Optimizing Return on Investment and Estimated Ultimate Recovery through Advanced MicroSeismic Monitoring Techniques

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Objective

Case studies are presented to evaluate Return On Investment (ROI) of fracture monitoring of hydraulic stimulation using geophysical methods. Time-dependent stress shadow effects cause rotation of principal stress and reduction of stress anisotropy. Over time, stress returns to the virgin reservoir stress. Focal mechanisms are analyzed to evaluate the dynamically changing stress field and to identify fracture sets and faults reactivated in real time. Operators can take advantage of these time-dependent effects by properly repressurizing parent wells prior to treating child wells, avoiding wellbore-casing deformation by identifying and skipping stages that intersect fault planes, and modifying well spacing to maximize the number of wells per drilling spacing unit (DSU).

Methods

Case histories presented include refracturing parent wells followed by offset child wells, wells treated in vicinity of active faulting, and situations where number of wells drilled per DSU are improved. ROI is calculated with consideration of monitoring costs and reported as improved revenue per well compared to local production type curves over the life of the well and calculated based on protected asset value per well when geohazards were detected and avoided.

Results and Conclusions

A significant ROI can be obtained by proper evaluation of microseismic focal mechanisms. For successful refracturing parent wells and creating containment of immediate child well treatments resulting in increased production on parent well by 35% and eliminates production loss on child wells by 25% allowing for 100% ROI after producing for 1 month. Furthermore, skipping stages identified as being susceptible to wellbore casing deformation saves as much as $2M/well and monitoring costs are recouped by saving one well. An increase of one well per DSU increases production by nearly 30% which yields a 6-month ROI.

Significance

Operators can take advantage of time-dependent stress shadow effects that can be quantified using advanced analytical techniques of microseismic focal mechanisms. Furthermore, geohazard avoidance is possible through real-time microseismic monitoring. In addition, maximizing number of wells per DSU increases production and allows operators to drill and complete their acreage correctly the first time through without the need for refracturing old parent wells and drilling child wells. These efficiencies lead to significant production gains and savings which are much more significant than microseismic monitoring costs.