

FEDERAL GEOTHERMAL PROGRAM PLAN
FOR
FISCAL YEAR 1983

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Budget and Planning Working Group
of the
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1.0 INTRODUCTION

The Federal government has been actively involved in the development of geothermal energy since 1970, when the Geothermal Steam Act was passed. Federal responsibilities and programs are divided among a number of agencies whose activities are coordinated through the Interagency Geothermal Coordinating Council (IGCC), which was established in 1974 by PL 93-410. The IGCC is comprised of the Departments of Energy, Commerce, Defense, Interior, Housing and Urban Development, Treasury and Agriculture, and the Environmental Protection Agency. The following sections delineate the FY 83 geothermal activities that are being undertaken by the member agencies.

2.0 PROGRAM PLANS FY 83

2.1 Department of Energy (DOE)

The overall objective of the Department of Energy's geothermal program is to perform high-risk, high-payoff research and development activities which will lead to the development of a technology base that could be used for future development by the private sector. The FY 83 Geothermal Program is structured around three areas: orderly completion of the hot dry rock (HDR) project pending access of reliable research data; completion of the government involvement in the geopressured resource definition work as the private sector assumes greater responsibility; and the performance of R&D in geochemistry, geoscience, and energy conversion research associated with moderate-temperature hydrothermal resources.

2.1.1 Hot Dry Rock Resources

The goal of the Hot Dry Rock Program is to establish the technical feasibility of extracting energy from the earth's hot, water-deficient rocks. Successful demonstration of extracting HDR energy has been proven with a 5 megawatt (MW) thermal loop at Fenton Hill, New Mexico. Continued testing of the thermal loop will address critical areas such as:

- flow control through multiple fractures
- thermal drawdown and reservoir longevity
- controlling dissolved solids contents of circulating fluids
- scaling and corrosion
- long-term environmental effects

Other key issues remaining are to demonstrate HDR energy extraction at commercial scale and to confirm the size and availability of HDR resources.

2.1.2 Geopressured Resources

During the past several years, the Geothermal Geopressured Program has established that there is a very large quantity of hot brine contained at high pressure in sandstone aquifers beneath the Texas-Louisiana Gulf Coast. Essentially all of this brine is saturated with dissolved natural gas (methane) for a total of about 5,700 quads of gas in place. The thermal energy content of the brines is about equal to the methane energy content, although the recoverable thermal energy is less. Principal program activities will concentrate on the production testing of four specially designed wells. Brine flow rates of up to 40,000 barrels per day will provide data on geopressured reservoir performance. Analysis of these data should allow industry to predict how much methane and thermal energy can be recovered from a geopressured reservoir.

2.1.3 Moderate-Temperature Hydrothermal Resources

Conventional oil and gas technology, currently employed for geothermal exploration, drilling, and reservoir production has proven expensive, unreliable, and frequently non-functional. Surface equipment, including power plant components, lack the efficiency and reliability for electric power generation for all except the high-temperature, high-flow rate, most benign hydrothermal resources. As a result, only a small percentage of the available hydrothermal reservoirs can be economically exploited.

Current research and development activities are in the areas of high-risk and are directed toward:

- substantially reducing hard rock drilling costs
- increasing moderate-temperature energy conversion through binary cycle technology
- increasing reservoir production rates through well stimulation techniques and improved downhole brine pumps
- developing reliable exploration techniques
- improving reservoir engineering methods for assessing site-specific capacity and longevity
- developing environmental control technology for air emissions, and solid and liquid waste disposal.

2.1.4 Geothermal Loan Guaranty Program (GLGP)

The Geothermal Energy Research Development and Demonstration Act of 1974 provided for the establishment of the GLGP and of the Geothermal Resource Development Fund. The objectives of the GLGP are to encourage the public and private sectors to accelerate the utiliza-

tion of geothermal resources by minimizing lenders' financial risk; develop a financial service infrastructure to ultimately provide financing of geothermal projects without Federal assistance; promote competition and encourage new entrance of firms into the geothermal marketplace. The GLGP has largely fulfilled its purpose and FY 1983 activities will concentrate on program direction to monitor loans presently outstanding.

