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Parent-Child Interference in the Duvernay Play: Guidelines for Completing Children Wells in Multiple-Well Pads

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Summary

Lately, Canadian basins have experienced an increased number of drilled and completed wells in unconventional reservoirs. Due to this accelerated field development, drilling many wells so close together seems to be the late-trend. Consequently, interference between the parent and children wells is inevitable with an associated production loss. The objective of this work is to utilize modeling approach to develop guidelines, for a typical pad in Duvernay, on infill timing and completion scheme to minimize the impact of parent depletion on the performance of children wells.

Theory / Method / Workflow

A reservoir modeling workflow was employed to integrate all steps, from constructing a geological model up to production simulation, including the analysis of reservoir petrophysics, geomechanics, completions and non-planar hydraulic fracture models using dedicated simulators.

The area of interest consists of 3 parents and 2 children wells located in-between the parents. At time zero, a 3D mechanical earth model was used to model the hydraulic fractures in the parent wells. A dynamic model was only created for these wells and the simulation was run for 5 years. Pressure distribution at the time that children wells came into production was extracted from the previous model and a 3D depleted stress distribution was computed by using a finite element method that includes the effect of pore pressure decrease over the stress magnitude and direction change.

Then, a complex hydraulic fracture model was run for the children wells using the new depleted stress distribution and a 5-well dynamic model was created this time. Finally, a sensitivity analysis was performed to optimize the hydraulic fracture parameters of the children wells with the objective of maximizing recovery by accessing more virgin area between the parent wells.

Results, Observations, Conclusions

Modelling results suggested that the completion schemes for infill wells should be tailored to specific reservoir stress conditions. Completion and hydraulic fracture parameters were sensitized for children wells at different infill times to evaluate the impact that each parameter had on their productivity. Hydraulic fracture modeling followed by dynamic modeling was done for the entire pad for all cases. Fracture geometry, hydraulic and propped surface area and fracture conductivity in children wells were extracted and analyzed versus production indicators (EUR, initial production, short and long-term cumulative production). Results indicated that the bigger fracture footprint into the depleted area, the less production the children wells have. Optimization was done based on diverting the propagation of hydraulic fracture from depleted area to virgin area around children wells.

Novel/Additive Information

This study shows a holistic approach in modeling the impact of parent well production on the performance of children wells. Coupled 3D-geomechanical model with reservoir simulation led to successful modelling of hydraulic fracture in depleted areas. Results confirmed that the main reason for under-performance of children wells is the effect of depletion of the parent wells on the hydraulic fracture of children wells. The realization of this type of studies allows the operators to know the current connectivity conditions between reservoir and wellbore therefore, opening a window for improvement and optimization in the Duvernay.

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