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

RESEARCH CAN KEEP GEOTHERMAL COMPETITIVE

Stephen Pye

Unocal Geothermal Division
Unocal Corporation
Los Angeles, California, 90017

OUR PROBLEMS: EXCESS ENERGY SUPPLY AND LOW ENERGY PRICES

New geothermal projects face two problems, with the most serious being a low price for geothermal fuel. The other problem is an excess of electrical generating capacity in the Western United States, which makes any new generation plant difficult to promote. This should be a temporary problem, because it is the result of a supply/demand imbalance. However, since it affects our activities it is frustrating because we have no control. Hopefully this problem will decrease as a factor in our local market within the next decade.

Our most serious problem is the low fuel price for geothermal. The price for all fuels has declined because of the current oversupply of fossil fuels (oil, gas, and coal) which are the primary competitors for the electric generation market. Other alternatives, including hydro, nuclear, etc., all have problems. Domestic hydro is fully developed, nuclear is out of favor, and other alternatives too expensive. Consequently, in the near term (5-10 years) fossil fuels will remain the primary competition. We must compete in this market.

CAN WE CHANGE THE PRICE TO SOLVE OUR PROBLEMS?

When will oil prices rise?

Oil prices will rise, and fall, when the members of OPEC allow them to rise and fall. When oil prices rise, the geothermal price rises, but so do costs. The costs of pipe, valves, etc., will rise because the energy required to produce them will be more expensive. As prices rise, demand falls (remember our excess capacity?). I do not believe we can rely on an increase in fossil fuel prices to solve our problem.

Geothermal - The premium fuel/worth ?% more

Geothermal energy is a premium fuel that should be politically favored because it is a domestic energy source, it's clean, yields lower CO_2 emissions and has no radioactivity hazard. But, will the customer pay a big premium, a little premium, or no premium? How much will the consumer pay for a secure fuel supply with environmental advantages? In the absence of a legislated incentive for geothermal or disincentive for competing fuels (i.e. reduce CO_2 emissions by X%) I believe any premium will be too small to have a major influence on geothermal project economics.

Conclusion -- We Must Be Competitive At The Current Price.

RESEARCH - A METHOD OF REDUCING COSTS

Since we cannot significantly impact the price we are paid for the product, we must control costs if we are to compete in the current market. The geothermal industry may have an advantage over fossil fuel competitors with respect to reducing costs. Since the fossil fuel industry is quite mature relative to geothermal, it is much farther out on the learning curve. Consequently, research efforts in geothermal should increase efficiency proportionally more than similar efforts would in the fossil fuel industry. But, this can only occur if we do the research.

That will require an all-out effort by the industry. Unocal is committed to increasing efficiency through research which can be seen by our willingness to devote manpower and financing to research projects. While our major effort is still devoted to our own proprietary research programs, we have been increasing our participation in joint-funded research. We hope that all sectors of the industry will participate in the joint-funded research projects as well as pursuing proprietary research.

AREAS FOR RESEARCH

There are many areas for research in the geothermal industry, but to effect a reduction in cost and risk we need to focus on only a few areas. The major cost areas are in drilling, production systems, and the lag time between expenditures and the revenue stream. The major risk areas are reservoir performance, injection and chemical reactions. Research expenditures should be concentrated in these areas.

If capital expenditures (drilling and production system costs) and the time delay between investment and income could be reduced, we could sell geothermal fuel at a lower price. The need to reduce capital expenditures is well understood. Advancing the revenue stream closer to the investment reduces the interest cost, which may be substantial. Shortening the time delay requires that the development move rapidly. Inherent in an accelerated development program is the increased risk in relying on reservoir performance predictions, including the long term effect of injection.

One approach to accelerating income is to develop smaller increments of power over a longer time. This would be feasible if transmission is available or if we could develop an inexpensive, long distance electric transmission system that fits this same incremental growth pattern. However, this is an area of research that is outside our normal business.

RESEARCH IN PROGRESS

I am going to discuss some of the research areas on which Unocal is working. Where possible I will be specific, but in some cases the sensitivity will require that I just make general comments.

We usually divide costs into finding, development, and operations, but it is easier to discuss research by the particular discipline -- exploration, reservoir, drilling, design/construction, and production.

Research success accomplishes either a reduction in actual costs (a drill bit that increases penetration rate) or a reduction in risk (an improved blow-out preventer rubber that reduces the risk of having a blow-out). The first is easier to measure than the second, but both are important.

Exploration

Research is aimed at identification of those areas with the most potential, at discovery of hidden systems and at methods to map the reservoir configuration. The work involves developing new methods or tools, as well as improving existing techniques. An example would be to develop seismic methods that are effective in mapping geothermal systems which are typically poor data zones. This involves technique, equipment and processing improvements.

Reservoir

Research in reservoir engineering centers on improving the ability to predict reservoir and well performance. It includes better reservoir simulation, reservoir definition and well test models. Determining the effects of injection with models and tracers also falls into this area. We not only do proprietary research in this area, but we also do cooperative research through the Geothermal Technology Organization. GTO still needs other companies to join in the research effort.

Drilling

Drilling wells is one of the major costs in geothermal development. Research in drilling is aimed at reducing well costs, which also affects exploration since the drill bit is still the ultimate exploration tool. Unocal is currently participating in joint funded research in the Geothermal Drilling Organization on air turbines, high temperature elastomers, and televiewer logging. We have also worked with selected suppliers on drilling fluids, bits, stabilizers, alloy materials, and drilling tool maintenance. We are continuing our research in cement degradation from temperature and CO_2 attack.

Design and Construction

Facility construction is the other major cost area in geothermal development. Research in this area is aimed at reducing construction costs or reducing maintenance costs. Proper materials of construction (corrosion resistant) fall into both categories, while designing to control scale fits into the maintenance cost area.

Production

Scale control, waste handling, chemical scale removal, H_2S abatement, corrosion controls, and fluid injectability are some of the research projects in this area.

COOPERATIVE RESEARCH PROJECTS

Geothermal may be competitive with fossil fuels if we succeed in some key research efforts and are selective in the projects we choose to develop. As companies, we cannot individually solve all the problems. There are, however, areas of research and development that are more suitable for cooperative effort and funding than for competitive, proprietary research. In the drilling area, these projects are typified by the Geothermal Drilling Organization projects. These are primarily developments that would normally be undertaken by the service sector, but the significant investment

requfred cannot be justified by the small geothermal market.

In the production area, we need to work with the code committees to make sure we have realistic, safe design and operation standards. This will require doing the research necessary for any changes that would be specific to geothermal, and is particularly important as we work with non-conventional materials in an attempt to handle corrosive fluids.

In the reservoir area, we need to develop methods to characterize the reservoir geometry (i.e., fracture orientation, intensity, frequency, etc.), monitor thermal injection fronts, and predict the chemical behavior. Once chemical behavior can be predicted, research can concentrate on reducing the cost of solving these problems. The problems include precipitation/dissolution reactions during production and injection, including corrosion and problems related to gases.

CONCLUSION:

The geothermal industry has an abundance of talented people. If we support their ideas for solving our problems, and manage a successful research program, we can improve the competitive position of the industry.