

A SYSTEMATIC APPROACH TO DECLINE CURVE ANALYSIS FOR THE GEYSERS STEAM FIELD, CALIFORNIA

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ABSTRACT

A methodology is derived for calculating the static pressure normalized flow rate histories of wells from the usual production records kept by operators, namely, flow rate and flowing wellhead pressure as functions of time. Then, a generalized approach is developed for analyzing the flow rate decline trend to estimate the future decline in well productivity, make-up well requirement, remaining reserves, and well life. The authors have observed, based on data from several hundred wells, that the usual decline trend at The Geysers is "harmonic" with occasional episodes of "exponential" decline in response to new power plants coming on line. In the approach presented here, two decline curves are prepared for each well: flow rate versus cumulative production and the logarithm of flow rate versus cumulative production; the former plot shows a linear data trend if the decline trend is exponential and the latter if the decline trend is harmonic. The authors have observed from well histories as well as numerical simulation that forecasting based on either a linear p/z trend with cumulative production or an assumed exponential decline is conservative, while forecasting based on a harmonic decline trend is optimistic. Because of data scatter or too short a history, in many cases the flow rate decline trend of a well may be fitted to either exponential or harmonic equation; in such cases the lower and upper limits of the decline trend can be established.

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