Drilling rigs: High-technology newbuilds move into action

IADC/SPE 59102

Deepwater Pathfinder—Planning and Execution of Drilling Operations

Deepwater drilling operations with the dynamically positioned drillship "Deepwater Pathfinder" began on January 27, 1999, in the Gulf of Mexico. The Pathfinder is the first new build drillship in over 20 years and the first purpose built large hull drillship design in operation. The Pathfinder is a DP-3 class ship, designed to drill in 10,000 ft (3,048 m) of water and originally equipped with 7,500 ft (2,287 m) of riser. The vessel's deck configuration and storage capabilities for dry bulk, liquid storage and tubulars are designed to accommodate the high demands of deepwater operations.

Rig specifications were determined to meet the objectives of **Conoco's** deepwater exploration program and a rig selection process conducted in mid-1996 resulted in the contracting of the Pathfinder. The Pathfinder is owned by **DDLLC** (a limited liability company, jointly owned by Conoco and **R&B Falcon**). Construction and delivery of the ship were accomplished on schedule and within 2% of the original budget.

This paper will summarize the design and construction phases of the project, describe the equipment and technology in use on the ship, describe the ships capabilities in harsh weather, review the preparations made by the Pathfinder team that resulted in a successful start-up and discuss the drilling operations conducted to date.

—S C Actis, Conoco Inc

IADC/SPE 59103

"Pride Africa" Ultra Deep Drillship: From Concept to Start of Operations

In 1997, when ultra-deepwater drillships, capable of drilling in water depths of 10,000 ft were needed by oil companies to explore ultra-deepwater offshore fields, a conceptual idea of what would be a vessel optimized for drilling operations for these water depths had been developed with **Gusto Engineering**, the designer of the Pelican class. Specific features such as optimized vessel motion, efficient power and dynamic positioning system, along with a "Dual Handling System" to reduce tubular handling time, were integrated in the design. Innovative technology has been used to obtain a Drillship with no downtime and low unproductive time such as tripping time.

IADC/SPE 59103: The authors describe how a concept for an ultra-deepwater drillship, the Pride Africa, became a reality ready to commence operations in less than 22 months.

The success in finding an existing hull which fitted particularly well in the design, allowing a shorter construction time, the creation of a joint venture between **Sonangol** and **Pride International**, and the finalization of a drilling contract with **Elf** to develop the Girassol field offshore Angola, triggered an exciting construction program.

This paper describes the process of turning a concept into an ultradeep drillship, ready to start operations, in less than 22 months. We will present the details on how an organization and a plan was set up, the way the detailed design was developed and adapted to the existing hull, how the shipyard was selected, then supervised, the selection and the cooperation of the vendors of the owner furnished equipment, and the commissioning and testing program.

—T F Duhen, Pride International, *et al*

IADC/SPE 59104

Deepwater Riser Management

The frontiers of drilling in deepwater environments are continually being pushed back and in the near future rigs will be drilling in water depths of 10,000 ft. To improve operational benefits and reduce operating costs, riser management is critical. To date, there are currently no accepted standards for marine riser inspection scheduling in deepwater, and the consequences of riser failure are higher in deepwater operations. The loss of a riser string will cost on the order of US $ 10 million.

The increased amount of time required for marine riser inspection for deepwater drilling and the uncertainty of riser fatigue damage have led to the development of a new deepwater inspection scheduling procedure.

This paper discusses how vortex induced vibration, riser fatigue and fracture mechanics analyses have been implemented to develop a deepwater riser inspection scheduling procedure. A low-cost, simple and robust concept for passive gauging to monitor fatigue is essential to implement the technique and a new solution developed will also be presented. This concept forms a calibration technique for the predicted riser inspection scheduling. It will also increase safety by providing an early warning of an accumulation of unexpectedly high fatigue damage.

This procedure has been applied to deepwater drilling operations in the Gulf of Mexico and West of Shetland. It shows that significant savings in cost and time can be made while maintaining high levels of safety.

—I Cummins, Transocean Sedco Forex, *et al*

IADC/SPE 59105

JU-2000: Efficiency by Design

The purpose of this paper is to examine the fundamentals of the wellbore construction process and how this has traditionally influenced rig design. By using an economic justification analysis to evaluate the tubular handling processes, a step change in performance and a breakthrough in rig design will be achieved.

