have put in the water and what the fish have taken out of the water. The factors of greatest importance are the oxygen removed and the carbon dioxide and ammonia added.

"Oxygen removed is the first factor that limits production, however, oxygen is easily replaced by running water over waterfalls. At the same time oxygen is replaced, carbon dioxide is removed. Theoretically, oxygen can continuously be replaced and most of the carbon dioxide removed by a chain of waterfalls. A two-foot drop will replace approximately 50% of the oxygen removed. There are ways of increasing the breakup and aeration of the water to achieve saturation in a two-foot drop, however, this is usually not done.

"Ammonia is not easily removed by waterfalls and will continue to accumulate until it becomes the principle limiting factor in raceway production. The ammonia can be in an ionic state or a gaseous state. The gaseous state is very toxic to fish and can be partially aeriated out of the water. The ionic state is less toxic, remains in the water and changes to nitrates. The amount of ammonia that will be in the gaseous state is related to pH, temperature and water chemistry. The amount of ammonia that fish can tolerate is dependent on these same factors plus oxygen and carbon dioxide levels. The higher the oxygen level, the more ammonia fish can tolerate. The level of ammonia that fish can tolerate is between .5 ppm and 2. ppm.

"The amount of oxygen removed, carbon dioxide produced

and ammonia produced is dependent on the amount of food fed in the raceway, not the amount of fish in the raceway. 5,000 pounds of fish could be fed 1% body weight (50 pounds of feed), and the ammonia, carbon dioxide and oxygen levels would be basically the same as if 2,500 pounds of fish were fed 2% body weight (50 pounds). The limiting factor is the amount of feed that can be fed per second foot of water and the amount of fish that can be stocked is dependent on the percent body weight that is fed.

"Oxygen required to metabolize 50 pounds of feed is approximately 2 ppm from one second foot of water. In a raceway with four sections and one second foot of water, the water will be aeriated three times, once between each section. Fifty pounds of feed can be fed in each section. This gives a total of 200 pounds of feed that can be fed in the entire raceway. Assuming 50% reoxygenation and saturation of 8 ppm, the oxygen at discharge would be 3 ppm. This is an absolute minimum level for production. A total of 8 ppm oxygen would be utilized in metabolizing the 200 pounds of feed.

"Approximately .2 ppm ammonia would be deposited in one second foot of water from metabolism of 50 pounds of feed. Feeding 200 pounds of feed in one second foot of water, the ammonia in the discharge would be .8 ppm.

"Maximum recommended inventory for commercial production of channel catfish on water at Fish Breeders is about 10,000 to 15,000 pounds per second foot of water. Yearly production will usually be three to four times the carrying capacity.

"Disease is usually a major concern in fish production. It should not be. 99% of all diseases are secondary expressions of poor water quality, poor feed quality and poor management (the human element). If good water quality is maintained, good feed is used and labor handles fish properly, disease should not be a problem.

"In order for a commercial hatchery to obtain maximum profit, production must be pressed to the limit. This means carrying inventory will be increased to the point disease will develop because of overloading. It is management's job to balance carrying capacity to water quality and stay below the point where disease is a problem.

"Summarized below are the problems which can be expected in starting a geothermal fish farm. These factors have prevented a faster growth rate in geothermal fish farming.

Identifying the Resource

"The extent of most geothermal sites considered for fish

production have not been identified. Surface springs show a potential but do not tell the complete story. Wells must be drilled before the volume, temperature and water chemistry is determinable. These must be known before a production potential can be analyzed. Considerable money must be spent before a decision can be made recommending a site for geothermal fish farming. The person with a geothermal resource must first identify that resource, and then see if it is suitable for fish production.

Facility Design

"People interested in building fish farms usually examine government hatcheries for models to copy. This is a poor place to study a good design. Poorly designed commercial farms go broke and disappear. Poorly designed government fish farms continue to operate indefinitely, consuming tax dollars.

"An engineer's dream is too often a fish culturist's nightmare. The KISS rule is the only rule to follow. KEEP IT SIMPLE STUPID. There has been little communication between fish culturists and engineers. This lack of communication has resulted in a situation where there are few, if any, engineers who understand the management of fish culture well enough to design a commercial fish farm. I cannot recall a commercially viable fish farm that was designed by an engineer. The entire industry has been designed and built by the fish farmers themselves. This does not mean there is no room in the design work for engineers. It means engineers are not in tune with the problems of fish culture and, therefore, behind the times.

Financing

"Financing is difficult. Geothermal is considered high risk. Fish farming is considered high risk, and high density production even a higher risk. Capital expenditure is high, operating expenses are even higher. An executive of a large company looking at fish farming said they consider some businesses as cash generating and others as cash consuming. They considered fish farming as cash consuming. It is a good description of fish farming.

"Contrary to common opinion, most fish farms that have gone broke did not do so because of underfinancing. Those started underfinanced have had a high success ration, while those adequately financed "spent it like they had it" and went broke. Too many mistakes were made too fast, and the investors ended up very disenchanting. Bankruptcy followed because of a lack of willingness, not ability, to refinance and do what was necessary to succeed.

Construction

"There is no substitute for good facilities. Concrete is usually best. The facilities will probably be the first fish farm the contractor has ever built.

Production

"Trying to achieve more production than the water quality will allow causes most production problems. If the rules laid down earlier in this paper are followed, production should not be a problem. Keep good water quality, good feed quality and keep labor stress down.

"Experienced personnel are not available. Personnel must be trained. There are many degree students graduating, but most do not have any experience. They need experience if they are being hired to run a new farm.

Processing

"A processing plant will not be available in most situations. A producer will need to build a processing plant. Very little machinery is available for processing. Most of the labor is hand labor.

Marketing

"No money is made raising fish until the fish are sold.

"A common misconception is there is an unlimited market for fish products such as channel catfish. The truth is, there is an unlimited potential market for channel catfish and other good fish. The potential is unlimited. The existing market is full. There is no room for additional production without additional marketing. Markets must be developed, and they cannot be developed without fish. The fish must be raised before the market can be developed.

"There were approximately 150,000,000 pounds of catfish sold in the U.S. in 1978. This production breaks down as follows: Brazilian imports 30,000,000 pounds; wild catfish harvest commercially in the U.S., 30,000,000; channel catfish raised on farms, mainly in Mississippi and Arkansas, 90,000,000; and 500,000 pounds raised in high density geothermal facilities. These catfish figures are listed in order according to quality and price, with the poorest quality listed first. There is a considerable difference in quality of product and price. The Brazilian fish sell as low as 60 cents per pound, wholesale. In catfish, as in any other product, one gets what he pays for.

Distribution

"Most geothermal resources are not near large market areas for fish. Distribution can be a major problem. The easiest market to develop is the fresh market. This complicates distribution, for the fresh market delivery must be available on a dependable weekly basis. In Idaho, Fish Breeders are in a good distribution area because of the 25,000,000 pounds of trout raised within 15 miles of the farm. Each production and market situation will have to be viewed individually to solve the distribution problem.

"These are the main problems in establishing a geothermal fish farm. No phase can be left out. A project will need to master each phase to be successful.

In Summary

"If you want to raise fish to get rich, you will probably go broke. If you want to raise fish because you like the challenge of fish culture, you will probably get rich. The best advice is to start small and grow slow."

Charles Richardson, Councilman, City of Susanville

(The following written remarks were prepared by Charles Richardson, council member, City of Susanville. He describes how the city became interested in geothermal as an energy source.)

Susanville is a small progressive city of 7000 population, situated in northeastern California at the north end of the Sierra-Nevada Range and near the south end of the Cascades. The economics of Susanville and of Lassen County are determined by the level of employment of Agriculture -- largely livestock, lumbering -- both logging and milling, and, government employment -- city, county, state and federal. Electric power is supplied through an independent distributor that purchases electric energy generated by PG & E. There is no natural gas supply so propane is imported by truck and delivered to individual tanks. Liquid fuels are imported by truck or rail and distributed by truck to users. Some coal is imported, and a large amount of wood is used of which some is sold by commercial woodcutters, but most is cut by the individual user. The City is located over a source of low temperature geothermal water which has been used only in a swimming pool since 1935, to heat a church since about

1963, and in years past to keep a log pond from freezing in winter.

The increasing cost of fossil fuel derived energy gives added impetus to Susanville's need to develop the available geothermal energy, although the City entered into the Susanville Geothermal Energy Project about 7 years ago. This was a project designed to explore the feasibilities of using low temperature geothermal energy and to provide techniques and knowledge that could be transferred to other similar communities with similar resources. The basic concepts of the Susanville Geothermal Energy Project were to create additional private sector employment and to improve the City's financial status. These aims pre-dated the well known "energy crunch" of the more recent past.

