Reservoir Flow Simulation under Uncertainty: How to Optimize the In-situ Upgrading Process?

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All reservoir models are endowed with uncertain subsurface parameters and simulation results must reflect the impact of these uncertainties; hence simulation results should always show uncertainty ranges or "error bars". We describe how recent developments in simulation techniques, tool capabilities and compute power enable simulation workflows in which it is almost equally easy to produce production curves with an uncertainty range, as it is to run a single simulation. In this workflow the uncertainties are integral part of the simulation models and our in-house simulation platform supports various methods, such as Design of Experiment or Monte Carlo, to quantify the impact of these uncertainties on simulation results.

Such a workflow is illustrated using Shell's proprietary In-situ Upgrading Process (IUP) as an example. After briefly explaining this recovery process and the modeling approach, it is shown how the main subsurface uncertainties were identified and how they impact the process efficiency. This shows that, in comparison to a conventional thermal recovery process, IUP is relatively insensitive to the subsurface uncertainties, which allows for a fairly straightforward approach to optimize the process.