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Field Trials of a Managed Pressure Drilling System Demonstrate the Actual State of the Technology

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Abstract

The development of systems for improving the management of downhole pressure has gained significant attention from the industry throughout the last five years. Many different concepts have been proposed and developed, but only a few field tests have been performed to demonstrate their capability in authentic operational scenarios.

Considering this lack of operational experience, the present work describes the efforts for planning and executing a series of four wells using a new managed pressure drilling (MPD) technology based on the Micro-Flux Control (MFC) method. The first two tests are planned to occur by the first quarter of 2006 in a relatively benign land well environment prior to two other offshore applications.

The offshore wells are scheduled for the second half of 2006, but this drilling scenario is much more challenging than those of the first two wells. The MPD system will be installed to assist the construction of difficult HPHT well sections to be drilled from a jack-up rig.

Not only does the present work describe the main aspects related to planning and executing the four applications, it also presents an analysis of the overall performance including the hardware and the software of the MPD system as well as the interfaces with the conventional rig equipment. Along with the report of the aspects associated with training drilling crews and their performance during operations, all the main engineering information used for decision making while planning and operating at the well site are also included.

Introduction

Exploration and development well construction keeps heading towards deeper targets in terms of both water and reservoir depth, yielding into a significant impact on operational costs. A recent study of historical data[1] from the offshore activity along the Brazilian coast shows that longer operational times and technical complexity are responsible for those high costs. Besides that, it is observed that equipment failure and problems associated with geopressure, such as: well control events and loss of circulation, are, respectively, the first and second major contributors to non-productive time. The narrow margin between the pore pressure and the formation strength plays an important role in the well construction process. While drilling through salt layers, constructing high-pressure, high-temperature (HPHT) well sections or dealing with extended reach wells and long horizontal sections, the pressure increase at the bottom of the well caused by circulation often creates operational problems, leading to non-productive time. Particularly in deepwater, drilling through faulted, fractured or depleted formations frequently experiences losses of circulation. Depending on the drilling scenario, wellbore instability is a geopressure problem that may also occur.

Conscious of these problems, the industry has been developing new techniques, labeled by the general name of MPD, in order to improve the management of downhole pressures. In other words, MPD is a family of technologies that offers more precise pressure management. It also provides fewer interruptions to drilling ahead.

Despite devising significant gains, some MPD concepts[2-7] introduce radical changes into the operational routine. Their implementation is more complex, demanding special training and considerable additional costs. In general, those techniques are still far from the operational routines, requiring additional time to be developed and deployed.

Besides those pioneer approaches, there is another group of MPD systems which have been inspired and fostered by underbalanced drilling (UBD). The essence of this MPD group of technologies is the ability to drill ahead with a closed and pressurized mud return including a rotating control device (RCD) and a drilling choke manifold. In addition, automation is a fundamental part of the process, providing, mainly, quick detection of influxes and losses of circulation. However, differently from UBD, MPD is, actually an overbalanced process, meaning that hydrocarbon influxes are not welcome. In fact, well control events are more easily contained, controlled and diverted, although still incidental to the operation. Some professionals consider those MPD systems as a kind of automatic kick detection/control process. As proved UBD pieces of equipment are the main additional parts of the system, those automated kick detection and control systems are much closer to field implementation.