Geothermal fluid temperatures of 140° to 150° F. were firmly established in the original project, but the volume or capacity of the source was not determined, so in conjunction with that project, the U.S. Bureau of Reclamation was funded and authorized to explore and evaluate the source. First, a number of shallow temperature gradient holes were drilled and observed. High elevation infra-red photos were obtained, electro-chemical analyses and resistivity surveys were made, and some seismic exploration was done. The information derived from these data sources has guided the Bureau of Reclamation drilling inside and outside the City to more precisely evaluate the reservoir. This function is now on the eighth deep temperature gradient hole.

Subsequent to the original Susanville Geothermal Energy Project and concurrent with the drilling tests, the U.S. Department of Energy entered into a contract with Aerojet Energy Conversion Company for a preliminary engineering study that is titled Multi-Use Geothermal Energy System with Augmentation for Enhanced Utilization. Quoting from the Abstract of that study: "Aerojet Energy Conversion Company has completed a site specific engineering and economic study of multi-use, augmented geothermal space/water heating and cooling systems. The study was conducted in cooperation with the City of Susanville, California.

The overall benefits to the City of Susanville, in both the public and private sectors, of using low temperature (150°F.-240°F.) geothermal resources are explored. Options considered, alone and in combination, include heat pumps, fossil-fuel peaking, user load balancing, and cascading from the geothermal system serving the public buildings into a private Park of Commerce development. A range of well temperatures, depths, flow rates, and drilling costs are considered to provide system cost sensitivities and to make

the study more widely useful to other sites. A planned development is emphasized for ease of financing and expansion. A preliminary design of Phase A of a Susanville Public Building Energy System and a conceptual design of an integrated Park of Commerce, Phase I, are included. This system was designed for a 150°F. resource and can be used as a model for other communities with similar resource temperatures.

With all of the above information, Susanville responded in 1978 to a DOE Program Opportunity Notice with a proposal to heat seventeen publicly owned or operated buildings in the City and in conjunction with this heating district to establish an industrial park to also make use of the geothermal energy. The projected industrial park is now envisaged as an agriculturally oriented operation consisting of greenhouses for food or other plant production and possibilities of controlled environment meat production and processing, including feed production. Others of my fellow panelists are addressing this type of use of the geothermal heat.

The heating district is to supply direct or enhanced heat by delivery of hot water to the specific buildings. This is mainly a winter usage of roughly 5 months. The industrial park will balance this part-time use with a full-time demand. The City will not be operating the installations in the industrial park, but will be the supplier of the heat there as well as to the buildings in the heating district. The City also should be the entity to develop the land for the industrial park.

Our contract has not been signed with the Department of Energy, but last minute details are being wrapped up, preparatory to entering into final negotiations for the contract. The City and its team of subcontractors are ready to go to work under the contract which is to run through fiscal year 1981 when the system is to have been installed, tested and operating. There will be a wealth of knowledge and experience that can be applied to many other communities in the United States, while leaving a functioning system in the City of Susanville. Jobs will be established and a step toward energy independence for Susanville and Lassen County will have been achieved.

Besides support of the people of our community, the Board of Supervisors and the County Planning Commission have been cooperative and supportive. Lassen Community College has hosted two conferences -- one of which was the final wrap-up of the Susanville Geothermal Energy Project, and was instrumental in setting up a Lassen County Geothermal Committee. The College has also provided greenhouse operation courses for jobs in the field. The City appreciates the support of these other governmental and educational entities in the effort.

Larry Howard, Presbyterian Intercommunity Hospital, Inc., Klamath Falls,
Oregon

(The following written remarks were prepared by Larry Howard, Director
of Environmental Services, Presbyterian Intercommunity Hospital, Inc. He
also used slides.)

Klamath Falls, Oregon, is in the south central part of the state, overlying a KGRA, approximately 50 miles long and 10 miles wide. In Klamath Falls, hot water (120° to 195°F) has been found at depths shallow enough to be reached by standard drilling techniques. Wells of 200 to 1,800 feet in depth are common. As early as 1912, homes in Klamath Falls have utilized this resource for its full potential. "Cheap" energy sources for the northwest, natural gas, oil and electricity, drastically slowed the development of geothermal potential. With the advent of the energy crises during the early 70's, alternative energy resource development has boomed.

Presbyterian Intercommunity Hospital (P.I.H.) was opened in October of 1965. During development and construction, the potential for geothermal was recognized and was a factor for site location. However, the risk involved at that time for incurring the added expense for drilling and the additional equipment to utilize the geothermal resource as an energy alternative was not seriously considered. With the standby requirement of a hospital, the geothermal system would have been a true additional expense. During the first indications of the energy crisis, hospital officials authorized the design and construction for the facility to change to geothermal in 1974. In December of 1976, P.I.H. switched to the new geothermal system, utilizing the 191°F. water for space heating, domestic hot water and snow melting.

Recognizing the importance of this resource, Klamath County and P.I.H. officials agreed to locate the new Klamath County Nursing Home adjacent to P.I.H., and a system of shared services was drawn up which would allow the two separate entities a means of reducing each others expenses.

Presently, our geothermal system is serving 203 beds at P.I.H., and 120 beds at the Klamath County Nursing Home, totaling 207,000 ft. of building space. The total costs of the geothermal changeover, including the new mechanical

building, totaled \$351,500.00. Seventy percent was paid for by P.I.H., and the remaining thirty percent by the county for the nursing home.

In the first full year of operation, on the original 98,000 ft. of building space, we reduced natural gas cost by \$31,200.00.

Prior to construction of the hospital addition, P.I.H. issued eight percent tax free bonds. Based on a 20-year life and an eight percent cost of capital, the present worth of the 20 year savings is \$1,276,604.00. Return on the investment, for this project, is in the neighborhood of thirty-four percent annually. This return on the invested capital considers only the 98,000 ft. of original building. The system presently serves 207,000 ft.

John Lund, Geo-Heat Utilization Center, Oregon Institute of Technology

(John Lund used slides and commented on direct heat uses throughout the world.)

"Use of geothermal in the U.S. is very limited in comparison to what is going on worldwide. We can learn a great deal from our international neighbors: Iceland, with large district heating projects; Hungary and the Soviet Union with large greenhouse projects; and New Zealanders who are rapidly expanding the use of geothermal industrial processing. These nations have set the pace for the United States.

"The first slide illustrates where the geothermal resources are in the world and some of the direct uses. Japan, New Zealand, Iceland, Italy, Hungary, and the Soviet Union are countries that seem to have the highest use in terms of non-electric or direct use.

Next slide:

"This table illustrates what is going on worldwide. Normally, we break it down to three basic categories: space heating and cooling; agriculture-aquaculture; and industrial processes. The real leader in terms of space heating is, of course, Iceland.

Next slide:

"Iceland meets about 50% of its energy needs through geothermal. The capital city of Reykjavik, a city of about 120,000 people meets about 99% of their energy needs through the use of geothermal.

Next slide:

"Japan probably is known more for spas, baths, and hot springs. This slide certainly indicates many of those locations throughout Japan. In connection with their powerplants, Japan seems to specialize in cascading-the principle whereby the highest temperature is used towards power generation, and out of the power generating plant the fluid is used for space heating, swimming pools, trying to squeeze the last drop of energy out. Several Japanese visitors to our country have commented that at Klamath Falls, very high temperature useful water is dumped; the Japanese think we should use it for swimming pools and so forth.

Next slide:

"In the U.S. in Klamath Falls, Oregon, space heating is really the main objective and the down-hole heat exchanger is the way heat is extracted from shallow wells. There are about 400-450 wells in the town. The majority of these wells use this down-hole heat exchanger which allows extraction of heat without the need to be concerned about extracting or disposing of the water.

"There are a number of wells and, as best we can tell, about 55 that actually pump the water and dispose of it. Some of the larger users, such as the hospital and Oregon Institute of Technology (OIT) actually pump the water, use it and dispose of it afterwards.

Next slide:

"This slide shows a top view looking down an eight-inch well casing with a two-inch diameter down-hole heat exchanger for the heating system and a three-quarter inch pipe for the domestic tap water. With this system we are able to supply all the heating needs for a particular residence. The main disadvantage is that it is one well to one home and actually one of these wells could supply probably a block of homes. It is a rather inefficient system, but in terms of environmental effects, it is quite efficient.

Next slide:

"Another use in Klamath Falls - snow melting. This happens to be one run by the State Highway Department. The white building on the left houses a 300-foot deep well with a closed loop down-hole heat exchanger in it; but instead of circulating city water through the closed loop, the Department circulates a mixture of anti-freeze and water through buried pipes underneath the pavement. That will melt up to about a half-inch per hour of snowfall. This is a very important intersection because this is an "upgrade" at a stop light used by many trucks in town. If it wasn't for that we would be in a lot of trouble during our snowy weather.

Next slide:

"The OIT campus in Klamath Falls has three wells varying from 1,200 to 1,800 feet deep. Each well has deep hole turbine pumps that can pump up to about 500 gallons a minute with a variable speed motor that permits pumping as low as 50 gallons per minute. Peak use probably runs up to 750 gallons a minute where we use a second well. This supplies all heating needs to the campus of about half a million square feet. The cost of this system, including the annual operating plus the amortization, is probably about \$30,000 a year. To heat by conventional fuel would probably run around \$250,000 to \$300,000 a year, indicating an approximate 10 to 1 savings on this project.

