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GEOTHERMAL PROGRAM REVIEW X

PROCEEDINGS

"Geothermal Energy and the Utility Market - The Opportunities and Challenges for Expanding Geothermal Energy in a Competitive Supply Market"

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NGA INDUSTRY CRITIQUE OF THE EXPLORATION COMPONENT

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Good morning. My name is Joe Iovenitti of Weiss Associates, and I have been asked to critique the Exploration component of the U.S. Department of Energy (DOE) Geothermal Program Review X. My comments focus principally on the hydrothermal portion of the DOE program, but I will also make some commentary on the Long Valley Exploratory Well and Geopressured-Geothermal components of the program, as well as some general comments.

Before I do that, I would like to review the current state of geothermal exploration in the United States.

According to Koenig (1989, 1990) who critiqued the DOE Geothermal Program in those years, geothermal exploration in the western U.S. has been conducted in virtually all of the apparent geothermal resource areas. Many of these areas which were under exploration in the 1960s and 1970s, and were explored in part under the U.S. DOE Industry Coupled Program have progressed to commercial status in the 80s. The DOE March (1992) Draft Multi-Year Program Plan for FY 1993-1997 states that 8 out of the 14 geothermal resource areas explored under this Industry Coupled Program in the late 1970s are currently under production. I do not think we will find anyone in this room, in the geothermal industry, or in the United States that will argue with the clear and outstanding success of that government program.

When the prices of oil dropped in the 1980s, many geothermal operators left the industry, and with the dramatic decrease in activity, many of the service companies went by the wayside also. By and large, the domestic geothermal industry today is emaciated.

As a result of the capital intensive nature of geothermal development, the historical long lead times to go from exploration to production, the highly entrepreneurial nature of the industry, and the lack of an economic market, virtually no new exploration has been conducted in the U.S. in about 10 years. The consequence of this lack of activity is an almost non-existent geothermal reserve base, outside of known producing fields and their immediate surrounds.

The U.S. DOE Deep Thermal Gradient Drilling Program in the Cascade Range is a notable exception to this stagnant condition. Like it's predecessor, the industry coupled program, the Thermal Gradient Drilling Program identified at least, one potentially viable geothermal resource: Newberry Volcano.

Combs (1991) in his critique of the U.S. DOE Geothermal Program Review IX, identified the following classic geothermal "catch-22":

> Some companies have found and do find themselves in the position of having to prove a viable geothermal resource with little capital to make a long-term power sales contract secure, which in turn, can be used to finance the drilling and testing programs to prove the viability of the geothermal power generation project.

Another geothermal "catch-22" is:

> Windows of electrical market opportunities may develop for geothermal resources but unless the reserves are in place, the industry may not be able to respond to these market opportunities.

As stated by some of the earlier speakers at this conference, to be cost-competitive with other energy resources, we must reduce the cost of exploration, development, and production activities, demonstrate geothermal's reliability, and instill confidence.

It is important to realize that exploration activities form the basis for: (a) detecting and delineating the resource; and (b) providing the foundation for understanding how to efficiently and cost-effectively develop and produce the resource.

The National Energy Strategy as reported in the DOE March (1992) Draft Multi-Year Program Plan for FY 1993-1997, predicts that 4,500 MWe of geothermal electrical generation capacity can be available by 1997, 11,000 MWe by 2010, and 22,000 MWe by 2030. In contrast, the most current geothermal reserve estimates reported in this Plan are 5,000 MWe and these are in producing fields.

Koenig (1989, 1990), Combs (1991), Wright (1991), and Meidav (1992) have all written on the need to explore now and begin to establish the nation's geothermal reserve base. Exploration forms the corner stone of a natural resource industry. If not pursued, we risk not improving our cost-competitiveness, and not being ready when the market window develops.

DOE GEOTHERMAL EXPLORATION PROGRAM

I will now make specific comments on the Exploration Component of the U.S. DOE Geothermal Program. These comments are part my own, part from the Geothermal Exploration Workshop held at LBL in September, and part from discussions with some of you at this conference.

There is no formal Geothermal Exploration Technology Component to this DOE Program Review. Some exploration activities do occur under Reservoir Technology, Hard Rock Penetration, the Long Valley Exploration Well, and Geopressurred-Geothermal. My recommendations to DOE follow.

1. Establish a formal Exploration Technology Program to address industry exploration requirements. The industry is in concert that basic exploration must be re-initiated. This exploration will in large part be directed towards undiscovered and generally blind systems, since virtually all the obvious ones have reportedly been drilled.

2. Conduct, document and publish a comprehensive integrated case studies for producing geothermal fields in various U.S. geothermal provinces.

