Determination of Effective Forces and Torques for Jam Release during Workover Operations in Directional Wells

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Abstract

Excessive frictions in directional wells lead to various downhole problems requiring frequent workover operations, during which it is very challenging to accurately determine the effective forces and torques for releasing a jam at a stuck position due to complex downhole situation, though extensive efforts have been made to analyze string forces during drilling operations. In this study, mathematical models have been formulated, validated, and applied to accurately determine the effective forces and torques for jam release at a stuck point during workover operations in directional wells by taking the frictions caused by string stiffness into account. According to wellbore geometry, a deflection of each string segment in a curved wellbore is first calculated. The stiffness-based contact force is then correlated with such a deflection by treating the bending segment as a simple beam that has both continuous and point contacts with the wellbore wall. Subsequently, the conventional soft-string model is modified by coupling such contact forces, while additional forces caused by string stiffness at the two-end contact points of the curved section have been taken into account. Therefore, dissipations of axial forces and torques along the string can be better identified by the newly modified model so that it is more accurate to determine the forces and torques for jam release at the stuck point. Compared to the conventional methods, it has been found from field applications that effective forces releasing a jam at a stuck point can be more accurately determined with a relative error of 23.8%, so that the corresponding workover operations can be accomplished in a quicker and cost-effective manner.

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