Next slide:

"Another use in Klamath Falls: Maywood Industry uses 114 or 115 degrees F. water to heat its entire plant. While unusual to use such low temperature water, it actually reaches the heat exchange at 100 degrees and then is dumped at about 60 to 55 degrees Fahrenheit. Thus, there is a very large temperature change taken out of this water and, of course, you have to have larger heat exchangers to do this sort of thing, but it satisfies the company needs for heat.

Next slide:

"The YMCA in Klamath Falls received a federal geothermal award and has already drilled one well and will drill a second well for heat including the swimming pool.

"Another project in Klamath Falls is the District Heating Project. We are currently proposing building several wells in the geothermal area of town piping water into the downtown area, initially heating 14 government buildings, expanding that to 11 blocks, and eventually to 54 blocks. The 54 block area will require a sixteen inch diameter pipeline. This pipe will be

placed in an approximately 4 x 6 concrete tunnel.

"Another project that is being proposed in Eastern Oregon is for the Ore-Ida Food Processing Plant. This is a large potato processing plant that will use several wells with an investment of probably about 4 million dollars to satisfy about 55 percent of their energy needs. If it goes on line, it could double the non-electric geothermal energy use in this country.

Next slide:

"The most recent industrial processing use is, of course, the Brady Hot Springs onion dehydration plant. A plant like this would probably handle about 10,000 pounds per hour of raw products and produce around 1,500 to 2,000 pounds of dry products at about 4 percent moisture content. Generally, you can meet demand with about 200 to 220 degrees F. water, although, I believe the temperature of the Hot Springs to be about 270 degrees."

Technical Assistance for Direct Geothermal Heat Projects

(Sharon Sellars, Department of Energy, Bob Schultz, EG & G Idaho, Syd Willard, California Energy Commission, Paul Lienau, Oregon Institute of Technology, and Ken Wonstolen, National Conference of State Legislatures, spoke on different forms of technical assistance available through their institutions.)

Ms. Sellars, U.S. Department of Energy

Ms. Sellars handed out a list of contact points for information available on direct heat use through the federal government (contained in Appendix 4). The following is a summary of her remarks.

The Energy Information Center located on Fremont Street in San Francisco, is a library that attempts to catalog and keep track of all the energy related and environment related publications of the Department of Energy and the Environmental Protection Agency. It is a joint project between those two agencies. They also have available on a computer system a very quick scanning process to obtain a listing of publications, studies,

and other materials, films and so forth, that might be available through those two federal agencies. For information on geothermal resources at the federal level, the U.S. Geological Survey has done the bulk of the work. Circular 790 has been published and is available and gives the location of the low to moderate temperature resources in this geographical area.

The Department of Energy is made up of two previous energy organizations, the Energy Research and Development Administration and the Federal Energy Administration.

The San Francisco Operations Office of DOE located in Oakland, which is the former ERDA component, carries on the same mission it had under ERDA, which is funding major research and development projects through contracts, grants and other types of financial vehicles. It is the office responsible for funding economic and engineering feasibility studies on site specific cases, and for demonstration projects of various types. The person to talk to in that office is Hilary Sullivan. She can provide outline information on the studies and projects that have been funded so far. She will not be able to explain current projects that are being considered for funding because proprietary information rules apply until funding decisions are made. Also the San Francisco Operations Office is linked to the various national laboratories in this area - the Lawrence Livermore Laboratory, and the Lawrence Berkeley Laboratory.

For commercial applications information the Regional Representative's Office is the source of information. It is located in San Francisco and carries out the functions principally that were carried out under FEA. Most recently, the office was given the lead for commercial applications projects of any of the new technologies that are considered to be ready for the market place. Geothermal energy is one. For more financial assistance information in addition to the direct funding contracts and grants available through the San Francisco Operations Office, there is the Geothermal Loan Guarantee Program. Although it is a national program, the management for the program is located in the San Francisco Operations Office. In addition, the U.S. Small Business Administration has a loan program for small businesses interested in using different sources of energy or energy conservation projects.

Bob Schultz, EG & G Idaho

Bob Schultz described the technical assistance his firm can offer.

"E G & G Idaho Incorporated is the prime contractor at

the Idaho National Engineering Laboratory to the DOE. Geothermal energy is not going to be commercialized by the federal government, by the national laboratories, by the Universities, by the state offices. It's going to be commercialized by individuals and private corporations. So what DOE is trying to do is to make programs, technology, legislation available to you as private parties to allow you to do your own thing, and help you do it in the best way possible.

"About four years ago we started at the Idaho plant a little program that we called Tech Assistance, it's now called User Assistance. This program, after fighting through the bureaucracy a long period of time, was finally accepted. It's basically a program where we service a particular region. OIT also does the same thing that we do in their assigned region. What is a user assistance program? Many times individuals who are new to the geothermal energy industry, want to try to utilize geothermal energy but really don't know where to start, what to do, how to think about, how to assess what they have. The Department of Energy has this program to allow its contractors to offer some free help to an individual to help him get his act together. The user assistance program is not to compete with the architectural engineering firms, with the geologic firms or geoscience firms. The idea is to give these individuals, these key groups, help with their technology, and program development ideas so the individuals that need some help can be assisted to the point where they can go get professional help. The Tech Assistance Program or the User Assistance Program is available, and you end up calling my office in our area. I will refer you to one of my Tech Assistance Engineers and most of these people are engineers, though I do have botanists, aquaculturists, etc., on my staff. They will all sit down and spend some time talking with you, maybe helping you do some conceptual calculations to the point where you feel comfortable to go out and do your own thing. The laboratories and Tech Assistance Program won't do it for you. It's really not a give away program, it's an assistance program. In the last two years our case load has been about fifty people per year. The last three months we were out on sixty some odd calls. These were calls where we went out in the field to give assistance, not calls that came in the office. So it really picked up. Obviously the funding is lower than the calls now so we are feeling quite backlogged. This type of help is available in California, through the Oregon Institute of Technology. We cover Idaho, Montana, Wyoming, Utah, Colorado, New Mexico, North Dakota and South Dakota right now."

Syd Willard, California Energy Commission

Syd Willard described in more detail the DOE-CEC funded document, Direct Use Applications of Geothermal Resources at Desert Hot Springs, California - Self Start Manual.

The manual addresses various steps involved in developing geothermal resources; location of the resources, identification of necessary permits, market assessment, regulatory and environmental constraints, siting considerations, and technology status. This is one report done for one section of the State. For example, it does not mention the large potential for catfish farming. The CEC also has a brochure describing its direct geothermal program. It describes low temperature demonstration projects funded by the State and identifies technical assistance provided by the State.

CEC is initiating two new projects in the direct heat program. One contract compares California's regulation of drilling and use of low temperature geothermal wells with other western states. The State Lands Commission (SLC) is performing the work for CEC through an interagency agreement. The SLC's recommendation will be presented to the California Division of Oil and Gas (CDOG) and will hopefully result in improved procedures which will encourage drilling of low temperature geothermal wells. Another contract will produce a market survey of direct heat uses in the State. CEC will identify specific users, locations, and quantify energy displacement possible from direct uses. A survey will be conducted to identify commercial and industrial energy needs and potential for conversion to geothermal.

Paul Lienau, Oregon Institute of Technology

Mr. Lienau described the services available through the Geo-Heat Utilization Center at Oregon Institute of Technology (OIT), Klamath Falls, Oregon.

A Technical Assistance Program provides assistance to public and private entities in the direct application of geothermal energy by performing limited resource evaluation, engineering feasibility and economic evaluation. This program

serves the states of Alaska, Washington, Oregon, California, Nevada, New Mexico, and Hawaii by providing individuals (working with the developer) interested in developing geothermal resources, up to 100 man hours of effort. The types of programs specifically worked on include district heating, aquaculture, greenhouses, and well measurement and completion practices.

OIT also performs Northwest Regional Resource Planning which involves planning for the commercialization of geothermal resources in the states of Alaska, Washington, and Oregon.

Research and demonstration projects designed to use geothermal energy which are ongoing or have been completed at OIT are district heating, sugar refining, potato processing, vegetable dehydration, alfalfa drying, greenhouses, aquaculture, hydrology, geochemistry, well testing and materials analysis of components in geothermal heating systems.

Ken Wonstolen, Research Associate for the Geothermal Policy Project of the National Conference of State Legislatures (NCSL)

Mr. Wonstolen spoke on the services provided to the states through NCSL and issues California may wish to deal with to provide a more supportive environment for the commercialization of direct heat projects. The latter portion of his remarks, because they are recommendation oriented, can be found in Part II, Section 6 of this report.

The NCSL is a nonprofit service organization funded by the states. The main office is in Denver, Colorado and the office of state/federal relations is located in Washington, D.C.

