COMMENTS ON PRICING OF GEOTHERMAL ENERGY

T. R. Fick
Bechtel Corporation

Bechtel has just concluded a study that included the effects on power plant design and busbar electric energy costs of the anticipated decline in geothermal brine temperature of the Heber reservoir. A two-stage flashed-steam energy conversion process was used, and two operating modes, constant brine flow and constant power output, were considered. Plant net capacities were taken at 50, 100, and 200 MW (e) as multiples of 50 MW (e) units.

The "cost of fuel" was estimated as a direct function of the cost of developing and operating the well field, including the cost of drilling more wells as the reservoir cools with time. Any connection between previous less direct costing bases, such as the cost of oil or nuclear fuel, was avoided. Capital costs for the well field and the power plant were estimated by the usual methods. Cost and power plant energy output were both expressed in levelized annual terms, and a plant capacity factor of 85% was assumed. Power plant cost calculations included the following assumptions:

- Operating and maintenance (O&M) at 2% of plant capital cost
- Administrative and general expense at 25% of O&M
- Insurance at 0.1% of plant investment
- Ad valorem taxes at 2.5% of plant investment
- Rate of return (ROR), 10.8%

The well field cost calculations included the following:

- Well cost at $425,000 per well
- Well annual maintenance at $50,000/well for production wells and $80,000/well for reinjection wells
- Operating cost at $70,000 annually, plus a factor varying with number of wells
- Royalties, 10% of gross field income
- Ad valorem taxes at 6% of field income
- Exploration, confirmation, and engineering as $2 million plus 5% of gross field income (only with 10.8% ROR)
- Administrative and general, 10% of O&M

- Investment tax credit, 10%
- ROR, 10.8% or 20%, depending on assumption of low or risk-adjusted financing.

As a result of the several concepts considered, estimates of a number of different busbar costs of electric energy were obtained. The lowest cost was 35 mills/kWh, assuming a 50-MW (e) plant without reservoir temperature decay and a 10.8% rate of return. The highest cost was 53 mills/kWh, assuming reservoir temperature decay and a 10.8% rate of return for the power plant and 20% for the well field. In all cases the well field costs were nearly equal to or greater than the power plant costs.

The results of the study emphasize that realistic "cost of fuel" and the effects of reservoir temperature decay are important and should be included in the pricing of geothermal energy.

ACKNOWLEDGMENT

The work reported herein is the result of a study funded by the U.S. Energy Research and Development Administration under Contract E(04-3)-1124. It should be noted that this report has not yet been approved by ERDA, hence the foregoing information should be considered preliminary.