Maximizing Oil Recovery in a Complex Geological Setting of a Matured Brown Field

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Abstract

Objectives/Scope: Field D consists of 68 multi-stacked reservoir packages in heavily faulted compartments. These reservoirs have been producing for over 20-years, utilizing different depletion techniques. More than half of the reservoirs undergo natural depletion, one-third receive water injection support, and a few rely on gas injection, contributing to the current field recovery factor (RF) of 27%. The natural depletion reservoirs (NDR) currently account a significant portion of the field's resources. Aspiring to increase the RF to 40%, the most practical approach is to convert the NDR into water injection reservoirs (WIR), aligned with the successful track record of WIR as the primary contributors, accounting for ~70% of the field's production. This paper outlines optimal strategies to enhance reservoir performance in Field-D, focusing on the conversion of NDRs to WIRs. The approach involves integrating techniques such as production surveillance data acquisition, classical reservoir engineering evaluation, analogue and reservoir simulation.

Methods, Procedures, Process: The initial approach involves a workflow for opportunity screening, which entails reviewing production data from NDRs based on predefined criteria. The aim is to identify any production and injection anomalies, as well as uncertainties related to breakthrough events, production allocation, contact movement, and unintended water injection. Subsequently, an integrated evaluation is conducted by analyzing production-pressure monitoring, data acquisition findings, and understanding the reservoir RF, with the support of regional analogues. The identified opportunities are then categorized into different groups before undergoing scrutiny within the modeling and simulation framework. The workflow incorporates typical dynamic simulation processes but is further enhanced with additional scopes, including identifying optimum drainage-injection points, well stringing through stacked layers, and ranking opportunities based on incremental value considering risk and uncertainty.

Results, Observations, Conclusions: By implementing this strategy, 11 out of 35 NDRs were successfully converted into WIR. Remarkably, 10 of these reservoirs had not been previously tapped, resulting in additional reserves and contributing to an overall field recovery factor (RF) at 38%, bringing the field closer to the desired RF target of 40%. The future development of the field will occur in phases, leveraging water injection to address pressure depletion and taking advantage of favorable mobility conditions. It is evident that chasing the remaining oil in a mature brown field is a continuous and challenging endeavor. One of the key obstacles faced in the field is the lack of accurate production-injection allocation data due to commingled production, aggravated by tubing leaks.
**Novel/Additive Information**: Conscious economic decision making should be exercised in identifying additional drainage and injection points, particularly in challenging heterogenous reservoirs where fluid displacement efficiency is uncertain. The strategy outlined in this paper is a cornerstone in helping a brown field to achieve the aspired 40% RF for WIRs, among other ongoing continuous creative solutions.