The goals of NCSL are the following: to improve the efficiency of state legislatures; to provide a cohesive state voice for dealing with the federal system; and to foster inter-state cooperation.

Energy related grant projects of NCSL include the Geothermal Policy Project. The basic aspects of the project are the following: to keep abreast of geothermal developments; to perform general policy analysis; to provide an information and referral service; to work directly with project states to stimulate and assist geothermal policy reviews; to sponsor workshops for legislators and the geothermal

community; and to prepare policy documents such as a state profile, issues and options, and legislative recommendations.

Financial Aspects of Direct Geothermal Heat

(Kathy Schlegal, Department of Energy; John Woods, Vice President, Bank of Montreal; and Pete Hansen, Derek Hansen and Associates, served as resource persons for the session on financial aspects.)

Ms. Schlegal, U.S. Department of Energy

Ms. Schlegal described DOE's Geothermal Loan Guarantee Program. The Program was created under the 1974 Geothermal Resource Development and Demonstration Act. Regulations for the program were published in 1976 and the first loan was approved in 1977. DOE has been working with the banking community and industry to streamline the program. Under the 1976 regulations, the federal government could guarantee a loan up to 75% of the total project cost to a maximum of \$50 million per project or \$100 million per borrower. Duration of the loan is a maximum of 30 years, and collateral is usually limited to project assets only. The project must be environmentally acceptable and show a reasonable assurance of loan pay-back. The program was set up to get lenders and the geothermal community to work together. DOE expects the lender to evaluate the project as though the loan was not being guaranteed by DOE.

Additions to the program since 1976 include authority to give principal assistance, increase loans to \$100 million per project and \$200 million per borrower, and streamlining the regulations to provide more financial flexibility (e.g., institutional investors may participate in financing, etc.).

Today, three applications for loans have been approved, five are being evaluated, four are inactive and several more are being prepared. These projects total in excess of \$400 million. The average time for processing a loan is five months to one year. DOE's goal is to streamline the total process down to five - six months. One way of cutting the time down is to go over the project with the sponsor prior to an application being filed. The majority of applications received have insufficient information for processing and additional data must be requested and received by DOE.

In response to questions, Ms. Schlegal stated that DOE has a grant program for geothermal, administered separately from the loan guarantee program. It is oriented toward projects which would advance the state of the art in geothermal development. These kinds of projects are more risky from a bank's point of view.

In response to whether DOE would consider approving a loan for needed further studies for a well defined project, Ms. Schlegal responded that it would be considered if the project can be proved worthwhile and a reasonable assurance of loan repayment is determined. Money already invested can be counted as equity.

DOE reviews a range of projects which require modest to substantial loans. It varies with the circumstances and borrowers. The guarantee program expires in 1984.

John Woods, Vice President, Bank of Montreal

Mr. Woods discussed his perspective on the financial aspects of direct heat geothermal projects. The Bank of Montreal is the most active bank in DOE's loan guarantee program. Mr. Woods offered some suggestions to developers as to what to include in a loan application.

Developers should demonstrate to lenders the savings in energy costs by using geothermal over other fuels. A back-up system should also be identified. Important ingredients in a loan presentation are: management considerations (extremely important with low temperature projects); marketing; a development plan with time frames, accomplishments, etc.; identifying assumptions made in the financial information; and security to support the loan.

Mr. Woods stated that he believed the biggest hindrance to success of the DOE loan program to be the investment requirement of 25% equity investment from the borrower. He has discussed with state authorities the concept of some state compensation for part of the equity for smaller developers. However, the concept of the State raising money on the open market through a general obligation bond for such a project, might not be well received by the Legislature. The State could benefit from participating in other ways such as encouraging

new construction, generating new employment and reducing taxes, and more vigorously supporting a preferred energy source.

Pete Hanson, Derek Hanson and Associates

In response to the question about a possible state guarantee of the 25% not guaranteed by DOE, Mr. Hanson stated that the State would be more likely to consider a lower percentage such as 10% to 15%. He felt that a positive role for the State would be to expedite the development of financial programs and the movement of capital. For example, the California Pollution Control Financing Authority has been successful in obtaining from the Small Business Administration (SBA) 100% loans for small businesses. Also, the SBA has authorization for \$75 million worth of loans through DOE. The criteria set up for these loans are basically the same as the SBA regular loan program.

Regulatory Procedures for Drilling and

Operation of Shallow and Low Temperature

Geothermal Wells - A California, Oregon, Idaho Comparison

(Panel members for this session were Doug Stockton, California Division of Oil and Gas, Debra Justus, Oregon Department of Energy, and David Maclain, Idaho Office of Energy.)

California

Doug Stockton, California Division of Oil and Gas (CDOG)

In California, it is the policy of the State that the people have the direct and primary interest in development of geothermal resources. Through the State Oil and Gas Supervisor they may require all wells used for discovery and production of geothermal resources to be drilled, operated, maintained, and abandoned to safeguard life, health, property, and public welfare, and to encourage

maximum economic recovery.

The CDOG developed statewide geothermal regulations in May 1974. Changes are currently being made in their regulations and they are developing new regulations to implement recent legislation (AB 2644). Definitions of the terms low temperature geothermal fluid, low temperature geothermal well, low temperature geothermal field, are being revised.

The CDOG has a fee structure established for shallow, intermediate, and deep low temperature well drilling. Fees start at \$25 for shallow wells (250 feet), \$200 for intermediate (250 - 1,000 feet) and \$500 for deep wells (greater than 1,000 feet). CDOG also has a new \$2,000 bond requirement for low temperature wells less than 2,000 feet. This bonding requirement went into effect January 1979. A \$10,000 bond is required for low temperature wells less than 5,000 feet to 10,000 feet, and a \$25,000 bond for wells greater than 10,000 feet. All well bonds remain in force for the life of the well.

Other CDOG requirements for low temperature wells pertain to: well spacing; casing; records from the operator including an accurate log and history of drilling; tests for blowout prevention equipment, cementing, pumping and plugging; fluid injection; and abandonment.

There are some areas in California, due to slope instability or other physical hazards, where no drilling is allowed.

Oregon

Debra Justus, Oregon Department of Energy

Debra Justus, with the Oregon Institute of Technology, currently working with the Oregon Department of Energy, explained regulatory procedures in Oregon for the drilling and operation of low temperature wells.

In 1975 Oregon legislation governing geothermal development was amended to exclude shallow and low temperature wells. These wells are drilled under water-well regulations through the Oregon Department of Water Resources (DWR). Water-well regulations pertain to wells less than 2,000 feet deep and less than 250°F.

A geothermal well (defined by statute as any excavation 500 feet deep or more made for the discovery or producing of geothermal resources) is regulated by the Oregon Department of Geology and Mineral Industries (DOGAMI). This department also regulates prospect wells. Prospect wells include geophysical test wells, seismic shot holes, mineral exploration drilling, core drilling or temperature gradient test wells less than 500 feet in depth drilled in prospecting for geothermal resources. Pending legislation will amend this definition to include test holes less than 2,000 feet. A permit is not needed before drilling a shallow, low temperature well because it is considered the same as a water well. A start card should be filed with the county watermaster. Information required includes location, proposed use, and expected depth. A bond is required for water well drilling. Water rights on shallow, low temperature wells are not defined by statute. The DWR general policy is that if water is not reinjected, a water right cannot be received.

The DOGAMI procedure for permitting prospect wells requires the filing of a plan of operation and hole locations, a blanket bond, and notifying other agencies. Stipulations can be added to the permit by other state agencies. The Department of Environmental Quality stipulations are made a condition of every permit. Permits are issued within 30 days of receipt of an application. Formation logs and notations of water zones encountered are required of every operator. Blow out prevention rules require operators to monitor hole temperatures. If exceeding 125°F. drilling is stopped to permit adequate measures to be taken as prescribed in DOGAMI rules.

A permit for drilling a geothermal well can take up to 45 days and is issued by the State Department of Geology and Mineral Industries. Receipt of a permit is conditioned by approval of local government. There are bonding, blowout prevention, casing inspections, and other requirements prior to drilling, and additional blowout prevention tests during drilling and abandonment. Drilling records are held confidential for a four-year period.

New legislation is currently proposed in Oregon which will require reinjection wherever practical. Reinjection for shallow/low temperature wells will be regulated by the Oregon DWR while reinjection for geothermal wells will be regulated by the Oregon Department of Geology and Mineral Industries.

Idaho

David Maclain, Geothermal Resource Coordinator, Idaho Office of Energy

Mr. Maclain explained how Idaho regulates low temperature wells.

Any geothermal resource developed for energy conversion purposes which will involve consumptive utilization of thermal water, requires a water appropriation permit. The potential for discord between those concerned with water resources and geothermal development is considered to be the most critical legal conflict facing geothermal development in Idaho. In Idaho, water rights are owned by the State.

The Idaho Geothermal Resources Act declares geothermal to be "unique unto itself", neither water nor mineral but closely related to both. Under this act, any private owner, holder of a state or federal lease, or a federal entity working on a federal withdrawal is required to obtain a geothermal resource permit before drilling or altering any well for exploration or production purposes.

