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ECONOMICS OF NATURAL DRY STEAM FOR ELECTRICITY GENERATION,
THE GEYSERS GEOTHERMAL FIELD, SONOMA COUNTY, CALIFORNIA

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Excellent cost and operating economics feature development and operation of the first commercial geothermal plant in the United States devoted to electricity power generation.

It is The Geysers plant located near Geyserville, 100 miles north of San Francisco in the Coast Ranges of California.

Dry superheated steam is found at a maximum earth temperature of 240°C. (348°F.) at depths ranging from 523 to 5,066 feet with a maximum well-head pressure of 479 psig. Quaternary Pleistocene volcanic rocks are believed to be the heat source.

The Geysers thermal area lies at the west end of a northwest-trending graben, 5.5 miles long by 1 mile wide which lies 5 miles southeast of the Clear Lake Basin. The majority of thermal areas in the Mayacmas Mountains are located in the Geysers and Anderson Springs grabens. Cobb Mountain represents the culminating uplift of the Mayacmas range. Because this uplift corresponds with a volcanic extrusion center and is spatially associated with the thermal areas, it is possible that forceful magmatic intrusion is responsible for the uplift of Cobb Mountain. Flanking grabens were formed due to horizontal extension of the crust across the arched area.

To date 51 steam wells have been drilled and completed with a maximum open-flow potential with an electric power equivalent of 270,000 kw. Maximum flow rate from any steam well is 222,000 lb./hr., at a well-head pressure of 110 psig recorded at Happy Jack No. 1.

Field development has been conducted since inception during 1955 to the present by Thermal Power Company and Magma Power Company of San Francisco, California.

Commercial power utilization of natural steam for electricity generation commenced at The Geysers during 1960 when Pacific Gas and Electric Company of San Francisco installed the first plant of 12,500 kw. capacity. This was followed by successive installations of 14,500 kw. in 1963; 26,500 kw. in 1967 and 27,500 kw. in 1968 for a combined total of 81,000 kw. Two additional 55,000 kw. units are scheduled for 1971 and 1972.

Pacific Gas and Electric Company has invested more than \$8,500,000 in plant and transmission facilities at The Geysers to date. It has budgeted an additional \$11,500,000 for expenditure by 1972.

Purchase price for steam at plant point is the lowest for any other type of energy. Pacific Gas and Electric Company paid 2.5 mills per kwh for the first two units during 1960 to 1965. This price was lowered during 1966 to 2.25 mills per net kwh. and during 1967 to 2.27 mills per net kwh.

Annual capacity factors of the turbo-generators has exceeded 90 per cent because units are operated normally at their maximum rating, or are shut down for maintenance every two months for a few hours for functional test of the plant automatic protection devices.

Predicted net thermal efficiency of Unit No. 3 is 14.3 per cent at 28,000 kw. Geothermal unit thermal efficiency is much less than that of a conventional steam boiler unit due to the condition that it utilizes natural steam which exhibits little superheat and low pressure.

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