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PROGRESS REPORT
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CHEMICAL RESERVOIR ENGINEERING AT FIVE
LOS AZUFRES PRODUCTION WELLS

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Background:

The joint study, underway since the 1982 startup of the initial 5-MWe Units at Los Azufres, examined thermal drawdown in the production zones based on combined analyses of the thermodynamic and chemical behavior during production. Analyses were prepared for several wells after 2.5, 4, and 5 years of production and were continued with data through 1992 when additional data on sustained reservoir production prior to the startup of the generators were acquired. For some of the wells, the pre-generation period represented a significant fraction of the total mass produced. To determine the effect on thermal drawdown of the pre-generation fluid production, a re-evaluation of the total heat extraction around these wells will be of value in comparing the effects of the early drawdown.

Objective:

The joint study evaluates the extent of the changes observed around five production wells in three structural zones where 5-MWe Units are in service in the potentially large Los Azufres geothermal field. The evaluation provides information concerning the extent of thermal decline in production fluid and thermal drawdown in the reservoir around the selected wells.

Program for 1994:

The study consisted of data reduction to prepare annual summaries of the CFE production and chemical databases for wells Az-5 and Az-13 in the Maritaro zone, well Az-9 in the El Chino zone, and wells Az-16AD and Az-22 in the Tejamaniles zone at Los Azufres. A summary database was prepared for: (a) monthly- and annually-averaged analysis of fluid production with respect to temperature, enthalpy, and thermal extraction rate; (b) chemical characteristics with respect to near-well and far-field geochemical temperatures; and (c) drawdown evaluation based on reservoir fluid temperature and total production volume based on a model of "just-penetrating" wells at the Los Azufres geothermal field.

Results to Date:

Except for a few omissions in the CFE database for the five wells, the reduced database has been completed through the end of 1993, starting with the first significant months of well production prior to initiation of electricity generation at the 5-MWe wellhead Units. A summary of thermal production was prepared for the 7 to 14 years of production at the five wells which included mean production data, thermal extraction rate, and cumulative fluid and thermal extraction. The data are compared to the data at the end of 1992 which do not include the pre-generation production data. For each well an analysis of the hemispherical drawdown has been initiated. The analysis consists of an annual database of reservoir drawdown radius obtained from the cumulative mass production data, the fluid density for the reservoir temperature estimated by the Na-K-Ca geothermometer, and estimated mean porosity obtained from Los Azufres staff. The drawdown data are expressed as an inverse linear relationship between the pressure in the concentric hemispherical shells (obtained from the geothermometer temperature) and the radius of the concentric shells. The observed data can be matched with type data for the resulting extrapolated far-field pressure. Completion of these analysis are awaiting the accumulation of the missing data for some of the wells and the completion of the drawdown tables.

Plans for 1995:

Completion of the joint project is expected in 1995. With incorporation of the few missing data for the individual wells, analysis of the total drawdown data will be used to evaluate the applicability of the just-penetrating well model to explain the thermal extraction behavior of the isolated wells and its capability as a prediction tool. The results will be reported at the Fourth DOE-CFE Technical Meeting and published in the geothermal literature.