A New Approach to Differential Sticking

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Abstract

Objectives/Scope: Since the first wells were drilled the risk of getting stuck has been ever present. As depth has increased so has the bottom hole annular pressure and the risk of differential sticking. Many remedies and preventative methods exist but of these not many are mechanical in nature (fluid composition and pressure manipulation being most common). This paper introduces a new drill collar designed to resist differential sticking.

Methods, Procedures, Process: This paper details a novel design of collar which will reduce side force generation and subsequently reduce the probability of being stuck. Traditional cylindrical collars are prone to stick without stabilization and spiraled collar designs are not optimal in preventing sticking even with their reduced contact areas, as even small thicknesses of filter cake and a pressure overbalance can produce significant side forces on the collar. The patent pending novel design proposes to run the collar at an OD to bit size ratio approaching one, with deep spiral flutes to balance the force vectors which significantly reduces the net side force in any one direction.

Results, Observations, Conclusions: FEA and other computer applications were used to design and evaluate a new drill collar against conventional smooth and spiral drill collars in the same nominal hole size. The analysis of embedded collar volume vs a range of mud filter cake thicknesses and hole ID showed significant reduction in side force generation using the new design of up to 95%. Theoretical results are confirmed by laboratory testing using a bespoke test fixture. CFD studies were also conducted and verified by laboratory experimentation for hole cleaning and erosion tendencies and a Vibration analysis done to ensure the new design does not induce any unwanted shocks. Fluid bypass area and weight per unit length are maintained at similar levels for a conventional collar design.

Novel/Additive Information: The collar design is novel with respect to shape and function and is patent pending. In addition to resisting differential sticking, it also shows benefits in hole cleaning and vibration reduction. This is achieved by maintaining a high fluid velocity through each flute and altering the frictional force direction and distribution along the collar length.