

Sensitivity and Uncertainty Analysis of Hydrocarbon-In-Place in Sandstone Reservoir Modeling: A Case Study

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Abstract : Kuwait Oil Company (KOC) has been producing from its major reservoirs that are well defined and highly productive and of superior reservoir quality. These reservoirs are maturing and priority is shifting towards difficult reservoir to meet future production requirements. This paper discusses the results of the detailed integrated study for one of the satellite complex field discovered in the early 1960s. Following acquisition of new 3D seismic data in 1998 and re-processing work in the year 2006, an integrated G&G study was undertaken to review Lower Cretaceous prospectivity of this reservoir. Nine wells have been drilled in the area, till date with only three wells showing hydrocarbons in two formations. The average oil density is around 300API (American Petroleum Institute), and average porosity and water saturation of the reservoir is about 23% and 26%, respectively. The area is dissected by a number of NW-SE trending faults. Structurally, the area consists of horsts and grabens bounded by these faults and hence compartmentalized. The Wara/Burgan formation consists of discrete, dirty sands with clean channel sand complexes. There is a dramatic change in Upper Wara distributary channel facies, and reservoir quality of Wara and Burgan section varies with change of facies over the area. So predicting reservoir facies and its quality out of sparse well data is a major challenge for delineating the prospective area. To characterize the reservoir of Wara/Burgan formation, an integrated workflow involving seismic, well, petro-physical, reservoir and production engineering data has been used. Porosity and water saturation models are prepared and analyzed to predict reservoir quality of Wara and Burgan 3rd sand upper reservoirs. Subsequently, boundary conditions are defined for reservoir and non-reservoir facies by integrating facies, porosity and water saturation. Based on the detailed analyses of volumetric parameters, potential volumes of stock-tank oil initially in place (STOIIP) and gas initially in place (GIIP) were documented after running several probabilistic sensitivity analysis using Montecarlo simulation method. Sensitivity analysis on probabilistic models of reservoir horizons, petro-physical properties, and oil-water contacts and their effect on reserve clearly shows some alteration in the reservoir geometry. All these parameters have significant effect on the oil in place. This study has helped to identify uncertainty and risks of this prospect particularly and company is planning to develop this area with drilling of new wells.

Keywords : original oil-in-place, sensitivity, uncertainty, sandstone, reservoir modeling, Monte-Carlo simulation

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