

The Subsurface Chance of Success: A Play Risk Analysis of Prospectivity, Sustainability and Commerciality of Gas Production from Tight Reservoirs in Saudi Arabia

Hamad Al Kharaa¹, Mohammed Al-Duhailan¹, and Hafiz Al Shammery¹

¹Saudi Aramco

ABSTRACT

A comprehensive methodology was established to analyze the subsurface risks associated with a complex tight gas sand play in northern Saudi Arabia. It is a new fit-for-purpose approach when executing a strategy with an accelerated de-risking process and considering the full asset-life-cycle. It is denoted by the Subsurface Chance of Success (SCS).

The SCS is defined here as the chance of success in executing a cost-effective prospecting program for productive reservoirs with enough gas-in-place to sustain gas production and maintain commerciality throughout the full asset-life-cycle. Its analytical expression represents a probability distribution function that combines the probability of success in the following: 1) finding required gas volume, 2) sustaining targeted production rate, and 3) maintaining minimum Long-Run Marginal Cost. The SCS is measured according to a Success Envelope defined by minimum and maximum SCS thresholds (Min SCS, Max SCS).

The chance of success in the tight gas sand play of northern Saudi Arabia is dependent on placing cost-effective vertical wells over identified individual small size, porous and gas productive sands (sweet spots). These sweet spots are within a complex depositional system of heterogeneous tight sands of pro-glacial channels. Existing gas accumulations in this complex system are pervasive and not dependent on well-defined traps. The derived analytical expression was used to simulate the SCS according to the following assumptions: 1) a model of sweet spots (30%) with limited areal extent in communication with an extensive low permeability (tight) matrix (70%), 2) possible Porous recovery is 50%, 3) gas contribution from tight is captured by the transmissibility factory of ($C=0.1$), 4) from nodal analysis, well productivity is based on 3 Inflow Performance Relation (IPR) classes (high, medium and low), and 5) underpressured reservoir.

The implementation of the SCS as a play risk analysis resulted in a significant impact not only on the ability to maintain full flexibility and agility in making decisions, but also to build a diverse gas asset portfolio through multiple exploration and appraisal programs.