An application for appropriation of public waters must also be made if the proposed well involves consumptive use of water. If the well is being used solely for the mineral resource (energy resource of material need) it does not require a water-use permit. A geothermal permit is a construction permit or regulatory permit. If third party protection is needed, a water permit should be obtained.

An indemnification bond of \$10,000 is required for each well and remains in effect for the life of the well.

If a well is being drilled in Idaho for low temperature uses and it has a domestic space heating or agricultural application (greenhouse, etc.), only a normal water well drilling permit and a water-right permit is required. The Director of the Idaho Department of Water Resources may require any wells to be cased according to geothermal resource permit requirements. The Director can also waive bonds if other bonds are in place.

Suggestions for changes in California's regulations were offered at the workshop. These can be found in Part II, Section 6.

PART II

KEY ISSUES RAISED IN THE WORKSHOPS

INTRODUCTION

The main issues raised in the four workshops can be grouped into six categories. These categories are:

- (1) local government needs and concerns regarding geothermal development;
- (2) suggestions to state agencies for increasing their effectiveness in expediting sound geothermal development;
- (3) federal government interaction with local and state government for geothermal projects on federal land;
- (4) approaches to intergovernmental coordination for geothermal project approvals;
- (5) problems with present transmission corridor planning approaches; and
- (6) issues specific to direct geothermal heat utilization including recommendations to public agencies for providing more support for the development of this resource.

Some of the issues discussed at the workshops identify problem areas that need to be addressed and others include recommendations for dealing with specific problems.

SECTION 1.

LOCAL GOVERNMENT NEEDS AND CONCERNS REGARDING

GEOHERMAL DEVELOPMENT

Issues Requiring Attention

Advance planning for geothermal development at the local level was viewed as a must by those counties which have experienced this development. There was general consensus among the counties that individual project by project review was an inadequate approach to dealing with geothermal development. Given recognition of the fact that advance planning is desirable, the counties identified the need for the following types of information: the nature and extent of the geothermal resource in their county; the existing state and federal regulations governing development of the resource; and, potential environmental impacts associated with geothermal development. Many counties believed that this information is needed in advance of developing policies related to geothermal.

While most counties concurred that advance planning for geothermal is a necessity, not all were convinced that preparation of a geothermal element to the general plan is the wisest way to proceed. Some felt that an energy element which included geothermal as one energy source, would be more appropriate. There was general concurrence among the counties that Office of Planning and Research guidelines for the preparation of an optional geothermal element should be flexible enough to permit local needs to be adequately addressed.

In order to carry out comprehensive planning for geothermal develop-

ment all local governments agreed that technical and financial assistance are needed. They felt that the most effective means of providing this assistance is through (1) a team of state agency staff traveling as "circuit riders" to the counties providing needed assistance in the preparation of a geothermal element, or (2) for the State to contract with a consulting firm which would in turn provide technical assistance to the counties. It was also suggested that counties could individually apply to DOE or CEC for grant monies for technical assistance.

In general, it appeared that apart from "The Geysers' counties" and Imperial County, other counties with geothermal resources tend to be outside the mainstream of information flow. This could be a contributing factor to the lack of geothermal development in these counties.

Related 1977 Geothermal Task Force Recommendations

The Geothermal Task Force recommended in 1977 that local jurisdictions adopt zoning ordinances designating areas for geothermal development and that funds be provided by the State to those areas with the highest probability of development in order to prepare the ordinances.

Recommendations to the Geothermal Resources Board

- ° Draft a letter to all counties in the State with geothermal resources inquiring about their interest in receiving various kinds of information regarding geothermal development.
- ° Secure funding to carry out the above information distribution and determine which agency will be responsible.
- ° Secure funding for providing technical assistance to counties

which are interested in preparing local policies and regulations for geothermal development. This technical assistance should take the form of either a team of state agency staff traveling to the counties or a consultant contracted by the State to work with particular counties.

- ° Explore whether a locally prepared energy element to the general plan which includes geothermal as one energy source, could meet AB 2644 requirements.
- ° Inquire into whether counties are interested in knowing more about their particular geothermal resources and if interested assist them in determining how to assess these resources. Counties should be provided with the information that the Bureau of Reclamation has the legal authority to do a reconnaissance survey for a public agency, for the purpose of identifying the geothermal resource. The contact person is Lyle Tomlin, Bureau of Reclamation, Federal Building, 2800 Cottage Way, Sacramento, CA 95821, (916) 484-4504.
- ° Encourage counties to contact the State Solid Waste Management Board for assistance in dealing with geothermal waste management concerns.

SECTION 2

STREAMLINING THE STATE'S ROLE

Issues Requiring Attention

Two themes which ran through each of the four workshops relate to state agencies involvement in geothermal development. These are: (1) the need for a clear statement of state policy defining what geothermal's status as "a preferred energy source" means (if geothermal development is preferred, the workshop participants felt there should be greater evidence of expected siting of geothermal projects); and, (2) the need for better integration of effort by the State when making comments (e.g. on plans, programs, and related activities), coordinated permit approvals that could reduce lead time for projects, and a well thought-out process for coordinated policy statements related to federal land management proposals. Satisfying these needs could be approached in a number of ways. Selection of one agency to coordinate the effort was one possibility that received support.

Two other items were raised as issues which the State should address. One is the need for clarification of the terms "exploration", "proven", and "unknown resources". The other is a suggestion that in each KGRA it would be useful to have one repository of geothermal information for easier access by the public and local agencies (current practice requires interested parties to contact state and federal agencies in Sacramento, the San Francisco Bay Area, and Washington for documents).

Related 1977 Geothermal Task Force Recommendation

The Geothermal Task Force recommended in 1977 that the GRB coordinate permit actions for geothermal projects. Under AB 2644, the CDOG assumes this role for exploratory geothermal wells.

Recommendations to the Geothermal Resources Board

- ° Vigorously pursue integration of individual state agency concerns on a geothermal project, combined hearings for permit approvals from the State, and coordinated state policy regarding geothermal development as positive actions in recognition of geothermal as a preferred energy source.
- ° Obtain clarification of the terms "exploration", "proven resource", and "unknown resource".
- ° Consider how to implement the suggestion that each KGRA contain a repository of information on geothermal issues of interest to that area.

SECTION 3.

FEDERAL GOVERNMENT INTERACTION WITH LOCAL AND STATE GOVERNMENT FOR GEOTHERMAL PROJECTS ON FEDERAL LAND

Issues Requiring Attention

Two major issues were brought out at the workshop dealing with local and state relations with federal land managers. First, the continuing slowness by the federal government to open up its resources for geothermal development. Second, the question of local and state permit authority over geothermal development on federal lands was of prime interest.

The first issue deals with a problem faced by federal land managers in their decision to open an area up to geothermal development. The federal land managers are looking for early policy input from local and state agencies on these matters. It also appears important from discussion at the workshop, that federal land managers solicit local and state agencies views early enough in their land management planning process to incorporate these views in their decision making process. Going one step further, federal agencies are suggesting that comprehensive plans reflecting state and local policies toward energy development (geothermal being one element) would give federal agencies solid ground for making better and quicker decisions on geothermal development on federal lands.

The second issue deals with permit authority on federal lands. The counties especially were interested in knowing how, when, or if a county could extend its permitting authority to geothermal projects on federal land. Also, the question was raised whether the State has any permitting

authority, or precedent for claiming authority on federal lands. The USGS reported that federal lessees are encouraged to obtain local permits. These questions were of interest to many participants but unanswerable at the workshop.

Another question raised was the need for both USGS and USFS to be involved at the pre-lease stage. There was some support at the workshop for providing a mechanism for an operator to deal with only one federal agency as his project develops.

Related 1977 Geothermal Task Force Recommendation

In terms of federal interaction with state and local agencies on a geothermal project, the Geothermal Task Force recommended that environmental documents be jointly prepared or shared with one another. This is taking place now on various projects as was discussed at the Federal Leasing and Environmental Review Workshop.

Recommendations to the Geothermal Resources Board

- ° Work with federal land managers to identify the kinds of local and state policy plans that need to be developed in order to expedite federal land use decisions that impact geothermal development.
- ° Address the issue of state and local permit authority on federal lands as it relates to environmental protection and land use.
- ° Investigate whether the involvement of both USGS and USFS in the geothermal pre-lease stage is necessary.

SECTION 4.

INTERGOVERNMENTAL COORDINATION

Issues Requiring Attention

A recurring theme ran throughout all four workshops. "It is the cumulative impact of so many agencies involvement with geothermal that slows down development of the resource." During the workshop on Federal Leasing and Environmental Review Procedures, several examples of agencies entering into memoranda of understanding (MOU) for geothermal projects were presented (see Part I, Section 2). It was mentioned in the workshop that it is important for staff having decision making authority to be participants in the MOU.