2.1.5 Heber Project

A cooperative agreement was executed between DOE and the San Diego Gas and Electric Company (SDG&E) on September 26, 1980, for the design, construction, and operation of a 50 MWe binary plant at Heber in the Imperial Valley of California. The plant is intended to demonstrate the feasibility of binary cycle technology on a commercial scale. In FY 1983, DOE will be continuing to provide support for this project. Funds are to be used for the continued design; procurement of long-lead time materials; and ultimately the construction and operation of the plant. In an attempt to achieve the project goal, the Heber project will address the following technical and environmental concerns:

- Determine reservoir performance characteristics of a specific liquid-dominated hydrothermal reservoir;
- Evaluate the validity of reservoir engineering estimates of reservoir productivity;
- Provide actual construction and operation data necessary for the financial community to evaluate the risks and benefits associated with geothermal investments.

2.1.6 Hydrothermal Industrialization

All FY 1983 activities associated with the hydrothermal industrialization program (except those related to the Heber project) are being terminated.

2.2 Department of the Treasury

The Department of the Treasury does not allocate funds directly to Geothermal activities. Departmental participation in this program is handled within the normal staff expenses. Treasury's geothermal-related functions are: 1) as a lender, under the guaranteed loan program, through the Federal Financing Bank; and 2) as administrator of the tax incentives that apply to geothermal development.

2.3 Department of Housing and Urban Development (HUD)

2.3.1 Community Planning and Development

The success of community development efforts is influenced by the availability and cost of energy. Therefore, the Department of Housing and Urban Development (HUD) is providing funds that may be used, at the discretion of the recipients, to assist communities in energy-related matters, including geothermal. Also, in 1980, Congress specifically authorized HUD to provide funding for energy production and conservation projects under the Community Development Block Grants (CDBG) program.

HUD also provides support to community energy projects under the Urban Development Action Grants (UDAG) Program. Revised guidelines have been issued to field staff for assistance to those localities that wish to make use of the UDAG program to finance energy conservation and alternative energy supply projects, including geothermal. HUD policy provides preferential consideration to energy applications by communities that relate the proposed projects to community-wide energy plans.

District heating systems, which may utilize geothermal resources, are encouraged under this policy. Twenty-eight cities completed HUD/DOE funded District Heating and Cooling (DHC) feasibility studies during FY 1982. Four of the 28 localities assessed geothermal resources and two of them are proceeding to develop geothermal DHC projects.

2.4 Department of Commerce (DOC)

The Economic Development Administration was established within the Department of Commerce for the purpose of stimulating business activity in economically depressed areas. Although EDA's mandate has not been changed, activities of the Administration may be eliminated or severely reduced as a result of possible FY 83 budget cuts. The Public Works and Development Facilities Program awards project grants for up to 80% of the cost of constructing facilities needed for long-term economic growth. The Business Development Assistance Program provides loans and loan guarantees to businesses establishing or expanding plants in economically depressed areas. EDA funding and loan guarantees are intended to stimulate or facilitate business development, and as such, EDA is neither a proponent nor a foe of geothermal development. Although projects involving the utilization of hydrothermal energy may be funded by EDA, they would not receive preferential consideration because of their geothermal utilization.

2.5 Environmental Protection Agency (EPA)

EPA's principal role in geothermal development is to control any resulting pollution. The Agency provides guidance, standards, and

pollution control regulations. Although EPA has no specific geothermal regulations in force, existing standards and regulations limit allowable levels of pollutants in the atmosphere, in and to receiving waters, in drinking water aquifers and on land.

In FY 1983 EPA plans to complete environmental research projects funded in earlier years to watch closely the progress of geothermal developers. At this time, no regulatory actions are planned which would impact the industry.

