Meeting the Challenges of Extended Reach Drilling Wells via an Integrated Geomechanics Solution

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ABSTRACT

Fields which are characterized by structural and stratigraphic complexities, including heavily faulted overburden and reservoir sections, stacked and compartmentalized reservoirs, salt bodies and overpressure regime, often present a very challenging drilling environment. Furthermore, after a period of production, wells may also have to be drilled through differentially-depleted reservoirs. Critical to the drilling and completions success of such wells are both the ability to characterize the subsurface stresses and pore pressure, and the implementation of optimal well engineering design and practices to overcome the difficult drilling conditions. A 3D finite-element geomechanical model was used during a feasibility study for extended reach drilling. The model included the reservoir section and overburden up to the seabed and the mapped faults and salt bodies. Data from different domains and scales, namely geology, petrophysics, seismic, reservoir engineering and drilling were integrated in the construction of the model. This richness in the input data increased confidence in the robustness and consistency of the model. The numerical model showed spatial and temporal stress variation both in magnitude and azimuth, driven by the structural and stratigraphic complexities, and also the differential depletion laterally and vertically in the stacked reservoir sequence. The stress model was then converted into a mud weight cube for easy and rapid assessment of the mud window variations within the entire model. This facilitated a field-scale understanding of possible drilling hazards for field development plans, well sequencing and risking and contributed to the optimal design trajectory. This method of 3D stress characterization overcomes many of the limitations of the traditional 1D geomechanical modeling assumptions, and provides a richer input for drilling design and execution. This is especially critical in ERD well designs in unforgiving drilling environments, where the margin for error is small. Additionally, integrating the in-depth understanding from the Geomechanics, Drilling Engineering and Reservoir Engineering domains is crucial in developing fit-for-purpose well planning and drilling execution of complex wells.