Optimization of Hydraulic Fracture Design Parameters, Using Unconventional Fracture Modeling (UFM) Approach, A Montney Example

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Poor understanding of fracture geometry and inability to accurately characterize hydraulic fracture led to an excessive cost of trial and error experiments. Hydraulic fracture and production modeling has become more standard on the last few years and it is being used as “predictable tool” in the unconventional reservoirs. In this paper, we bring in a scientific approach and illustrate with some Montney field example how this modeling techniques are being used to understand and optimize hydraulic fracture parameters in unconventional reservoir.

Advanced logs from vertical wells and 3D-seismic were used to build an integrated geological model. None-uniform Discrete Fracture Network (DFN) model was constructed and 3D geo-mechanical model was built and initialized, using sonic log and available seismic data. Hydraulic fracture modeling was completed by utilizing actual pumping schedule and were calibrated against micro seismic for validation. Unstructured grids were generated from complex fracture model and dynamic model was constructed and calibrated against historical production data. History matched model was then used as predictive tool to run sensitivity on various frac design parameters.

Different fracture design parameters such as proppant tonnage, fluid type/proppant size, cluster spacing, number of cluster per stage and pumping rate were considered for sensitivity analysis and optimization. To reduce hydraulic fracture modeling and simulation run time, 240m synthetic well was designed and used. Hydraulic frac modeling followed by dynamic modeling was done for all cases. Same modification from history matched model was imposed to all models. Frac geometry, hydraulic and propped surface area, frac conductivity were extracted and compared. EUR, Initial production (IP), short term (3 years) and long term (15 years) cumulative production were plotted and analyzed. 5 best designs were selected and used to model hydraulic frac in an actual well. Production modeling and forecasting was done for all 5 cases. Optimum frac design parameters were selected by considering both acceleration and incremental recovery with respect to the base case, and cost of the frac job.

For the first time, the optimum design was implemented in a real well. The actual production profile of this well was in-line with forecast and it has exhibited significant improvement compare to similar wells in the area. This can only confirm the strength of this novel workflow.