2.6 Department of Agriculture

2.6.1 U.S. Forest Service (FS)

The Forest Service is responsible for consenting to the issuance of leases by BLM for National Forest System lands and for providing terms and conditions for adequate protection of those lands. In accordance with the general aim of giving priority to mineral leasing activities by streamlining its leasing policy, the Forest Service in conjunction with BLM has resolved to eliminate the leasing backlog of several hundred geothermal lease applications by the end of FY 83, except where directed by Congress to not process lease applications in wilderness, congressionally mandated wilderness study areas, and Rare II recommended wilderness and further planning areas. The Forest Service reviews exploration and development operating plan proposals involving National Forest System lands to provide terms and conditions for adequate protection of these lands.

2.7 Department of Interior

2.7.1 Bureau of Land Management (BLM)

2.7.1.1 Noncompetitive Leasing. In accordance with the BLM/Minerals Management Service (MMS)/FS Memorandum of Understanding for the Geothermal Program signed in December of 1981, the BLM will attempt to process all new lease applications within 90 days of receipt. The BLM is projecting approximately 350 new lease applications in 1983, over 100 of which should be for lands in California. In addition, the BLM intends to make available for new noncompetitive lease applications approximately 900,000 acres of relinquished noncompetitive leases. Over 500,000 of these acres are located in Nevada.

2.7.1.2 Competitive Leasing. The BLM does not intend to publish a list of competitive lease sales for 1983, as was done in 1982. The only lands of interest remaining to be offered are administered by the Forest Service which is receiving appeals to many of its leasing decisions. Sales will be advertised and held as soon as possible after lands become available.

2.7.1.3 Exploration and Development Proposals. The BLM has experienced no difficulty in keeping current on all exploration and development proposals. Timely response should be no problem in 1983. The BLM is anticipating a modest increase in activities as a result of the large number of leases issued in 1982, primarily in California.

During FY 1983, BLM will continue its efforts to assist other agencies in the Federal government to expedite the geothermal leasing program by parcelling and evaluating all of the remaining unleased Known Geothermal Resource Area (KGRA) parcels. The Secretary of the Interior has indicated that increasing the number of areas of public lands under lease for geothermal development by the private sector will ultimately reduce our Nation's dependence on imports of foreign energy resources. Already, the number of KGRA sales has increased from 6 held in FY 1981 to 16 in FY 1982. Currently, there are 4 KGRA sales scheduled for FY 1983.

It has been observed that, since the establishment of over 107 KGRAs, a number of these areas have not received any bids after being offered for lease at competitive sales. Most of these KGRAs not drawing bidders have been classified on the basis of "competitive interest" and not on geologic indications of a geothermal resource. No more than 2 of these areas had been removed for KGRA status (that is, revoked) between FY 1974 and FY 1982. However, since it was apparent that many of these areas were only "prospectively valuable" for geothermal development, 9 of these KGRAs were revoked in FY 1982 alone. They included the following: San Ysidro in New Mexico; Ford Dry Lake, Little Horse Mountain, Lovelady Ridge and Witter Springs in California; Gillard Hot Springs in Arizona; and Salt Wells Basin, Monte Neva Hot Springs and Fly Ranch Northeast in Nevada. Together, these comprise 76,582 acres and will be made available to the public for noncompetitive lease applications. Additional KGRAs which have not been successfully offered after one lease sale will be revoked in FY 1983. Other plans designed to ensure that only those areas with economic potential as a geothermal resource be designated as KGRAs include requiring that areas have electrical power generating potential, that is, have mean reservoir temperatures of at least 150 degrees centigrade, and no longer using "competitive interest" alone as a basis for classification.

BLM is also responsible for the management, supervision, permitting, inspection and monitoring of all Federal geothermal leases in the United States. This currently includes 1,873 leases involving 3,308,341 acres (Nevada: 1,263,868; Utah: 553,075; Oregon: 409,804; Idaho: 193,357; California: 539,431; New Mexico: 210,404; Colorado: 16,874; Washington: 62,503; Arizona: 54,382; Wyoming: 4,643). Of these, 9 leases containing 7,342 acres are producing and 28 involving 47,593 acres are considered to be producible. It is likely that an additional 400 leases will be approved and issued in FY 1983.

