PROCEEDINGS, Fourteenth Workshop on Geothermal Reservoir Engineering
Stanford University, Stanford, California, January 24-26, 1989
SGP-TR-122

GEOTHERMAL RESEARCH AT EPRI

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ABSTRACT

The rules by which the energy game is played have been changing since 1985 and may not firm for some time. This has affected the way in which geothermal is viewed within the utility industry. The net result has been to downgrade the relative importance of geothermal and geothermal R&D. Some of the reasons for the downgrade are reviewed and the content of EPRI's Geothermal Program discussed.

A DOWNWARD TREND

In 1982 many utilities with access to geothermal resources viewed themselves as eventually owning and operating geothermal power plants. Those who were not already involved in development at The Geysers contemplated participation in the development of hot water resources. As it happened, the course of events did not take the expected path. Only two hot water plants, Utah Power and Light's 20 MWe single stage flash unit at Roosevelt Hot Springs in Utah, and the 45 MWe binary cycle plant of San Diego Gas and Electric at Heber in California, were owned and operated by electric utilities. And only one of those is in operation at this time. All others are owned and operated by second or third parties as qualifying facilities. As a result, the number of utility players did not increase as originally expected but declined. In fact, most have now withdrawn to the sidelines either as power purchasers or with no particular interest, pending future developments relating to power demand, capacity need, alternative energy costs and deregulation.

The original expectation did not materialize for three basic reasons. These were related to low energy costs, revised estimates of when new generating capacity would be needed, and pending deregulation. It was also clear that geothermal would have difficulty competing with oil below $18 to $20/bbl. Since there was little need for new generating capacity the urgency for pursing geothermal, or any other resource for that matter, simply diminished. Furthermore, it was not clear how geothermal would fit in a deregulated industry. The sum of these factors was enough to cause many utilities to back off and re-examine their geothermal objectives, or to indefinitely postpone them. In the prevailing economic environment attention turned to other more pressing issues and R&D priorities shifted. Primary emphasis is being placed on coal and nuclear generation technologies, environmental issues, and storage system technologies. Priorities for renewable resources were lowered and technologies having regional limitations, such as geothermal were pushed to the bottom if not off the list entirely.

During this same time, federal emphasis on energy research slowly eroded. Some in the industry, under the circumstances, did not find it difficult to follow suit. It is now clear that the federal lead in geothermal research is crucial. For this reason, it is unlikely that the present trend will turn around unless signaled by federal energy policy. Unfortunately, one result is that advanced geothermal research is pushed farther into the future.

THE UPWARD TRENDS

Any upward trend that might be in the making is not yet in sight. However, in trying to discern future direction global issues are likely to play an important role. In the past it has served no purpose to prophesy gloom, and certainly that is not the intent here, but the truth is that oil supply is more out of our control than at any time in the past. It would be naive to think that this does not pose an unpredictable risk to the health of the economy. Externally, the world's appetite for energy can flare in any expanding world economy. The problem can be compounded if authoritative estimates are correct that the world's supply of oil is just over 30 years. Even if one takes the

optimistic view and assumes twice as much, we have reached a point in time where the end of the oil era is more or less predictable. As it approaches price gyrations could be severe.

Consumption pressures may be compounded by environmental factors such as acid rain and the greenhouse effect. If the greenhouse effect is taken to be real by the political establishment, it could accelerate the use of oil, the reason being that oil produces only 160lb of carbon dioxide per million BTU's while coal produces about 225lb and gas about 126lb. >This simply suggests that the time is approaching when it may become necessary to consider other options that might be available. For example, is it realistic to think that a nuclear-biomass-solar-geothermal energy economy might be practical in the long run, and dramatically reduce the greenhouse gases at the same time? Many obstacles lie in this path. Certainly, the resource base seems to be there, particularly if the hot dry rock and magma resources are as large as thought. On the other hand, the vested interest in coal technology is enormous and could not be rapidly changed. In any case, there is a need to develop a good understanding of the potential options and such considerations may drive the next upturn in geothermal development.

1988 IN PERSPECTIVE

In 1988 EPRI's geothermal budget was about $2.3 million. In 1989 it will be around $1.5 million. In order to fit within this 35 percent reduction the scope of some projects had to be reduced and others terminated. Before discussing the program content for this year I want to mention three projects that are being phased out.

