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REPORT OF THE
ENERGY RESEARCH ADVISORY BOARD
ON HIGH-TEMPERATURE-RESOURCES DEVELOPMENT

Prepared by
The Geothermal Panel

May 1, 1980

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Department of Energy
Washington, D.C. 20585

May 2, 1980

Dr. Ruth Davis
Assistant Secretary for Resource Applications
Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Dear Dr. Davis:

I am pleased to transmit on behalf of the Energy Research Advisory Board, the report on High Temperature Resources Development prepared by the Board's Geothermal Panel.

The principal conclusion of this study is that the DOE should focus on developing geothermal capacity in the U.S. and not only on programs that demonstrate geothermal capability. The now deactivated Industrial-Coupled Reservoir Case-Study Program was a well conceived, well executed example of a geothermal capacity demonstration program. The Geothermal Panel of the Energy Research Advisory Board strongly recommends that this program should be reactivated in FY 1981 with a minimum budget of \$30 million.

Sincerely,

A handwritten signature in cursive script, reading "Solomon J. Buchsbaum".

Solomon J. Buchsbaum
Chairman
Energy Research Advisory Board

WESTERN GEOPHYSICAL

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Carl H. Savit, Senior Vice President, Technology

May 1, 1980

Dr. Solomon J. Buchsbaum
Chairman
Energy Research Advisory Board
Forrestal Building
Washington, D.C. 20585

Dear Dr. Buchsbaum:

As authorized by ERAB, the Geothermal Panel appointed a subpanel on High Temperature Resources Development. That subpanel was asked to study the problems and opportunities of high temperature resources development and to prepare a report in accordance with terms of reference formulated by the Geothermal Panel.

The report of the subpanel was submitted to the panel on February 5, 1980. The panel accepted the report with minor changes.

The final report is presented herewith.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read 'Carl H. Savit'.

Carl H. Savit
Chairman, Geothermal Panel

CHS:ba
Enclosure

REPORT TO ERAB GEOTHERMAL PANEL

By: Subpanel on High Temperature Resources Development

February 5, 1980

The subpanel met in Washington on February 4, 1980. Members Rex (Chairman), Butler, Dolan, Hunt, Keller and Otte were present. Mr. Roberts was absent.

The following reports the answers that were developed to the questions posed in the terms of reference together with recommendations for DOE action.

Summary

The Subpanel draws four principal conclusions concerning the high temperature resource program.

1. The industry-coupled reservoir case study was well conceived, well executed and of outstanding importance in achieving development of geothermal energy as a substitute for imported oil. It should be reactivated in FY 1981 with a minimum new budget of \$30 million.
2. The DOE should focus on developing geothermal capacity in the U.S. and not stop programs with a demonstration only of capability. The National Energy Act, the Loan Guaranty Program, the demonstration plant program, the Industry-coupled reservoir case study program are all needed to accomplish this capacity objective. Capability attainment alone is neither an appropriate stopping point nor an effective use of Federal funds.
3. Technological emphasis should focus on the substantial impacts of improvements in drilling technology, especially in the utilization of diamond Stratapax bits, high-temperature turbo drills, well pumps, and high temperature logging equipment. The program to evaluate and develop well stimulation techniques should be accelerated.
4. There is a major need for several 10 MW demonstration plants in new fields that utilities could use as "icebreaker" plants. These small plants would verify technical solutions to the wide variety of hot-water field problems known to exist and discovered only as a result of simultaneous operation of actual fields, gathering systems, and power plants. This demonstration program should be focused on placing the maximum amount of data into the public domain and thereby provide utilities with greater assurance that the hydrothermal fields that are being discovered in increasing numbers are brought across the threshold of commercial power production. It is our recommendation that this demonstration be an ongoing effort for a number of years and would be a key element in achieving the DOE goals for growth of geothermal capacity. We recommend focusing on 10 megawatt size units rather than wellhead power generation units.

Terms of Reference

- A. Evaluate the need for government cost-sharing of reservoir confirmation for high-temperature reservoirs, by addressing the following issues:
 - 1. What was the value of the industry-coupled reservoir case-study program of FY 1978 and 1979?
 - 2. Do the provisions of the NEA and other upcoming legislation obviate the need for continuing the industry-coupled program?
 - 3. What should the role of the Government be, if any, in stimulating the confirmation of high-temperature resources?
- B. Evaluate the technology and component development program for high-temperature reservoirs, by addressing the following issues:
 - 1. Are the technology and component development programs responsive to industry needs?
 - 2. Do the technology development programs focus on all of the important issues? Are there any changes in emphasis you would recommend?
 - 3. How much does industry rely on the Government to support high-temperature technology development?
 - 4. How can we measure the impact of this program on industry?
 - 5. Is there an adequate benefit/cost ratio for the technology development programs.