Recommendations to the Geothermal Resources Board

The following recommendation, developed in workshop #3, is the most concise statement made during the four workshops on the subject of inter-governmental coordination:

One agency should take the lead role to coordinate the following activities of federal, state and local agencies having jurisdiction over a geothermal project:

1. Environmental review.
2. Consolidated hearings.
3. Development of a single set of criteria for regulatory agency requirements.
4. Lead agency determination should be made on an individual project basis.

Workshop participants felt that the following groups in particular should receive this recommendation: GRB TAC, CEC, quarterly meeting of federal land managers and state agencies, and OPR.

SECTION 5.

TRANSMISSION CORRIDOR PLANNING FOR GEOTHERMAL

Issues Requiring Attention

Transmission corridor planning for small geothermal power plants in remote areas proved to be a difficult issue to deal with in workshop #3. The lack of state policy relating to needed transmission corridors and the lack of early coordination between the utility and government entities on proposed corridors appeared to be key factors contributing to the complexity of transmission planning for geothermal generated power. The major issues brought out during the transmission corridor workshop were the following:

First, some public agencies expressed concern that the utilities were not involving government bodies early enough in their planning for alternative corridors. A lack of early coordinated planning for transmission lines between utilities and public agencies and also among public agencies themselves, was cited as a general problem which impacts negatively on geothermal development.

Second, the consensus of workshop participants was that a statewide plan for transmission corridors needs to be created with geothermal electricity as one important subpart. This plan should be prepared by state agencies with input from local government, industry, and the public. Such a plan also could serve as one criterion for future federal land use planning in the State. The plan could identify the electrical transmitting capacity of existing lines and statewide needs for additional capacity. Some reservations were raised about the usefulness of such a plan because of the

implied tendency toward greater government involvement, and the ability to reach consensus on transmission corridor locations. Nonetheless, workshop participants felt that this recommendation for a Statewide Transmission Corridor Plan should be sent to Governor Brown, Secretary for Resources, Director of Conservation, GRB, Geothermal Policy Committee of Energy Commission, and appropriate legislative committees.

The third issue that workshop participants discussed was wheeling. All participants agreed that wheeling is an important issue when faced with a small scale geothermal power plant and an expensive transmission system. Much discussion was devoted to wheeling and the participants recommended that a legal opinion on wheeling be requested of the Attorney General's Office and the Public Utilities Commission.

Related 1977 Geothermal Task Force Recommendation

The Geothermal Task Force recommended that the Public Utilities Commission sponsor legislation giving common-carrier status to the transmission facilities of all electric utilities, publicly or privately owned, requiring necessary interconnections to allow transfer of electrical energy and authorizing the PUC to set rates of compensation for such practices. (Dissent filed)

Recommendations to the Geothermal Resources Board

Investigate the benefits which could be gained for geothermal development, from the development of a Statewide Plan for Transmission Corridors, as described above.

SECTION 6.

EXPEDITING THE COMMERCIALIZATION OF

DIRECT HEAT PROJECTS

Issues Requiring Attention

Recommendations made at the 4th workshop for expediting the commercialization of direct heat projects focused on both local and state government. The recommendations relate to the marketing of geothermal energy to industrial developers, the benefits of geothermal district heating legislation, and reducing the regulatory requirements for low temperature wells.

Geothermal Energy for Industrial Parks

The consultant to the City of Susanville on geothermal matters, Fred Longyear, was a strong advocate for bringing together geothermal resource developers with economic development interests for the purpose of supplying industrial parks with a stable, low-cost supply of energy year round. He believes that geothermal hot water systems will become more economically attractive for development where industrial parks are also being planned. Individual developers can run into economic obstacles when drilling an expensive well and only using a small part of that energy as an individual. The availability of geothermal energy can be used as one incentive for an industrial development package. Direct use of geothermal energy is more of an economic development effort than an energy development effort. This will be even more so when the institutional procedures are brought into line for geothermal direct use.

District Heating Legislation and Other State Initiatives

The National Conference of State Legislatures (described in Part I, Section 4) is undertaking a Geothermal Policy Project. Ken Wonstolen, Research Associate on this project, was asked to discuss the kinds of state actions which could be taken to facilitate the direct use of geothermal resources. Mr. Wonstolen directed his remarks to the issues associated with District Heating through geothermal. His remarks were as follows.

Among the vehicles for carrying out district heating are investor-owned utilities, publicly owned utilities and joint enterprises such as a joint power authority. In some states amendments have been proposed to public utility codes to clearly authorize political subdivision to provide district heating service. Unlike private corporations, political subdivisions can only perform those actions for which there is express or implied legal authority. The legal authority for entering into district heating on the part of a public utility is still questionable in many states.

Oregon is the first and only state to enact comprehensive Geothermal District Heating legislation. This approach has the advantages of high political visibility and creating a special district with a specific mandate to use geothermal resources. Possible disadvantages to this approach are that the initial district formation can be difficult, and it contributes to the proliferation of special districts.

New Mexico and Utah are considering District Heating legislation in the form of proposed amendments to the existing special district statutes. In New Mexico the proposal is to authorize municipalities to form heating districts. This authorization would extend by implication to special districts. In Utah, through consultation with legislators, metropolitan water districts were selected as appropriate vehicles to develop district heating. The advantages of the New Mexico and Utah approach are that it utilizes existing political subdivisions, and it is easier to draft amendments than to put a comprehensive bill together. The disadvantages of this approach versus creating special districts specifically for geothermal district heating are that the political visibility is lower, and the mandate is diluted.

The basic parameters involved in starting a special heating district begin with the formation of a district and a determination of its boundaries. The purpose and functions of the heating district need to be identified. The purposes could be to produce, distribute, utilize, sell, and dispose medium heat geothermal resources for public/private heating and cooling. Such functions could also include management of waste heat and cogeneration sources of supply. The district could encourage integrated development of cascaded uses. Since political subdivisions are not risk-taking entities, questions may be raised regarding their involvement in exploratory drilling unless the resource is demonstrated. Ken Wonstolen's opinion is that where a resource has been demonstrated or where the federal government may supply the funds, a political subdivision may have the ability to drill on its own. In an area where the resource has not been demonstrated there will have to be some innovative approaches to discovery, such as a joint venture or buying from a geothermal supplier.

Another basic parameter is the powers of the district to sue and be sued, to contract for services and employ personnel, to acquire and dispose of property within and without the heating district, to fix rates and to appor-tion service charges. It is important that heating districts have the power to acquire easements on public byways and existing corridors and further, to have the power of eminent domain to complete a transmission system and possibly to acquire sources of supply. An additional power which would be useful to heating districts is joint enterprise authority. It can take the form of a joint power authority with other political subdivisions or joint ventures with private companies.

It is important for heating districts to have bonding authority, both general obligation bonds and revenue bonds, especially the latter. The marketability of these bonds would be improved if the state declared district heating bonds a legal investment for various trust funds and institutional investors.

A matter that needs clarification is whether Public Utility Commissions (PUC) have rate jurisdiction over heating districts. NCSL suggests that states consider exempting heating districts from PUC rate regulation.

Three categories of state actions were identified which would create a more supportive environment for direct heat projects. The first category relates to stimulating an initial market through financial assistance

for demonstration projects, geoheating public buildings where feasible, developing innovative building codes (e.g., San Diego solar hot water initiative), and providing public education and technical assistance programs.

The second category of state initiatives deals with financial incentives. A basic option is a state loan guarantee program. In terms of taxation, residential and commercial alternative energy systems (specifically geothermal) may be exempted from property tax assessments, and be given income tax credits or deductions for expenditures. Innovative financing should be explored, such as state-supported exploration bond issues. Royalties and severance taxes on production for direct use might be waived, perhaps on a BTU basis. Also, property taxes on direct use sources of supply lease/production could be deferred until commercial production is reached.

The third category deals with legal and regulatory options. Streamlined regulatory procedures comprising one-stop permitting, an ombudsman to help projects get going, generic environmental assessments that distinguish between exploration and development impacts, and inter-agency coordination should be implemented. Geothermal zoning elements should be prepared to eliminate the need for special use permits and case by case review. Flexible lease size should be allowed for direct use projects. Geothermal resources may be defined to exclude fluids susceptible to direct use. Such a definition might be based on nature of the use, and/or physical (temperature and depth) characteristics. A physical definition would characterize the geothermal resource as having high enthalpy and would subject the resource to leasing, royalties and severance taxes. Hot water would be characterized by a low enthalpy, be subject to appropriation and be exempt from royalties and severance taxes.

A major issue with geothermal development is the nature of water rights in relation to geothermal. Beneficial uses of water should include enthalpy utilization. Water rights could be limited to consumptive use or offsets. Economic drilling levels could be designated to limit liability for lifting costs.

In the entire direct use area states have a great opportunity for innovative land use and economic planning. Integrated development of cascaded multiple uses makes sense in terms of land use and energy efficiency. Perhaps energy corridors could be developed which would include industrial parks and transmission networks.

