SPE 110432

Learning Curve Benefits Resulting From the Use of a Unique BHA Directional Behaviour Drilling Performances Post-Analysis

Regis Studer, Total; Christophe Simon, DrillScan; Jean-Michel Genevois, Total E&P UK; and Stéphane Menand, Ecole des Mines de Paris

This paper was prepared for presentation at the 2007 SPE Annual Technical Conference and Exhibition held in Anaheim, California, U.S.A., 11–14 November 2007.

Abstract

With the current market's high prices for drilling units and sophisticated directional and formation assessment services, low systems reliability or poor directional performance in the execution of complex wells (ERD, HPHT, Deep Water applications) can spell costly Non Productive Time (NPT) for operators. Over the past two decades, many Bottom Hole Assembly (BHA) models have been developed to address the directional performance issue, but their application in an operational environment has generally failed for lack of strong associated BHA analysis methodologies.

This paper presents a unique automated methodology for Post Analysis of BHA directional behaviour. It is based on modern 3D analytical models, combining BHA, BIT and formation effects with highly flexible data management. Implemented in user-friendly BHA management software, it can be used to define a BHA run segmentation and to determine the influence of the BHA settings in particular geological formation blocks. The Post Analysis clearly displays the final results of the BHA (objectives and performances versus prediction window), highlighting any problematic intervals drilled.

Already, the methodology has solved challenging directional performances issues, generating significant savings and optimising the learning curve process. The field applications referred to in the paper have demonstrated that, without a proper methodology, a model offers little added value.

The examples discussed here from Total E&P affiliates deal respectively with Rotary, Rotary Steerable System (RSS) and Steerable Motor (SM) directional BHAs. Case studies have led to BHA and bit design modifications. The results were well beyond expectations, ensuring good well positioning through the reservoir by improving BHA stability and manoeuvrability. Efficient drilling (reduced sliding, improved hole quality) was also achieved with a single SM BHA in 17 1/2" applications during kick-off, and successive build-up and slant drilling intervals.

The methodology and its associated BHA Management® software have proved an undeniably valuable tool for the drilling community. The model is also run at the well Pre Engineering stage to check BHA design proposals by making multiple sensitivity analyses and by fine-tuning solutions to the operational context. Finally, in an industry with high personnel turnover, the software's global data management system ensures good capitalization of know-how and ongoing learning curve benefits.

Introduction

Historic

In the 1980s, driven by the constant improvements in bit life and breakthroughs in Measurement While Drilling technologies (MWD), engineers began to introduce "science" into what was then the exclusive preserve of directional drillers in order to gain a better understanding of the way rotary BHAs behaved. Until then, experience was mostly confined to personal tally books and the upshot was inconsistent directional well trajectories and usually short BHA runs – in the region of 150 to 300 m.

The early stages of the technological revolution in I.T. opened the doors to R&D efforts at developing 2D[1,2] (hole inclination prediction only) or 3D[3,4,5] (hole inclination & azimuth predictions) BHA model software. These tools modelled BHAs as beams supported by contact points (collars - stabilizers - hole contact). Their main outputs were: BHA deformation & side forces at contact points with the hole and at the bit.

Two modelling schools co-existed, one relying on the side force developed at the drill bit (magnitude and direction) and the other imposing hole curvature in the same direction as the side force at the drill bit to neutralize it, introducing the equilibrium curvature concept.

The models were basic and simple to use, but did not incorporate methodologies developed by experienced users. They nevertheless pushed BHA run lengths up to between 1500 and 2350 m. The BHA Management® software co-