AAPG Datapages/Search and Discovery Article #90315 ©2017 Asia Pacific Region GTW, Oil and Gas Resources of India: Exploration and Production Opportunities and Challenges, Mumbai, India, 6-7 December, 2017

Scenario Based Geo-Cellular Model Building For A Tight Oil Reservoir With Limited Data And High Uncertainties – A Case Study From Barmer Basin, India

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ABSTRACT

The N-L Barmer Hill oil Field (NL-BH) is located in the northern Barmer Basin, northwest India, and was discovered by Cairn in 2014. The field comprises of six Exploration & Appraisal wells spread across a large area. The primary reservoir belongs to Barmer Hill Formation of Upper Paleocene age, lithologically composed of biogenic microcrystalline quartz - commonly referred to as quartz-phase porcellanite. In NL-BH Field, the Porcellanite facies (represented by siliceous diatomite) is diagenetically altered and is characterized by good porosity (~10-25%) but low matrix permeability (~0.01-2mD). The reservoirs are highly laminated, with millimeter to centimeter scale inter-beds of porcellanite, claystone and organic material.

NL-BH field being in the early stage of the life cycle of an asset monetization, the estimation of total inplace volumes with range of associated uncertainties is critical in making decisions for an optimum initial development plan and efficient reservoir management during the production phase. This paper illustrates the benefits of capturing the principal geological uncertainties through discrete plausible sub-surface scenarios (based on key uncertainties), demonstrated by reservoir modeling case study from the NL Barmer Hill Field. The deterministic models, built on these sub-surface concepts, have been linked within a probabilistic framework using a Monte Carlo Simulation and the possible volumetric outcomes are plotted on probabilistic distribution function to ascertain the P50 volumes. There is a distinct possibility that the P50 outcome from probabilistic distribution function may vary significantly from the otherwise assumed initial 'base case'. In such a scenario, a new base case static geological model should be built, by integrating the available seismic interpretation, petrophysical, geological and reservoir engineering data, with hydrocarbon estimates closer to the P50 estimates from the PDF (probalistic distribution function). The P90, P10 in place volumes will also be derived from the probabilistic density function and will help in building corresponding low and high case models for dynamic simulation. The key to success in this approach lies in evolving an appropriate list of key high impact sub-surface uncertainties derived from the sensitivity analysis of all potential parameters affecting the STOIIP estimate. The method also provides a way of quantifying the relative impact of different uncertainties which in turn can be used to steer further data acquisition in the field.