FEASIBILITY OF GEOTHERMAL POWER GENERATION FROM PETROLEUM WELLS

by

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Abstract

There are three types of petroleum wells potentially capable of supplying geothermal energy for electric power generation: (a) a producing oil or gas well with a water cut, (b) an oil or gas well abandoned because of a high water cut, and (c) a geopressured brine well with dissolved gas. This paper considers the basic technical and economic aspects of power generations from each of the three types of wells and presents case histories of estimating the available power capacity of a typical well (or a group of wells) in each of the above categories. We have conducted these assessments for commercial developers and operators.

The power capacity of wells in the first category is determined primarily by the production rate and temperature of the produced water, ambient temperature, and conversion efficiency of the geothermal power plant. The factors that control the wellhead temperature of the produced fluid are: formation temperature, well depth, well diameter and production rate. Our assessment of some producing oil wells in the Middle East showed that in spite of an attractive formation temperature, the wellhead temperature of the produced water was too low compared to the ambient temperature to allow commercial generation of geothermal power. However, solar energy or the gas being flared in such a field could be used to boost the temperature of the produced water and increase the power capacity.

The power capacity of an abandoned gas well depends on: (a) production rate and temperature of the produced water, (b) ambient temperature, (c) conversion efficiency of the geothermal power plant, (d) water salinity, (e) gas content in the produced fluid, (f) heating value of the gas, and (g) the characteristics of the equipment used to generate power from the produced gas. The production rates of water and gas from such a well depends on the hydraulic properties of the formation, gas content (dissolved as well as free) in the formation water, formation temperature and pressure, and well design. It is shown that the well's productivity could be substantially improved by working it over; both pumping and self-flowing the well are considered. A conceptual design of a hybrid system to produce power from both the produced gas and water is proposed. A case history of assessment of such a gas well from the U.S. Gulf Coast is presented in the paper; it is concluded that power generation from the well is technically feasible, and can be commercially acceptable. The possible approaches to improving the project economics are discussed.

The power capacity of a geopressured well is determined by all of the factors considered above for an abandoned oil or gas well plus the amount of overpressure in the formation. A geopressured production well that supplied the U.S. Department of Energy's demonstration power project in Pleasant Bayou, Texas, in the late 1980's was re-assessed. The well is estimated to be capable of generating 3.9 MW of which 1.5 MW is from geothermal energy, 1.9 MW from the produced methane and 0.5 MW from kinetic energy of the produced fluid. Injection of the power plant waste fluid is an important issue in developing a geopressured project. For the example above, the net power available after deducting the parasitic power for injection is 3.1 MW. The economics of such a project is dependent on the market price of natural gas; if the gas price is high enough it would be more profitable to sell the produced gas rather than generating power from it.

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