In this effort, the inverse problem with respect to delineating geothermal reservoirs should be examined. That is, we know in producing fields where production is coming from, as well as it's geologic nature. Given this, is there any data set or combination of data sets that identify the reservoir and its internal structure. Such an analysis would allow calibration of exploration techniques and identification of those techniques which worked and didn't work, and most importantly, why. Additionally, these fields should become the laboratory for testing new exploration techniques, as well as improvements in existing methodologies.

This work would form the basis for critical understanding of the nature of the systems selected, their occurrence, and how to explore and develop them.

3. Develop conceptual geothermal geoscientific models for each of the US geothermal provinces to guide exploration, and eventually development and production activities.

4. Develop laboratory physical models of hydrothermal systems to support field exploration activities and numerical simulations. For example, it will be very interesting and informative to see what would happen if we would take the clay deformation models of Cloos (1968) as reported in Wright (1991) and place them in a hydrologic and thermal field.

5. Develop slim-hole reservoir engineering techniques, the associated geophysical logging tools and drilling capabilities, as recommended by Combs (1991). The latter are currently being worked on but I have not seen any documentation on the reservoir engineering component. The need for this is obvious (see Combs, 1991).

6. Upgrade the methodology to evaluate the geothermal resource potential of an area. No major new work on this methodology has been completed since USGS Circular 790 in 1978. In addition, correlations between heat-in-place and fluid deliverability should be developed.

7. Establish a strategic alliance between DOE, United States Geological Survey (USGS), academia, and industry, along with a functional mechanism which will allow for such an alliance.

8. Establish international cooperation on exploration issues in the form of conferences, technical exchanges, joint programs, etc.

9. Fund existing methodology enhancement and new technology development. An example of the former is a more critical understanding of temperature data and heat transfer mechanisms. An example of the later are the geophysical techniques discussed by Philip Wannermaker, earlier at this conference.

10. Train a new generation of geothermal explorationists to inject new ideas, and vitality into our industry. New and bright people will not be attracted to an emaciated industry. Many in the industry have spoken of the need to identify our geothermal reserves in the ground, equally important is our industry's need for a people reserve.

11. Establish a computer data base for raw data, interpreted data, articles, reports, etc., so published information could be readily obtained and evaluated.

12. Establish ASTM standards on critical geothermal exploration activities such as determining resource potential, reservoir size and production capacity.

13. Establish either a cost-shared industry coupled exploration program, or a revolving fund industry exploration program.

14. Establish a Peer Review Committee consisting of DOE, USGS, academia, and industry to evaluate the programs, to keep the program focused, practical, and pertinent, as well as to justify each of the program components under its purview.

LONG VALLEY EXPLORATORY WELL

1. This is the Magma Energy Program. The Long Valley Exploratory well satisfies the near-term efforts of the U.S. DOE Geothermal Division's which as stated in the DOE March (1992) DRAFT Multi-Year Program Plan for FY 1993-1997 are "...to expand the Nation's use of this flexible renewable energy option.", in that it is investigating the hydrothermal system at Long Valley. The well also addresses long-term energy research (e.g., deep drilling in hostile environments).

2. I am disappointed to find no mention of the Magma Energy Program or the Long Valley Exploratory Well in the DOE March (1992) DRAFT Multi-Year Program Plan for FY 1993-1997. This reflects, in my opinion, a significant imbalance in the DOE Geothermal Program, see General Comments below. I recommend that this activity continue to be funded.

GEOPRESSURED-GEOTHERMAL AND EXPLORATION

1. The California Energy Commission with match share funding from the Idaho National Engineering Laboratory (INEL) will be investigating the existence of geopressurred resources within the State of California.

This effort must be applauded for it is exactly the type of forward thinking required to identify the U.S. geothermal reserve base. However, it is extremely ironic that federal funds are being spent through INEL on this resource base which is significantly more immature than hydrothermal, when no comparable programs exist for hydrothermal resources. This, in my opinion, is another major imbalance in program priorities.

GENERAL COMMENTARY

The U.S. DOE should be funding projects with a short-term payoff, as well as those that provide a long-term payoff. Certainly, the majority of the funding will not be in the latter category, but nevertheless, some funds should be appropriated.

I recommend that DOE take a more balanced approach to funding geothermal energy related projects. I challenge the DOE to establish a system that will be accountable to the geothermal energy industry and the country. Possibly the strategic alliance between DOE, USGS, academia, and industry (described above) may provide this accountability.

Short-term issues to move the geothermal energy industry forward should always take priority, because by definition, if short-term industry problems are not addressed there may not be a geothermal energy industry in the U.S. for DOE to assist.

Long-term issues should also be addressed such that our industry can become and remain technologically competitive, and cost-effective. The funding levels for long-term projects should be adequate to deal with the next phase of issues, but moderated by the results of an analysis of the likelihood and significance of success. In order words, we need to know the potential benefit to the geothermal industry of any activity being considered for funding. The outcome of such an analysis should prioritized how that portion of the U.S. DOE geothermal energy budget is set aside for long-term efforts.

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