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Title: Comparison of Methods for Modeling Borehole Instability and Its Consequences

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Abstract:

Drilling and completion problem costs are often associated with borehole instability in weak, fissile or reactive shales, especially in tectonically disturbed areas. Advanced well planning tools are required to determine the optimal window of bottomhole pressure or mud density and fluid properties for drilling vertical, horizontal and deviated wells in these settings. A number of predictive methodologies have been developed for assessing borehole instability risks, ranging from relatively simple linear elastic models through to more complex non-linear models that require numerical simulation. In addition to selecting an appropriate model for a given borehole instability risk analysis, the accuracy and applicability of these model-based predictions depend heavily on the criteria used to identify the onset of unacceptable levels of risk – such as the probability of getting stuck, not being able to clean the hole, or developing a large annular area to cement.

This paper will demonstrate the application of several different predictive models that are available in a borehole stability analysis software package. Various instability risk criteria will be shown, including: 1. shear yielding initiation at the borehole wall; 2. cross-sectional area of rock yielding; 3.average radius of the yielded zone, 4. total volume of yielded rock for a given stratigraphic unit, 5. total volume of yielded rock that detaches from the borehole wall, 6. borehole breakout width or angle; 7. rubble fill percentage for horizontal wells; 8. borehole wall convergence (i.e., squeezing in plastic shales); and 9. hole enlargement due to erosion. Advanced techniques for predicting yielded rock detachment will also be demonstrated using FLAC, a numerical geomechanical software program. Calibration techniques for developing practical instability risk estimates based on offset well experience will be shown with several field examples.

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