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Advanced Drilling Engineering Methodology Proves Robust in Preventing Mechanical Lock-up While Deploying Sand-Control Completions Through Complex 3D Drains

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Abstract

In Deep Water development wells, the challenge of successfully positioning the drain through the pay zone is key to meet the economics of a project. The industry today provides a wide range of advanced geosteering solutions that are essential to face such challenges. It is indeed possible to drill tortuous 3D horizontal drains to enhance well placement through the sweetest parts of a reservoir sequences along several thousand meters, the directional bottom hole assembly (BHA) being able to trip in and out of hole without too much issues. The question remains whether the Sand Control (SC) completion string will make it to target depth (TD) at all times? This paper shows that the success of running completion to the intended depth depends critically on the well trajectory surveys spacing (standard versus continuous) taken into account in the torque and drag analysis.

This paper illustrates a recent case of failing to reach TD while running in hole (RIH) a SC completion string in a complex 3D well drilled as part of a major deep water development project in West Africa. The reservoir drain was lost with the completion string stuck 170m above TD and a costly sidetrack had to be drilled to recover the well.

A thorough post-mortem analysis of the case was performed, deploying a unique 3rd party approach based on an advanced drilling engineering methodology, to determine the root causes of the incident:

- First, the surveyed well trajectory was reconstructed to precisely define the borehole oscillation along the 12 ¼ in. and 8 ½ in. drilled sections, using an advanced rock and bit-BHA coupling model,
- Second, simultaneous torque, drag and buckling analysis using stiff-string model were conducted in the reconstructed tortuous well trajectory and compared with standard surveys.

This innovative methodology allowed a precise reproduction of lock-up during the incident while using standard friction factors values (0.22 cased hole & 0.35 open hole) with the stiff-string model, instead of unrealistic 0.6 friction factors using the conventional soft-string solution. The analysis showed the mechanical lock-up of the screens through the tortuous open hole as well as lock-up of drill pipe just above the top of the 9 5/8 in. liner.

Combining both advanced solutions processes is proving very robust in preventing reoccurrence of such an incident. The method can be deployed while drilling, and permits the design of “ad hoc” SC completion strings and centralization to overcome the mechanical hole conditions and ultimately managing successful deployment at an intended depth.

Introduction

Being deterministic in analyzing the possibility of setting a completion as per plan before running in hole raises multiple problems. The major one is assessing if the completion design is fit for purpose to maximize the well recovery. Considering the cost of a complex well, a misplacement of the Sand Control (SC) completion due to incapacity to run it in hole as expected can represent a serious decrease in the yield of a well and a significant loss for the operator.

Lock-up is often due to excessive friction between the completion and the borehole. It is usually caused by excessive buckling or/and high wellbore tortuosity. Although basics torque and drag (T&D) calculations are nowadays becoming common practice to anticipate such situations, it appears not to be sufficient in complex wells where 3D tortuous horizontal