FRACTURE AND WELLBORE SPACING OPTIMIZATION IN MULTISTAGE FRACTURED HORIZONTAL WELLBORES: LEARNINGS FROM OUR EXPERIENCE ON CANADIAN UNCONVENTIONAL RESOURCES

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This paper was presented at the international Petroleum Technology Conference held in Kuala Lumpur, Malaysia, on December 10-12, 2014.

ABSTRACT

Horizontal wellbore drilling and completion technology with multistage fracturing has revolutionized the exploitation of unconventional resources in North America in recent years. Many unconventional oil and gas reservoirs with ultra-low permeability have become economical as a result. Yet, the development and completion costs of these resources can be further improved by optimizing the number of fracture stages placed on each wellbore and the number of wellbores drilled per section of land.

This study highlights our operational and analytical experience on an integrated workflow for optimization of fracture and wellbore spacing to develop the unconventional resource in Western Canadian Sedimentary Basin (WCSB). The study is based on fracturing design and optimization, microseismic fracture mapping, reservoir modelling and production analysis for numerous case studies on various formations in Canada including Beaverhill Lake, Cadomin, Cardium, Doig, Dunvegan, Duvernay, Montney, Viking, Slave Point and Sprit River formations.

The typical workflow for fracture and well spacing optimization studies includes multiple and iterative steps: minifrac tests, fracture modelling and calibration, fracture job execution, microseismic monitoring, reservoir simulation and production data analysis. In this integrated process, hydraulic fracture models were built based on fracture job data, rock mechanics and log data, and then calibrated with minifrac data and microseismic fracture mapping results. Three-dimensional reservoir simulation models were constructed using laboratory core data, petrophysical and geological data, and reservoir fluid PVT properties. The calibrated fracture models were integrated into reservoir simulation models. The reservoir models were fine-tuned by history matching the production data. The fine-tuned models were then used to run multiple scenarios by varying fracture size, the number of fracturing stages per wellbore and wellbores per section. Fracturing treatments with different pump rate, proppant size, pumping schedule and proppant tonnage were further investigated to optimize fracture geometry and conductivity for production enhancement. Optimal fracture and wellbore spacing scenarios were recommended for subsequent drilling and completion planning in the field.

Such optimization studies have helped to minimize operation cost and improve the economics of resource development. Our workflow and experience in the WCSB can be a useful guideline to improve economic success of unconventional resources in other basins around the world.

To order the full paper, visit https://doi.org/10.2523/IPTC-17853-MS