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GEOTHERMAL RESERVOIR ENGINEERING - UTILITY INDUSTRY PERSPECTIVE

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The perspective of the utility industry, concerning geothermal energy, has not changed dramatically during the past year. There have been minor changes, but most were positive and all were small increments. This is somewhat surprising given the dramatic down turn in the federal research and development program and delays encountered by three of the key pacing geothermal power plant projects. It indicates an unexpected strength in the industry.

Some of the key issues and changes in utility industry perspective are discussed herein, recognizing that a consensus of opinion is sometimes slow to form and that most measures of perspective are indirect and not very accurate.

Strong Interest Continues Utility interest in geothermal energy has never been greater. Evidence of this interest is manifest in modest increases in the utilities estimates of future generating capacity, roughly 10 percent last year. The problems associated with finding an adequate steam supply for the 50 MWe power plant at Baca, the necessity to shut down the East Mesa binary plant for modification, and the negative report by the California Public Utilities Commission on the Heber flash plant were disappointing of course but apparently have not diminished interest. These events simply tend to confirm the view of some that not all issues have been resolved and suggest that strong continuing commitments will be necessary for the commercialization of geothermal resources. Most of the geothermal utilities are willing to consider such commitments.

Value vs Price One of the key issues is still the cost of geothermal power. While the cost of geothermal heat is usually calculated by accountants and economists and the price established by negotiation, both are based on reservoir performance data developed by the reservoir engineer. Most utilities do not have sufficient information or knowledge about the reservoir to calculate the cost of producing geothermal energy and must prepare for price bargaining based on its value to the company. The value may not be the same for different companies.

Different geothermal fluids may have different temperatures and enthalpies, and do not all have the same intrinsic value. A first order estimate of the value of a particular geothermal heat source from the utility perspective can be established by comparing conversion efficiencies. Geothermal energy must be converted to electricity at temperatures significantly lower than for fossil and nuclear fuels, therefore, the conversion efficiency is lower, the heat rate higher. For example, the Heber binary plant is expected to have an overall thermal efficiency of about 12 percent while a conventional fossil plant would be around 36 percent, or possibly higher. Therefore, a Heber BTU is worth only one-third that of a fossil BTU in that area for power generation. This concept can be further refined by including second order factors for such things as differences in inherent availability factors for different power plant types, capital cost, operations and maintenance costs, etc. The alternate energy source might range from "avoided cost," to dominant energy source or a mix of all energy sources, depending on the needs of the utility, to establish an equivalent value for geothermal energy. The value thus established can then be used as the basis for negotiating price.

Reliability of Energy Supply Perhaps the most frequently cited concern relates to the reliability and longevity of new reservoirs. This has been a persistent issue and efforts to resolve it have been slow. EPRI with the help of Stanford has been trying to partially overcome this problem by developing a utility oriented reservoir assessment manual. The idea is to make the utilities more comfortable with the subject matter and increase their capability in this area. The problem with most of the existing literature is that it is not tutorial and is not geared to utility needs.

The utility has a vital interest in the iterative path that combines the various technical disciplines and diagnostic activities designed to assess the value of specific geothermal energy deposits. In a logical sequence of decisions, the utility contemplating a geothermal project must be able to assess the probability

of success of the project. It must also determine whether the project is a sound business venture and allocate some level of importance to the project within the company. To accomplish these efforts, close interaction between the utility counterpart and the reservoir engineering activity is essential. Physical and thermal models of the reservoir together with reservoir capacity and sustainable production rates are key sets of information needed to convey confidence that a project can be successful. Estimates of the reliability of energy supply are difficult to develop but may be inferred in a crude way from reservoir data on producing potential.

Plant Type and Size Once a reservoir has been shown to be interesting enough for a power plant project, feasibility studies will follow. During this phase, the quality of the energy is the next most important set of information. Information about temperature, enthalpy, presure and well production rates are necessary to allow the utility to determine the type and size of plant to be built. Generally it is not a question of selecting a power plant type, but matching the type with the thermodynamic characteristics of the geothermal fluid for optimum busbar cost and resource utilization.

The utility perspective on power plant size has changed somewhat during the past year. While most utilities still prefer 50 MWe plants, or larger, for commercial use, some have an interest in small plants down to one MWe and most are now interested in smaller plants from one MWe to 20 MWe as the first unit on each new field. A strong interest in wellhead units has also emerged, as a means of achieving early involvement in field development, assessing reservoir potential, and developing design criteria for larger plants to follow. Wellhead units can also be useful in assessing the economics of distributed systems compared to central plants. Interest in this concept stems from speculation that the economics of quantity might outweigh economics of scale for some geothermal systems. Also small units are more easily recycled in the event of reservoir or well failure. This aspect may be attractive where the producing potential of the reservoir has not yet been proven.

Accurate and complete geothermal fluid chemistry is essential for developing requirements for scale and corrosion control, and also requirements for environmental control systems and design criteria for these systems.

Other Issues The concern for the reliability of long term energy supply is one of the main issues, as noted, and busbar energy cost runs a close second. Other issues of high priority with the utilities include capital availability, land use, and future potential of the resource. While licensing can be a difficult issue, environmental protection is thought to be practical since the threat to the environment is low and present environmental control technology appears to be capable of meeting most existing standards. Issues that arise later in the project include plant type, plant size, cooling water availability and scaling and corrosion. EPRI's Geothermal Program is attempting to address a number of these issues, as a part of its current research and development plan.

Conclusion While the capability of the utilities is still deficient in the area of geothermal reservoir assessment, interest in geothermal power is high. Filling this gap by cooperative exchange, consultation and increasing in-house capability can only accelerate geothermal development.