GeothermEx
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EXPERIENCE WITH EGS / HDR / HFR DEVELOPMENT

GeothermEx's involvement with Enhanced (or Engineered) Geothermal Systems (EGS, also referred to as Hot Dry Rock or Hot Fractured Rock) began in the late 1990s, when we helped guide a new effort by the US Department of Energy to advance the status of EGS technology. The initial focus of our work was a technical evaluation the results of the first-ever EGS project (at Fenton Hill, New Mexico) and to identify sites for new EGS projects in the United States. Another major focus of this work was to gain the interest and participation of the US geothermal industry in EGS developments. GeothermEx's approach addresses areas within or adjacent to existing hydrothermal developments, thus advancing EGS techniques for developing and utilizing created or enhanced fracture systems in locations where additional heat recovery can increase the generation from existing projects. This approach was adopted in both of the two EGS field projects in the United States that have been supported by the Department of Energy (Coso and Desert Peak).

GeothermEx is the technical manager of the Desert Peak EGS and Bradys Hot Springs EGS field demonstration projects, located in western Nevada, and for another demonstration project in southwestern Alaska. In implementing EGS field projects, we combine EGS techniques successfully used elsewhere with our own long and practical experience in the development and utilization of conventional geothermal resources. We serve as liaison between the field operator and numerous research organizations, developing methodologies that meet the needs of both while advancing EGS technology. Implemented in the field and the laboratory, these techniques culminate in the stimulation of attractive lithologies to increase generation from the existing power plants, or to supply stand-alone facilities.

GeothermEx has undertaken the first comprehensive evaluation of the power generation prospects from EGS using numerical simulation techniques. The study investigated a number of practical issues, including defining project success criteria (net generation profile over the project life) and identifying the reservoir and operating characteristics that have the most impact on long-term generation. GeothermEx has also developed methodologies to assess the EGS resource base in a country or region using conductive heat flow, heat recovery factor and a dimensionless variable called the EGS Sustainability Coefficient.

Our work in this area has led to a modular alternative to conventional EGS production/injection system design. In this approach, named Earth Energy Extraction ("Triple-E") System, injection to the reservoir is implemented using an array of ultra-thin diameter (2.5 to 7.5 cm), low-cost wells which are each terminated close to and at a shallower level than the top of the productive interval in a normal-diameter, pumped production well. The flow rate in each individual injection well is low, allowing significant heating of the injected water even before it reaches the reservoir. The Triple-E approach avoids one of the main technical limitations associated

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with EGS development: creating a significant reservoir volume. The technical feasibility of Triple-E System design has been confirmed by analysis of heat transfer between the injection holes and the surrounding rock, and heat transfer in the reservoir between the rock and the injected fluid.

More recently, GeothermEx has been investigating certain broader issues regarding EGS systems, such as how to optimize the relationship between resource depth and temperature. The optimum depth for an EGS reservoir (defined in terms of maximum net MW capacity of a well or the minimum drilling cost per net MW capacity) becomes increasingly shallower as temperature gradient increases, even though a deeper development would exploit higher temperatures. GeothermEx has also extensively evaluated the economics of EGS development. The results indicate that with adequate research, development and demonstration over the next decade or two, EGS power should become commercially competitive in the United States by 2050. Elsewhere, price supports for green power are helping to accelerate the pace of commercial EGS development.

Since the ability of geothermal energy to make a significant impact on the world energy scene depends upon the successful, large-scale deployment of EGS, GeothermEx is actively applying its practical experience with conventional geothermal development in this emerging area.