2.7.1.4 Geothermal Utilization

California

- The Geysers-Calistoga KGRA - Currently there are 19 Federal wells on 7 producing leases which supply dry steam to geothermal electric power plants. Based on 5 megawatts average capacity per well, this amounts to about 95 megawatts of electrical power delivery from Federal geothermal wells. By the end of FY 83 there are expected to be 5 new producing leases with about 30 additional wells for a total of nearly 50 producing wells on 12 leases. Hence, nearly 250 megawatts of electric power may be produced from Federal leases in The Geysers by the end of FY 83.
- East Mesa KGRA - In East Mesa KGRA, one Federal lease with 5 production hot water wells currently can supply sufficient steam to produce 10 megawatts of electric power. An experimental power plant at the site is expected to be operating again shortly, but no additional power development is anticipated by the end of FY 83.

Utah

- Roosevelt Hot Spring Unit, Roosevelt Hot Springs KGRA - One well is presently producing through a single well generator, with an estimated electric power output of less than 5 megawatts. No more are expected to produce by end of FY 83. However, a 20 megawatt power plant is under construction, scheduled to be completed by November 1985. That will utilize the 6 presently shut-in producible wells and possibly two more scheduled to be drilled soon. No Federal wells are currently being drilled in the Roosevelt Hot Springs Area of the subject KGRA. It is expected that three additional wells will be required to supply the 20 megawatt plant being constructed at present. All will probably be completed before the end of FY 83.

Nevada

- No Federal geothermal wells are currently being produced in Nevada. Nevertheless, at least 3 areas are believed to be producible and await contracts and plant construction. These are: Beowawe Unit (Beowawe KGRA with 2 shut-in producible wells), Desert Peak (Brady-Hazen KGRA) with 2 Federal and 3 private geothermal shut-in producible wells, and Dixie Valley KGRA with 5 shut-in producible wells. Several other areas may be producible but

have not been explored sufficiently to this time. During the next year, it is unlikely that any significant changes will occur in Nevada since the Beowawe sales contract is the only one currently being negotiated.

2.7.1.5 Drilling Activity

California

- Geysers-Calistoga KGRA - Currently, 4 Federal geothermal development wells are being drilled in the Geysers-Calistoga KGRA. It is anticipated that at least 12 more will be drilled and completed in FY 83.
- East Mesa KGRA - No Federal wells are presently being drilled in the East Mesa KGRA. However, 3 permits have been issued and plans are being reviewed proposing 6 more. It is anticipated that all 8 may be drilled and completed by the end of FY 83.
- Mono Long Valley KGRA - One Federal well is currently being drilled. It is anticipated that at least one more will be drilled before the end of FY 83.

Nevada

- Currently, Federal wells are being drilled in Desert Peak and Tuscarora Units in Nevada. Present unit requirements will assure that at least 6 more will be drilled in FY 83.
- No Federal wells are currently being drilled in any other state. Nevertheless, currently proposed operations are expected to result in submission of Plans of Operation and the drilling and completion of at least 6 more in Oregon, New Mexico and/or Arizona.

Geothermal Exploratory Drilling (30 CFR 270.78). It is expected that the issuance of new Federal leases will result in drilling 2,000 observation holes in FY 83 and at least 100 new shallow temperature gradient holes, and these will probably be apportioned - 25 in California; 10 in Nevada; 20 in Utah, 20 in New Mexico; 10 in Arizona and 15 in Oregon.

Federal Geothermal Units. To conserve geothermal resources, to assure more equitable development and to minimize costs, many Federal geothermal leases have been assigned to Federal geothermal units, principally by request of the participants. To this date, 15 Federal Units have been approved, 2 of these have been terminated so that 13 remain. They are located in California (Glass Mountain, Mono Long Valley, and Truckhaven), Nevada (Alum, Aurora,

Beowawe, Desert Peak, Fish Lake, McCoy, Soda Lake and Tuscarora), Utah (Drum Mountain and Roosevelt Hot Springs). Total leases unitized exceeds 300,000 acres.