Response to A-1

DOE's industry-coupled program was extremely worthwhile, with both planned and unplanned impacts. The result was that many new geothermal reservoirs were evaluated that would not otherwise yet be tested. Even in the case of non-commercial wells there has been significant development of drilling technology and experience from this program especially in the area of loose formation control and drilling in lost-circulation conditions. By putting substantial drilling data into the public domain the program has reduced exploration risks by sharing learning curve experiences. Academic and theoretical studies bear little relation to industry-scale operations while the industry-government coupled programs provide data at the level of operational credibility. Even unsuccessful wells have had great value in permitting industry to share its experience and to avoid repetition of mistakes. Successful wells stimulate new field development.

We view the fact that the present known hydrothermal geothermal resource base is quite limited results from the limited amount of exploration that has been carried out. If exploration can be accelerated through continuation and expansion of the industry-coupled program we think that the resource base could be expanded massively in a relatively short period of time.

Response to A-2

The roles of the National Energy Act and of the industry-coupled program are fundamentally dissimilar. NEA addresses the economics of field development and power plant construction while the ICP stimulates exploration, discovery, and evaluation of the size of the resource base. Both NEA and ICP are essential to permit realistic national planning and determination of the potential contribution of geothermal energy to U.S. energy needs. The ICP is essential to the DOE goals of power on line by 1975 and 1990.

The fundamental question with respect to the industry-coupled program is the issue of geothermal capacity versus capability. It is the unequivocal recommendation of this Subpanel that DOE should strongly focus on capacity. Demonstrated long-term economic viability is necessary for a utility to be able to justify investment in new facilities. Unless capacity is proved, the investment will not occur. Substitution of geothermal energy for imported oil should be a prime goal. That means that the "Industry-Coupled Program" (ICP) for drilling of high temperature geothermal resources is strongly recommended.

Of the \$24.5 million spent in FY 1979 on Resource Definition we understand about \$15 million was used for the ICP. In FY 1980 there is essentially no funding for this except for completing the existing contracts. We recommend that the FY 1979 program level be doubled and the program funded at an amount of \$30 million in FY 1981. This would permit doubling the area covered previously and permit a follow-on to current programs. A rapid stimulation of new discoveries is needed and will most effectively be stimulated by the ICP. The Geothermal Loan Guaranty program and NEA have their major impact on development once a resource has been discovered. The ICP is the most cost-effective vehicle for stimulating new discoveries.

Response to B-1 and B-2

The Geothermal Drilling and Completion Technology program appears to be well conceived, broad based and well directed, and maintains close liaison with the industry. There is some concern that the program will not be adequately funded and continued through the commercialization of those products with demonstrated merit.

The energy conversion technology sub-program appears to be well funded, properly conceived, and well directed.

All activities under the Geochemical Engineering and Materials program are addressing important industry problems but we feel that the scale deposition control studies should receive increased emphasis.

The program addressing reservoir stimulation is vital and needs more DGE/HQ attention and funding.

In general, the Geoscience Technology Development program appears to be proceeding at a satisfactory pace, but the committee felt that more emphasis should be given to the generation of reflection seismic case studies.

One change of emphasis that we recommend is the need for a demonstration program that funds several 10 MW power plants and their associated fluid handling systems. These smaller units are especially needed to support utilities in their demonstration of resource and technology feasibility and commerciality. In view of the regulatory and economic constraints faced by utility companies, we feel that an "icebreaker" concept is essential and should be the primary priority of the power plant demonstration program.

Response to B-3

To a substantial degree the Government has acted as a catalyst to stimulate high temperature technology development. It has brought together developers and service companies and stimulated cooperation and funded key activities and continues to develop badly needed new technology.

Response to B-4

At this point, it appears that qualitative measures may have to suffice. However, the consensus of the Subpanel that these programs should be expanded is in itself a measure of past success. Areas that should be amenable to early quantitative evaluation include decreases in cost-per-foot drilled and increases in well productivity after stimulation.

Response to B-5

Absolutely yes! We feel that the drilling, logging, and well stimulation programs are especially valuable. The initial testing of a new drill bit developed under this program especially indicates that drilling costs may be reduced substantially. In addition to the geothermal industry, this will also benefit the oil and gas drilling industry.