Accurate Casing Wear Prediction Model Validated in Deviated Well

ADVANCED MODELING USING STIFF-STRING METHOD CORRELATES WITH ULTRASONIC LOG IN PREDICTING CASING WEAR FOR STATOIL NORTH SEA

CHALLENGE

Various methods for estimating downhole casing wear have been developed by the industry with the goals of improving well integrity and longevity, and making casing designs more cost effective. However, precise casing wear prediction caused by drillstring movement has been difficult to achieve. Numerous industry models have failed to correlate sufficiently with wear logs. A Statoil deviated well in the North Sea provided the context for validating a new casing wear prediction method using a stiff-string model. The model calculates contact loads with greater accuracy by accounting for bending stiffness of the string and contact position of the drillstring at any given casing depth for different operations.

SOLUTION

Conventional soft-string modeling follows the wellbore curvature and does not predict the contact points between the drill pipe and inner casing wall. While the soft-string method is very good at predicting hook load, a more accurate method is needed for predicting casing wear that is distributed around the casing, depending on the operation and its parameters. This stiff-string method, part of the new CasingWear™ well integrity software application, presents a sound engineering approach to estimating and quantifying wear at any point around the casing at any casing depth.

In the validation process, wear modeling and estimation were performed for a detailed well data set, and the results were compared with measured values from an ultrasonic wear log. The data set considers wear results resulting from any of five different operations: drilling, back reaming, sliding, rotating off-bottom, and reciprocation. This comprehensive method distributes wear among multiple wear grooves, to produce a more accurate simulation of actual downhole conditions. This greater accuracy helps reduce wear over-prediction that is common to soft-string models, and significantly improves the ability to understand, predict, and avoid wear-related casing integrity issues.

RESULT

Accurate results from advanced modeling using a new stiff-string method to analyze casing wear significantly improved operator’s ability to understand, predict, and avoid casing-wear-related well integrity issues.

MODEL ACCURACY HELPS REDUCE CASING-WEAR-RELATED WELL INTEGRITY ISSUES

CASE STUDY
RESULTS

In the North Sea application, log measurements of remaining wall thickness correlated well with the remaining wall thickness predicted by the CasingWear modeling. Also, the 360˚ azimuthal location of wear grooves at casing cross-sections measured with the log correlated very well with the location of the worst groove predicted by the model.

Validation of the new modeling method helps establish a more exhaustive technique for predicting wear groove depths and respective groove locations. Also, the development of a comprehensive set of downhole wear conditions as a function of total operation time for a given casing depth provides a new planning tool for mitigating casing wear.

Success of the rigorous stiff-string model provides a pre-well planning and design tool for optimization of operational parameters to mitigate wear. A more effective casing design can be engineered based on estimated maximum wear conditions. This method helps reduce the common practice of overdesigining the casing string by using an overly large safety factor. The result is a more precise casing design and a reduction in overall well costs.

The CasingWear model can also help prevent casing failures due to unplanned wear conditions. When an operation results in higher-than-planned wear, subsequent operations can be modified to maintain total wear within design limits. In addition, nonproductive time (NPT) operations that can lead to unplanned wear can be modeled. The actual wear analysis can be related to the overall loss of well integrity and reduced well life, which can thus be avoided in future operations.