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Keynote Address: Challenges of Incorporating Dynamic and Fracture Behaviour into the History Matching Process

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SUMMARY

Integrating dynamic data into reservoir numerical models is essential for capturing the actual dynamic flow behaviour and the true performance of a reservoir. History matching efforts could prove to be fruitless without including such data into the reservoir model. Fractures and super-high permeability streaks are two examples of important flow features that open-hole logs and core sampling do not provide a satisfactory characterization and can be overlooked. Thus a log and core-based models will not be able to predict the actual performance of the field. It is not uncommon to measure dynamic permeability values, through pressure transient testing, at magnitude(s) of order higher than those obtained from core samples and core-log correlations, indicating presence of un-interpreted high permeability intervals within the reservoir.

This integration of dynamic data, and the identification of reservoir fractures, in their different forms, poses a challenge for the simulation engineer during the history matching process. Variable impact of the different types of fractures (due to their varying size, shape, proximity and continuity) on the flow performance and water cut development forms an additional difficulty during.

The presentation discusses some of these challenges associated with modeling of a giant carbonate Middle East reservoir, aiming as starting a brainstorming discussion of what options and alternative approaches are there for incorporating the dynamic permeability into the simulation model, and for identification of fractures presence, type, size and continuity in the reservoir.

Dynamic modeling of fractured reservoirs poses several challenges for the reservoir engineer. The source of these challenges is attributed either to fracture characterization and/or numerical modeling. The objective of the current work is to demonstrate how fracture characterization is critical to dynamic modeling, from history matching of the observed performance in the wells to the predictions of future field performance and ultimate recovery estimates.

In order to achieve an acceptable history match, an engineer will attempt to compensate any deficiencies in the fracture characterization, which would not be known to him or her, by altering the fracture characterization itself, or modifying one or more matrix properties that might not necessarily require such modification. This means that the resulting model might not be a true representation of the underground reservoir.

These inaccuracies in the model, which might go unnoticed for a while, eventually manifest themselves in the form of deviating predictions from true future performance, either in the form of infill well results or total field performance.

It is, therefore, of critical importance that the initial characterization of the fracture system in a reservoir be as accurate as possible, and that any future modification during the dynamic modeling stage be done as a team effort, where the proposed modifications by the engineer can be validated and qualified by the geo-scientist