This paper will outline the developmental steps taken by the rig designer, and in parallel the technological development of tubular-handling systems that contribute to this step change in performance. Actual field performance for the pipe handling systems will be presented, including the innovative process that allows casing to be assembled in stands and racked back in doubles in preparation for casing the well.

Also, handling of single 80- or 90-ft joints of casing and/or drill pipe is analyzed under parameters such as eliminating couplings/tool joints and the subsequent reductions in make up and break out time. The elimination of tool joints in particular not only reduces the requirement for tool joint maintenance, but also the risks that can be associated with the mechanical failure of these components. Furthermore, it can also be demonstrated that the percentage of casing wear that can be attributed to tool joint hard banding, is significantly reduced.

IADC/SPE 59107: A new hydrodynamic washpipe assembly has demonstrated significant economic advantages. This sealing system has cut drilling costs for the Woodside Goodwyn A platform by some US $500,000 on one well.

The innovative use of both an automated vertical and horizontal pipe racking system, providing the rig design with a smaller, lighter derrick structure and increased efficiency, will be illustrated.

The resultant benefits of this combined approach will yield performance advantages of up to 20% over traditional jack up designs.

—H W Day, Friede and Goldman Ltd
—M Williams, Varco Drilling Systems

IADC/SPE 59106 (ALTERNATE)

World Class Extended Reach Well Drilled with Small Rig

A particularly challenging extended reach (ER) well was recently drilled and completed off the coast of California. Although not as long as some recent record ER wells, the difficulty level on this well is considered to be world class due to the capabilities of the drilling rig and its support modules. The well design, rig upgrades, operational practices and contingency plans were all built around extending the capability of the rig. The small rig size severely impacted the ability to deal with problems such as hole cleaning, directional control, fluids management, stuck pipe, remedial cementing, extra pipe handling, etc.

The well was drilled from a small platform drilling rig offshore Santa Barbara, to 19,555 ft MD (5,960.1 m), at 8,357 ft TVD (2,547.1 m) and 15,987 ft (4,872.6 m) reach in a water depth of 842 ft

(256.6 m). Significant changes in technologies and practices were introduced to ensure success, and to improve drilling performance. To successfully implement these changes, a detailed training program for the crews, supervisory and service personnel, and the engineering staff was combined with onsite engineering support.

This paper will describe the rig package, upgrades justifications, the fit-for-purpose well design changes and the advanced drilling practices that were introduced to successfully drill and complete the well. Furthermore, the specific challenges encountered on the well because of the small rig package, and the solutions adopted, will be reviewed. Based on an ever-expanding database of ERD experience with different rig packages, an Extended Reach Difficulty Index will be presented, which takes into account factors such as the rig; package, wellpath geometry, drilling hazards, local experience and learning opportunities.

—M G Mims, K and M Technology Group, et al

IADC/SPE 59107 (ALTERNATE)

A New Hydrodynamic Washpipe Sealing System Extends Performance Envelope and Provides Economic Benefit

As drilling programs have changed, more demands have been placed on components. Higher pressures, increased rotational speeds, and increased volumes have universally resulted in shorter component life of conventional washpipes and packing. This has in turn increased the cost of rig operation due to unscheduled down time for swivel packing maintenance and changeout.

This paper will describe the operating principles, development and field performance of a new hydrodynamic washpipe assembly. Recent field tests of the new assembly have demonstrated significant economic advantages. This sealing system has cut drilling costs for the **Woodside** Goodwyn A platform. by approximately US $500,000 on one well based on an operating rate of about US $8,000 per hour. When a washpipe fails, the BHA has to be puffed back up to the casing shoe, which can be as far as 3,000 m-4,000 m.

BHA removal and reentry can typically take 12 to 24 hours. The greatest advantage the hydrodynamic washpipe assembly has over conventional washpipes is the way it addresses the wear mechanisms associated with high pressure, high speed and dynamic runout. To facilitate cleaning the hole as drilling progresses, high rotary speeds (e.g., 180 rpm) are required. At such speeds, the life of conventional 4-in. diameter washpipe assemblies rarely exceeds 100 hours of drilling time, and is typically 30-50 hours. With the new hydrodynamic washpipe assembly, **Atwood Oceanics** reports runs in excess of 400 hours with speeds of 180 RPM and pressures exceeding 5,000 psi.

—M Kalsi, Kalsi Engineering Inc, et al