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Optimizing Appraisal Strategies For Tidal Clastic Reservoirs

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ABSTRACT

Tidal sandstones have proven to be good reservoirs in several fields. However, subsurface uncertainties associated with their heterogeneity, specifically reservoir distribution, extent and properties make them challenging development targets. This study assesses different appraisal strategies to reduce the reservoir uncertainties in the tidally influenced oil-bearing Upper Bahariya sandstones in a field in the Abu Gharadig Basin in the Western Desert, Egypt. The clastic reservoir-units within the shallower Abu Roash formation are well developed with most of the wells in the field targeting these sands. 4 crestal wells that penetrate the Upper Bahariya reservoir produced gas from the deeper Kharita reservoir. While the Upper Bahariya can be imaged on 3D seismic data, the individual reservoir-units are below seismic resolution. The limited data suggests low reservoir connectivity, however, analogues from fields in the Basin have shown that the Bahariya has reasonable production potential. This re-enforced the need for appraisal to ascertain the size of the prize to optimize field development strategies. Two appraisal approaches were analysed, local appraisal and field-wide appraisal. The local approach focuses the appraisal around existing wells to establish reservoir connectivity, while the field-wide approach addresses uncertainties in structure and oil-water contact. An appraisal campaign that combines the two approaches was proposed to accelerate development and maximize recovery.

Subsurface uncertainties were identified and different geological realizations were conceptualized. A well-test conducted in good reservoir quality sands indicated limited connected volumes around the producer alluding to uncertainties in reservoir distribution and connectivity. Hydrocarbon column height and saturation were also found to be the top uncertainties as the crestal wells did not log the oil-water contact nor did they penetrate the saturation transition zone. Sand distribution realizations were based on facies interpretation from well-log signatures from the field and core from regional analogues. These realizations were then used to estimate a range of in-place volumes, production potential and sand predictability. Primary and secondary reservoir-unit appraisal targets were established based on these parameters. Appraisal well locations were selected to address different local and field-wide uncertainties and were ranked based on their appraisal value. The down-side of encountering water-wet sands or shales and the inability to convert the appraisal well into a development well was considered as a risk that also influenced the ranking of well locations.

The local appraisal approach tests the geological realizations to explain the limited reservoir connectivity around the producer by testing for structural or stratigraphic compartments. The field-wide appraisal approach addresses the uncertainty in column height by appraising the unpenetrated flanks. It also addresses the uncertainty in the overall facies depositional trends by appraising different directions based on the conceptual geological models. Although the local appraisal approach carries lower risk than the field-wide appraisal, it has a lower appraisal

value. This is because local appraisal fails to address the column height uncertainty or test the upside opportunity of encountering unpenetrated tidal-channel sands. The best technical solution was found to be an appraisal campaign that combined the two approaches. The proposed appraisal strategies present decision-makers with viable options along with the knowledge of the potential up-sides and risks associated with each approach, thus enabling the acceleration of development decisions.