Although this acreage is exempt from the lease acreage limitations, the approved agreements will require more than \$1,000,000 to be expended during FY 83 to show diligent exploration. Currently, 3 (Beowawe, Desert Peak and Soda Lake) must commence production by FY 84. It is anticipated that at least 3 more units will be proposed and approved before the end of FY 83. This will increase the required financial outlay and development activities and substantially increase the BLM-Geothermal Supervisory and field monitoring duties.

2.7.2 United States Geological Survey

Through its Geothermal Research Program (GRP), the USGS is undertaking a comprehensive assessment of hydrothermal resources to describe the nature and estimate the location and energy potential of these resources. This work involves multidisciplinary research to (1) understand the factors that control the characteristics, occurrence, and size of various types of geothermal systems, (2) conduct resource assessments through development of reliable resource estimates for both the identified and the inferred but undiscovered geothermal systems, (3) develop new concepts for improving the technology for resource assessment, and (4) identify and define geological constraints to development of geothermal resources as sources of energy.

These activities are structured into four broad categories: (1) resource characterization, emphasizing geological, hydrological, geochemical, and geophysical aspects of all types of geothermal environments so that general conceptual models of processes of fluid and heat flow may be developed and refined; (2) regional resource assessments and national resource inventories, including acquisition, reduction, interpretation, and computer storage of data on the characteristics, distribution, and size of geothermal systems and estimates of the location and energy potential of both identified and inferred but undiscovered resources; (3) resource assessment technology, including evaluation and improvement of instrumentation and methods of data reduction and interpretation; and (4) studies of permeability within geothermal systems, including an understanding of the processes of rock fracturing and of mineral deposition and dissolution that affect permeability and consequent fluid flow within geothermal systems.

Principal emphasis for FY 83 will be on the continuation of the multi-year program of investigations on the geothermal potential of the Cascade Range for resource characterization and regional assessment purposes. This region apparently contains abundant hidden resources (i.e., those without surface manifestations), including those of sufficiently high temperature for electrical power production, based on research drilling and other studies during the past

two years. Specific investigations in FY 83 will include a new geologic map of the Cascades, heat flow determinations, hydrologic modeling, geochemical analyses, seismic refraction surveys, geoelectric soundings, and interpretation of gravity, magnetic, and other geophysical and geochemical data. A decrease in FY 83 program funding will, however, drastically reduce research drilling. In addition, budget reductions since FY 80, when the major effort in the Cascades was initiated, have delayed completion of the Cascades work by about two years; it is now scheduled for completion in FY 86.

FY 83 plans also include:

- (1) Continuation of only a minimal effort, primarily heat flow determinations and geochemical studies, toward a resource characterization and regional assessment of the northern Great Basin, another region with seemingly abundant hidden resources,
- (2) Phase-down of GEOTHERM, the computerized geothermal resources information system,
- (3) Participation in interagency efforts to develop a program of deep research drilling into the roots of hydrothermal systems,
- (4) Completion of preliminary energy recoverability estimates for the Gulf Coast geopressed geothermal resources, termination of all assessment work on these resources because of budget reductions, and continuation only of a small effort toward characterization of geopressed geothermal resources elsewhere in the U.S., principally in California,
- (5) Continued improvement and development of chemical geothermometers to estimate subsurface temperatures and of certain promising seismic and geoelectric techniques useful in the assessment of geothermal resources, and
- (6) Hydrologic modeling, geochemical studies on the origin of geothermal fluids, water-rock interactions in the geothermal environments, and the evaluation of geothermal systems as inferred from the chemistry of their fluids.

2.7.3 Fish and Wildlife Service

Although the Fish and Wildlife Service does not have line item funds for geothermal in FY 83, the Service plans to continue its role in the fish and wildlife aspects of the Federal Geothermal Program in cooperation with the lead agencies and to further the Department's accelerated geothermal leasing program in keeping with their objective of supporting the sensible and orderly development of energy and mineral resources.