Regulatory Requirements for Low Temperature Wells

In the workshop session dealing with an Oregon-Idaho-California comparison of regulations for low temperature well drilling and operation, some suggestions were made by the workshop participants regarding changes in California's regulations. The suggestions were as follows: the number of permits required and state agencies involved with low temperature well drilling should be reduced; the areas of categorical exemptions and/or negative declarations should be expanded to cover low temperature wells; bonds for low temperature wells should be eliminated.

Related Geothermal Task Force Recommendation

The Geothermal Task Force made two recommendations related to low temperature geothermal. They are: 1) establish a statewide policy to encourage the use of non-electric hot water geothermal resources for commercial and noncommercial uses where the development is consistent with environmental quality concerns; and, 2) ask the Division of Oil and Gas to sponsor legislation to eliminate bonding requirements for the "life of the well" for low temperature geothermal wells which are not a threat to health, safety, or the environment.

Recommendation to the Geothermal Resources Board

Based on the above described workshop sessions dealing with low temperature geothermal, the following are recommendations for GRB action.

1. In conjunction with local government, explore the concept of linking the development of low temperature geothermal resources with the development of industrial parks.

2. Explore the possibility of geothermal district heating legislation for California. Analyze the Oregon, New Mexico, and Utah experiences.
3. Examine the taxing structure for low temperature geothermal wells and consider changes which would make development of this resource more attractive.
4. Look into the concept of flexible lease size for direct heat projects.
5. Consider supporting a redefinition of geothermal resources to exclude fluids susceptible to direct use.

Other recommendations made at the workshops include expediting the permit process, increasing the applicability of categorical exemptions, and eliminating bonding requirements for low temperature wells. (Note: The Division of Oil and Gas has never received an application to drill for low temperature resources.

For information on how to obtain workshop materials listed in the following Appendices, contact Suzanne Butterfield at the Department of Conservation (916 - 322-5873).

APPENDIX 1

WORKSHOP #1

COUNTY PLANNING FOR GEOTHERMAL DEVELOPMENT

Agenda A-1a
List of Attendees A-1b
List of Workshop Materials A-1c

WORKSHOP ON COUNTY GEOTHERMAL PLANNING

Holiday Inn North
 1900 Canterbury Road
 Sacramento, California
 (916) 927-3492
 December 7 and 8, 1978

AGENDA

Thursday, December 7, 1978

10:30-10:45 -- Welcome and Introductions
 Objectives of the Workshop

Priscilla Grew, Director
 Department of Conservation

10:45-11:45 -- Overview of Geothermal
 Resources and Presentation
 of State Agencies' Concerns
 Questions

MODERATOR: Priscilla Grew
 Dept. of Conservation
 Panel: Dept. of Conservation
 Calif. Energy Comm.,
 Air Resources Board,
 Dept. of Water Res.,
 State Lands Comm.,
 Dept. of Fish & Game

11:45- 1:05 -- LUNCH

1:10- 2:15 -- Geothermal Legislation

MODERATOR: Steve Larson
 Dept. of Conservation

- . 1978-79 Geothermal
 Legislation
- . Implementation of AB 2644
 (Power plant siting
 authority)
- . Implementation of AB 2644
 (Exploratory Wells)

Panel: John White, Assembly
 Committee, Land Use,
 Natural Resources
 and Energy; Nancy
 Deller, Calif. Energy
 Comm.; Simon Cordova,
 Div. of Oil and Gas

2:15- 2:25 -- BREAK

2:25- 3:25 -- Advance Planning for Geothermal
 Development - Local Government
 Experience

MODERATOR: Kathryn Tobias,
 Office of Planning
 and Research

PANELISTS: Dowell Martz, Chairman, Napa
 County Board of Supervisors

Jim Chapman, Lassen County Board of Supervisors

Don Johnson, Private Consultant, former Lake
 County Planning Director

Mary Jadiker, Lake County Energy Council
 and Planning Commissioner

Leonard Fabian, Imperial County Planning Staff

Rollin Russell, McCulloch Geothermal

December 7, (continued)

- 3:30- 4:45 -- Small Group Sessions
County Concerns with Geothermal Development
- 4:45- 5:15 -- Large Group Reconvenes - Setting Priorities
Raised in Small Group Sessions
- 5:15- -- ADJOURN

Friday, December 8, 1978

- 8:45- 9:00 -- COFFEE
- 9:00-10:30 -- Preliminary Draft Guidelines
for County Geothermal Elements
Group Discussions
Kathryn Tobias,
Larry Mintier,
Office of Planning
and Research
- 10:30-11:30 -- OPEN SESSION
- 11:30-12:00 -- Preview of Upcoming Workshops
Suzanne Butterfield
Workshops Coordinator
- 12:00- -- ADJOURN

WORKSHOP ON COUNTY GEOTHERMAL PLANNING

December 7 and 8, 1979

Holiday Inn
1900 Canterbury Road
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LIST OF WORKSHOP MATERIALS

Geothermal Resources Board Technical Advisory Committee membership list

California Division of Oil & Gas CEQA compliance process for exploratory
geothermal wells

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to the

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Federal Leasing/Environmental Review Procedures - Expediting the Process

GEOHERMAL RESOURCES BOARD

WORKSHOP #2

January 18 and 19, 1979
 Senator Hotel, Southern Pacific Room
 12th and L Streets
 (916) 442-5081
 Sacramento, CA

A G E N D A

THURSDAY, January 18, 1979

1:00 - 1:15 - Welcome and Introductions,
 Workshop Preview

Priscilla C. Grew, Chairperson
 Geothermal Resources Board

1:15 - 2:15 - Federal and State Leasing
 Processes (Legal Requirements
 and Administrative Policy)

PANEL: Don Hoagland, State Lands
 Commission
 John Moon, Bureau of Land
 Management
 Bob Rice, U. S. Forest Service
 Leroy Mohorich, U. S.
 Geological Survey

2:20 - 2:50 - Forest Service Land
 Management Planning

Bob Rice, U. S. Forest Service

1. Upcoming Land Management
 Plans and Geothermal Concerns -
 Are They Coordinated?

2. RARE II Update

2:50 - 3:00 BREAK

3:00 - 3:45 - Interagency Efforts to Expedite
 Environmental Review and Leasing
 for Geothermal

MODERATOR: Michael Gersick, Department
 of Conservation

Existing Interagency Efforts at:

1. The Geysers--The NCPA/Shell
 Project

PANEL: Matt Brady, California Energy
 Commission
 Joel Verner, BLM, Ukiah

Thursday, January 18--cont.

2. Coso

PANEL:

Syd Willard, California
Energy Commission
Tom Dodson, U. S. Navy

3. Magma and Republic Power Plants
at East Mesa

Roger Haskins, BLM, Riverside
Dick Mitchell, Imperial County

3:45 - 4:30 - Recommendations for New Interagency
Efforts to Expedite Environmental
Review and Leasing of Geothermal
(to be continued in Friday small
group sessions)

FACILITATORS: Kathryn Tobias, Office of
Planning and Research
Judy Warburg, Department of
Water Resources
ALL WORKSHOP PARTICIPANTS

4:35 - 5:30 - Final Report of Federal Streamlining
Task Force - "Streamlining the Federal
Leasing and Environmental Review
Procedures"

Presentation

PANEL:

Marty Domagala, Department
of Energy, San Francisco

Critique

Don Hoagland, State Lands
Commission
Syd Willard, California Energy
Commission
Jack Lahr, BLM

Request for Comments from
Workshop Participants

FRIDAY, January 19, 1979

8:30 - 9:00 - Workshop Registration

9:00 - 9:15 - Welcome and Summary of
Thursday's Sessions

WORKSHOPS COORDINATOR

9:20 - 10:50 - Small Group Workshops
(3 Concurrent Sessions)

A. Interagency Cooperative
Efforts to Expedite
Leasing - an action plan
for Thursday's Recommendations

FACILITATORS: Kathryn Tobias, Office of
Planning and Research
Judy Warburg, Department of
Water Resources

B. Geothermal Leasing Plans for
Interagency Coordination

Don Hoagland, State Lands
Commission
Roald Bendixon, Bureau of
Land Management

C. Bureau of Land Management
Wilderness Assessment -
Providing Feedback to BLM
on Wilderness/Geothermal
Tradeoffs for: COSO, Randsburg,
East Mesa, Yuha, Tecopa, Cady
Mountains, Amboy Crater

Jack Lahr, Bureau of
Land Management

10:50 - 11:00 - BREAK

11:00 - 11:45 - Reports from Small Group
Workshop Participants

WORKSHOPS COORDINATOR

11:45 - 12:30 - OPEN SESSION--Items

1. AB 2644

WORKSHOP WRAP-UP

WORKSHOP ON FEDERAL LEASING

January 18 and 19, 1979

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LIST OF WORKSHOP MATERIALS

Proposed Geothermal Program - BLM California - 1979

Bureau of Land Management - Geothermal Leasing Program in California -
April 1978

Memorandum of Understanding regarding the Northern California Power Agency
Geothermal Unit #2 Power Plant at The Geysers, Sonoma County, California

Federal Register, November 29, 1978, Part VI, CEQ, National Environmental
Policy Act, Implementation of Procedural Provisions; Final Regulations

The Role of the U.S. Geological Survey in the Federal Geothermal Leasing
Program by Reid T. Stone, Henry L. Cullins, and Max D. Crittenden, USGS,
Menlo Park, California 94025

Interim and Final Reports of the Interagency Geothermal Streamling Task
Force to the Interagency Geothermal Coordinating Council

Geothermal Leasing in California - State-Federal-Local Agency Task Groups
Working Paper

APPENDIX 3

WORKSHOP #3

TRANSMISSION OF GEOTHERMAL GENERATED ELECTRICITY FROM REMOTE AREAS

Agenda A-3a
List of Attendees A-3b

GEOHERMAL RESOURCES BOARD

WORKSHOP #3

TRANSMISSION OF GEOHERMAL POWERED
ELECTRICITY FROM REMOTE AREAS

February 15 and 16, 1979

El Rancho Inn
1100 El Camino Real
Millbrae, California
(415) 528-1234
(5 minutes from
San Francisco
International Airport)

AGENDA

THURSDAY, FEBRUARY 15, 1979

9:30 a.m. - 10:00 a.m.

