



OTC 18521

Optimizing Powered Rotary Steering Through Better Understanding of the Downhole Environment

F. Al-Bani, N. Galindez, and P. Carpen, Saudi Aramco, and F. Mounzer and D. Kent, Baker Hughes Inteq

Copyright 2007, Offshore Technology Conference

This paper was prepared for presentation at the 2007 Offshore Technology Conference held in Houston, Texas, U.S.A., 30 April–3 May 2007.

This paper was selected for presentation by an OTC Program Committee following review of information contained in an abstract submitted by the author(s). Contents of the paper, as presented, have not been reviewed by the Offshore Technology Conference and are subject to correction by the author(s). The material, as presented, does not necessarily reflect any position of the Offshore Technology Conference, its officers, or members. Papers presented at OTC are subject to publication review by Sponsor Society Committees of the Offshore Technology Conference. Electronic reproduction, distribution, or storage of any part of this paper for commercial purposes without the written consent of the Offshore Technology Conference is prohibited. Permission to reproduce in print is restricted to an abstract of not more than 300 words; illustrations may not be copied. The abstract must contain conspicuous acknowledgment of where and by whom the paper was presented. Write Librarian, OTC, P.O. Box 833836, Richardson, TX 75083-3836, U.S.A., fax 01-972-952-9435.

Abstract

This paper discusses drilling optimization in two major fields operated by Saudi Aramco. Both fields have layered limestone reservoirs consisting of tight zones alternating with porous zones and are drained using innovative MRC (Maximum Reservoir Contact) techniques along with real-time geosteering.

The well profiles produce difficult torque and drag environments. While drilling rigs employed have upgraded to top drive systems, traditional drilling practices still rely primarily upon surface measurements provided by the drilling contractor. Often these gauges are rudimentary and their measurements unrepresentative of downhole conditions, particularly when operating at a great depth in horizontal holes.

In the applications discussed in this paper, the situation was greatly improved by introducing a new downhole drilling sensor tool. Integrated into a high-speed rotary closed-loop drilling system, powered by an integral modular motor, a step change in drilling performance has been achieved.

In most applications, the new tool has been placed between the modular motor and the steering head to give the directional drilling crew a clear understanding of the true environment being encountered by the steering head and bit. Optimization of performance with such advances has resulted in a 100% increase in overall rate of penetration (ROP) in some applications.

Using real well examples, this paper discusses: measurements the tool records and transmits; dramatic differences between downhole measurements and surface indicators; how information is applied to optimize

the real-time drilling process, and how this continuous application evolved from the original research initiative.

Introduction

In the last few years, rotary steerable drilling systems (RSS) have become the preferred tools for drilling complex or lengthy drain holes, primarily because the tools can negotiate the planned well path without stopping to “steer” as with conventional steerable (motor) systems. The advantages of these tools has been exhaustively described in numerous papers and articles, in trade journals and with the SPE since the introduction of these systems began in the early 90s. One hallmark of RSS has been the ability to average a significantly higher overall ROP over a given section of hole primarily for the same reasons as described above.

A feature of these tools that most interests the reservoir department is the capability for geosteering to very precise tolerances. RSS tools can steer to a true vertical depth (TVD) target or, if preferred, hold an exact angle to intersect zones of interest.

Despite the large gains in applied technology in downhole drilling and measurement systems and widespread upgrade of rig-rotary drive systems in the last decade, drilling rig measurement gauges have seen comparatively little advancement. Used to monitor vital drilling information, many drilling rigs still rely upon dead-line weight indicators, surface rotary torque gauges, and surface standpipe pressure gauges. These gauges are typically of robust construction to withstand the rough handling often encountered during drilling or while the rig is being moved (as in land rigs). Calibration is typically fairly rudimentary (as compared to scientific instruments), and sensitivity is poor.

In practical terms, for most operations the gauges and measurements are more or less fit for purpose. The basic measurements were never intended for use in the designer wells on the boards or currently being executed. For vertical or basic directional drilling applications with large robust tool strings, these instruments can cope with most string weight, pump pressure, and torque reading requirements.