Title of article: Sidetrack and Recompletion Risk Evaluation - Waterflooded Reservoir

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Abstract

Sidetrack or recompletion time (tR) is optimized for the pair of a production and injection well simultaneously under uncertainty with respect to expected monetary value (EMV) or risked net present value (NPV) as the objective function to properly understand and shed more light on the critical parameters influencing tR. The option to sidetrack or not is also evaluated. Analysis is aided by a recent time dependent analytical waterflood performance model with respect to cumulative injected water for adequate economic analysis. There exist two zones, a productive and lower zone and a lesser producible upper zone that has low recoverable reserves, of which both zones are penetrated by both wells. The injection well enhances oil production in the production well by the displacement mechanism of waterflooding. Though sidetrack is simultaneous considering negligible time interval between sidetrack of both wells, it is actually a sequential operation with regards to the decision tree schematic. A possible outcome is, if sidetrack to produce from the upper zone fails, then no sidetrack to the upper zone through the injection well. Decision tree analysis is brought to fore considering the probability of success (POS) of continual production (injection) from (to) the producing zone and production (injection) commencement possibility for the upper zone. Uncertainty of parameters including POS in evaluating the objective function, EMV, is made possible by probable values using distributions for Monte Carlo simulation run. EMV and tR are optimized for each run by constraining tR to either, after water breakthrough time to the lower zone or from time 0. The objective function is solved with a constrained non-linear generalized gradient optimization scheme. Significant match was obtained for waterflood performance, and NPV of each terminal branch of the decision tree between the analytical approach and reservoir simulator generated data. Notably, optimal tR obtained through the analytical approach is highly dependent on POS of production and injection from (to) the upper zone. Evaluation of possible dependencies of POS is essential as regards to the sequential operation brought largely by geological uncertainties and may be to a lesser extent by the sidetrack operation based on the influence of probable pathways. Other criteria for selection of optimal time are more suitable for selection of an optimal range and not a single value. These criteria in essence, boost the EMV and cannot stand alone as an optimization tool.