Registration in
Portola Room

10:00 a.m. - 11:15 a.m.

Welcome and Introductions

Priscilla C. Grew, Chairperson
Geothermal Resources Board

Introduction of Group

Participants

Overview of the two days
events

Suzanne Butterfield,
Workshops Coordinator

Introduction of Michael
Doyle, Co-Director, Center
for Collaborative Problem
Solving - explanation of
role

Michael Doyle and Participants

11:15 a.m. - 11:25 a.m.

Coffee Break

11:25 a.m. - 12:00 p.m.

Informational presentations
on wheeling, transmission
corridors, geothermal anomalies,
wilderness study areas

Workshop Resource people

THURSDAY, FEBRUARY 15, 1979 (Continued)

12:00 p.m. - 1:00 p.m.

Lunch - (buffet lunch available)

WORKSHOP SESSIONS

1:15 p.m. - 2:15 p.m. - Workshop Session I

Group A - question 1 -- Portola Room, section a
Group B - question 2 -- Portola Room, section b
Group C - question 3 -- Penthouse
Group D - question 4 -- Cortez Room

2:20 p.m. - 3:20 p.m. - Workshop Session II

Group A - question 2 -- Portola Room, section b
Group B - question 3 -- Penthouse
Group C - question 4 -- Cortez Room
Group D - question 1 -- Portola Room, section a

3:25 p.m. - 4:25 p.m. - Workshop Session III

Group A - question 3 -- Penthouse
Group B - question 4 -- Cortez Room
Group C - question 1 -- Portola Room, section a
Group D - question 2 -- Portola Room, section b

4:30 p.m. - 5:30 p.m. - Workshop Session IV

Group A - question 4 -- Cortez Room
Group B - question 1 -- Portola Room, section a
Group C - question 2 -- Portola Room, section b
Group D - question 3 -- Penthouse

5:30 p.m. - 6:30 p.m.

Social Hour - Cocktail Lounge
(Hors d'oeuvres will be provided)

6:45 p.m. - 8:30 p.m. - El Rancho Inn Restaurant

6:45 p.m. - 7:00 p.m.

Closing Remarks of the Day

Suzanne Butterfield

7:00 p.m. - 8:30 p.m.

Dinner

Informal Review of Work Sheets
developed in Small Group Sessions
(sheets will be posted in dining
area)

FRIDAY, FEBRUARY 16, 1979

8:30 a.m. - 11:35 a.m. -- All Workshop Participants, Michael
Portola Room Doyle as facilitator

8:30 a.m. - 9:10 a.m.

Question 1

Presentation of
recommendations developed
in group sessions

Group A, B, C, D
Spokespersons

Assignment of priorities
to recommendations

All Workshop Participants

Feedback from responsible
Agencies

9:15 a.m. - 9:55 a.m.

Question 2

(Same Format as Question 1)

9:55 a.m. - 10:10 a.m.

Coffee Break

10:10 a.m. - 10:50 a.m.

Question 3

(Same Format as Question 1)

10:55 a.m. - 11:35 a.m.

Question 4

(Same Format as Question 1)

11:35 a.m. - 12:00 p.m.

OPEN SESSION

12:00 p.m.

CLOSE OF WORKSHOP

WORKSHOP ON TRANSMISSION CORRIDORS

TRANSMISSION OF GEOTHERMAL POWERED
ELECTRICITY FROM REMOTE AREAS

February 15 and 16, 1979

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APPENDIX 4

WORKSHOP #4

THE POTENTIALS FOR DIRECT GEOTHERMAL HEAT UTILIZATION IN CALIFORNIA

Agenda A-4a
List of Attendees A-4b
List of Workshop Materials A-4c

WORKSHOP #4

THE POTENTIALS FOR DIRECT

GEOHERMAL HEAT UTILIZATION IN CALIFORNIA

March 8 and 9, 1979
 Holiday Inn North
 1900 Canterbury Road
 Sacramento, California
 (916) 927-3492

AGENDATHURSDAY, MARCH 8, 19798:30 a.m. - 9:00 a.m.

Registration, Kona Room

9:00 a.m. - 9:15 a.m.

Welcome and Introductions

Priscilla C. Grew, Chairperson
Geothermal Resources Board9:15 a.m. - 9:35 a.m.Overview of Low Temperature
Geothermal Resources in
CaliforniaRoger Martin, California
Division of Mines & Geology9:35 a.m. - 10:00 a.m.Potential Uses of Direct
Geothermal HeatJohn Lund, Oregon Institute
of Technology10:00 a.m. - 10:15 a.m.

Coffee Break

10:15 a.m. - 12:00 p.m.Commercial Users of Direct
Geothermal Heat

SPEAKERS WILL INCLUDE:

Rollin Russell, McCulloch Geothermal
 Ken Boren, Geoproducts
 Pete Belcastro, Medo-Bel Creamery
 Larry Howard, Presbyterian Intercommunity
 Hospital, Klamath Falls
 Leo Ray, Catfish Farms of America
 Dick Matherson, Agrigrowth Industries
 Charles Richardson, City of Susanville

THURSDAY, MARCH 8 (continued)

12:00 p.m. - 1:15 p.m.

Lunch

1:15 p.m. - 2:30 p.m.

Commercial Users, continued

2:30 p.m. - 2:45 p.m.

Coffee Break

2:45 p.m. - 5:00 p.m.

How to get a direct geothermal
heat project started

Problems which may be encountered

What the State can do to provide
a more supportive environment

-ALL WORKSHOP PARTICIPANTS

-RESOURCE PERSONS (to be arranged)

FRIDAY, MARCH 9, 1979

8:30 a.m. - 9:00 a.m.

Registration, Maui Room

9:00 a.m. - 10:30 a.m.

Financial Aspects of Direct
Geothermal Heat Utilization

PANEL:

John H. Woods, Vice President
Bank of Montreal
Ken Bromberg, Geothermal Loan
Guarantee Program, Department
of Energy

10:30 a.m. - 10:45 a.m.

Coffee Break

10:45 a.m. - 11:15 a.m.

Technical Assistance for
Direct Geothermal Heat Projects

Sharon Sellars
Department of Energy

11:15 a.m. - 12:00 p.m.

Regulatory Procedures for drilling
and operation of shallow and low
temperature geothermal wells -
A California-Oregon comparison

PANEL:

Deborah Justus, Oregon Department
of Energy
Doug Stockton, California Division
of Oil and Gas

Discussion of desirable changes
to California's regulatory
procedures

RILAY, MARCH 9 (continued)

12:00 p.m. - 1:15 p.m.

Lunch

1:15 p.m. - 2:30 p.m.

Regulatory Procedures, continued

2:30 p.m.

Workshop Wrap Up

Return to: Suzanne Butterfield
Workshops Coordinator
Geothermal Resources Board
Department of Conservation
1416 9th Street, Room 1335
Sacramento, CA 95814

or, call (916) 322-5873
(916) 322-6823

I will / will not attend March 8th and 9th Workshop
on Low Temperature

Name _____

Organization _____

Address _____

THE POTENTIAL FOR DIRECT GEOTHERMAL
HEAT UTILIZATION IN CALIFORNIA

March 8 and 9, 1979

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| Donna Benner-Drury
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- | | |
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LIST OF WORKSHOP MATERIALS

State of Idaho - Well Construction Standards - Rules and Regulations,
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and Minimum Well Construction Standards, June, 1978

Information and assistance available through the Federal Government (in
regards to direct geothermal uses)

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Space Heating, by John W. Lund, Professor of Civil Engineering Technology,
Associate Director of the Geo-Heat Utilization Center, Oregon Institute
of Technology, Klamath Falls, Oregon

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Montreal (California)

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of Oil & Gas, Pub. # PR 75, 1978