

Paper Number 81433
Title **A Probability Approach to Development of a Large Carbonate Reservoir with Natural Fractures and Stratiform Super-Permeabilities**
Authors T.R. Pham, B.A. Stenger, U.F. Al-Otaibi, N.I. Al-Afaleg, Z.A. Al-Ali, Saudi Aramco; S. Sarda, Beicip-Franlab
Source Middle East Oil Show, 9-12 June, Bahrain

Copyright 2003. Society of Petroleum Engineers

Abstract

This paper describes a development strategy with peripheral water flood for Haradh Arab-D reservoir, a large oil bearing carbonate part of the greater Ghawar field. In a heterogeneous matrix permeability background, geological discontinuities such as faults, fractures, and stratiform high permeability streaks lead to a decisional divergence between development options. In this regard, optimizing the field development plan aims to find a proper balance among several conflicting requirements.

In the case of Haradh Arab-D, the field development options are divided into two components. The first component is a development scheme that is the most cost effective with respect to production plateau, oil recovery and reservoir conformance. This option involves a multi-disciplinary team addressing the development challenges by extracting information from nearby development experience, quantifying uncertainty with deterministic and stochastic modeling techniques. An array of different reservoir simulation models (Single media full field model, Dual-porosity-permeability model, Local grid refinement model, and Streamline model) was used for the purpose (1). This results in a preliminary development plan with the application of the horizontal well options with respect to well placement, horizontal direction, completion interval selection and the length of the horizontal section.

The second component, the focus of this paper, is the sensitivity analysis and risk assessment running concurrently with reservoir simulation to develop a Pareto chart for different reservoir parameters such as Fracture density and connectivity, Super-permeability layers, Skin damage, Aquifer size, and Kv/Kh ratio. The most sensitive parameters with respect to oil recovery are identified for re-assessment and further improvement and optimization of the development plan. Data acquisition program, reservoir performance evaluation and production injection strategies are conducted with these sensitivities in mind. They are executed with the highest priorities given to the most sensitive parameters.

In order to ensure that the target objective is achievable, wells drilled during the initial development phase are tested to validate the development strategy. Monte Carlo simulations again are run on periodic basis with actual field data input to further optimize the development.