Several field stations in the west have been actively following the Federal Geothermal Program in order to achieve early identification of endangered species and critical fish and wildlife habitat issues. Plans are to continue this modest activity in FY 83. It is believed that early coordination with BLM, USGS and FS is essential to expedite the Federal Geothermal Program. To make the best use of limited resources and avoid unnecessary delay on projects involving important fish and wildlife considerations, it is imperative that the Service be informed of upcoming actions and areas of potential conflict on a continuing, timely basis.

The Service also plans to continue its staff support of the IGCC's working groups and panels.

2.7.4 Bureau of Mines

The Bureau of Mines program in the geothermal area is to study mineral resource extraction from geobrines. Many geothermal fluids contain significant quantities of mineral and metal values. Successful recovery of these brine constituents could add to the reserve base and aid in the disposal of spent geothermal fluids in an environmentally accepted manner. The program consists of two parts:

- (1) The extraction of minerals containing metals such as: manganese, zinc, lead and silver. This program is funded at about \$200,000.
- (2) The geobrines of Searles Lake, California contain an estimated 135 million pounds of tungsten. While these brines are too dilute to process solely for tungsten, with appropriate technology it might be economically recovered as a byproduct during existing commercial processing that produces bromine, potassium salts, soda ash, salt cake, and boron chemicals. Key to recovery was the development of an ion exchange resin by the Bureau of Mines for sorption of tungsten. This latter program is funded at \$210,000.

2.7.5 Bureau of Reclamation

In recent years the Bureau of Reclamation of the Department of the Interior (DOI) has funded several projects studying the utilization of geothermal fluids to augment the limited water resources of the western United States. Three desalting plants were built and testing was conducted. Although the desalting process proved feasible, the reservoir that was utilized for the testing was determined to be insufficient for full scale production and the tests were terminated. DOI recently completed studies of geophysical testing of approximately 10 sites in Arizona, Nevada, and California. Plans are to select the most promising of these sites, and, if funding is available, and investigations approved, initiate more extensive surface testing.

2.7.6 The National Park Service

The National Park Service (NPS) is not now anticipating any research programs in geothermal during FY 1983. Activity will be limited to policy and programs coordination within the Department of the Interior, and monitoring of on-going geophysical studies being conducted by USFS and USGS around Lassen Volcanic National Park/Lassen National Forest, California.

2.8 Department of Defense

The DOD Geothermal Plan is an attempt to program the systematic verification of the geothermal resource potential of DOD lands and prepare for geothermal development so as to minimize its impact on the continued mission capability of the DOD activities involved. Initially, geologic investigations are performed at DOD sites which have indications of geothermal potential. In FY-1983 these sites will include Imperial Valley, Boardman Bombing Range, Puget Sound and selected East Coast Sites. After preliminary geologic investigations are completed the next step is to conduct thermal gradient or observation drilling. In FY-1983 this will be done at Imperial Valley and Twenty-nine Palms, CA.

If the determination is made to pursue development based on the estimated geothermal potential then a contract for the development of the resource will be prepared. Typically the contract will request the contractor to explore and develop the resources, construct the electric power plant and operate the plant at no capital cost to DOD. The contractor will recoup his investment through the sale of electricity to DOD.

This approach has been used at the Naval Weapons Center (NWC), China Lake, CA and the Naval Air Weapons Training Complex (NAWTC), Fallon, NV. A contract was awarded on December 6, 1979 to develop the geothermal resource at NWC China Lake. To date six geothermal wells have been drilled and it has been proven that the resource can supply the electrical needs of NWC China Lake for 400 years. A contract was prepared and advertised for developing the resource at NAWTC Fallon in FY-1982. The contract is expected to be awarded in FY-1983.

An important aspect of the DOD geothermal plan is to provide environmental overviews and monitoring at selected sites. A Programmatic Preliminary Environmental Assessment was prepared and published for NAWTC Fallon in FY-1981. Data will be provided for an environmental overview for Imperial Valley in FY-1983.

Work is continuing in materials and corrosion testing at specific DOD sites. Of particular concern to DOD is the impact of geothermal emissions on electronic and avionic equipment and components. Testing and monitoring will continue in FY-1983.