The first is actually a group of four projects related to EPRI's efforts to develop technology for upstream hydrogen sulfide removal from geothermal steam. The approach is based on the reboiler concept. The primary effort in this area has been to scale the technology from a 1000lb/h experimental unit to a 200,000lb/h commercial type system designed for use with geothermal fluids having a noncondensable gas content of up to 8 percent. This was done in cooperation with the Philippine National Oil Company and Pacific Gas & Electric Company, who did the design studies. It was not possible to complete the detailed design, however, most of the engineering analyses were completed. The reason for calling your attention to it is that confidence was gained that the design would function as expected and that it could be cost effective depending on the gas content in the geothermal steam, in the range of 3 to 8 percent. One of the by-products of this effort has been the development of techniques for estimating heat transfer in condensers having high gas concentrations.

The second project that should be mentioned is the crystallizer effort. A number of tests were run at Cerro Prieto to investigate the feasibility of removing silica by precipitation and crystal growth in a flash crystallizer vessel. I must report that the results from this particular set of tests were not very encouraging.

The third effort being closed out is the Mobile Chemistry Lab project. The one thing that should be mentioned in relation to this project is that an effort is being made to preserve the data accumulated over the last several years and to prepare it for publication.

THE YEAR AHEAD

In 1989 the program will pursue four projects. Three are continuing and one is new. The three continuing projects are as follows:

Modular Binary Wellhead Power System Design
Geothermal Information Series
Trace Element Specification, Transport, and Distribution.

Modular Binary Wellhead Power System Design: The objective of this effort is to create a single design that will have the flexibility to perform over a wide range of geothermal fluid temperatures and flows. Because of the wide range, the capacity of the system will be in the range of 2 to 7MWe, depending on the exact conditions at the wellhead. The reasons for pursuing this effort is to fulfill a perceived need for a small modular power system that can satisfy the following applications:

- First unit in new fields
- Development of small fields
- Development of low temperature fields
- Staged development of larger fields, and
- Backfill in existing fields

The design effort is being done by the Pacific Gas & Electric Company. Most of the engineering analyses have been completed and detailed process, mechanical and civil design efforts are now under way. The present plan is to complete the

design around mid-year.

Geothermal Information Series: The goal here is to capture and preserve some of the more vital lessons learned about geothermal development over the past decade. Radian is the general contractor for this effort. The first document will be a set of guidelines for geothermal fluid chemical sampling and analyses. This document is in the final stages of preparation and should reach the publisher in about two months. The next document in this series, as presently planned, will be a set of guidelines for power cycle selection. A third document will be started this year although the final choice of the subject matter has not yet been made.

Trace Element Transport and Distribution: The approach used in this project is to develop analytical techniques for estimating the transport and distribution of arsenic, boron, mercury and other toxic trace elements in geothermal fluid flow streams, based on fundamentals. This includes considerations of the metallic ores most likely to be present in geothermal reservoir rock formations, the solubilities of such ores at reservoir temperatures depending on the presence of other mineral species, as applicable, and the speciation and bulk quantities as the temperatures and pressures change when the fluid passes through the power plant. The project is studying both the liquid and vapor streams with special emphasis on steam and condensate. The final report on arsenic is now available. At present an effortis underway to program the techniques used for arsenic on the personal computer to simplify their use. The effort on mercury will continue this year and is scheduled for completion early next year. This work is being done at San Diego State University.

As previously mentioned, the present plan calls for starting one new project in 1989. EPRI will participate with the Hawaiian Electric Company and the University of Hawaii at Manoa in the evaluation of the geothermal resource in Hawaii, one of the critical paths in Hawaii's deep sea cable program. Their plan for the basic assessment is to use a combination of data from existing wells, several new slim hole wells, and geological and geophysical surveys that have already been completed. It is hoped that large bore confirmation wells can be drilled later in the program. EPRI plans to cofund the analytical portion of the effort. Both the mobile chemistry laboratory and the crystallizer equipment will be transferred to the project to aid in geochemical analyses and to study silica removal.

CLOSURE

In closing three points should be kept in mind. First, the energy market, except for the remaining standard offer No.4's promises to be highly competitive. It will be a challenge but, geothermal can find a niche in that market. The second point is that federal energy policy sets the R&D pace and if the downtrend is to be reversed, it must start with policy. The final point is that much of the long-range research has been suffered in the pursuit of solutions to near-term problems. It may be time to adopt a more proactive approach to R&D.