OTC 17995

Extending the Mooring Capability of a Mobile Offshore Drilling Unit

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Abstract

After successfully using an all steel Pre-Installed Mooring System (PIMS) to double Transocean Marianas' mooring capability in the 1990s, Shell improved the PIM system's performance by using polyester ropes in the system. The upgraded mooring system allowed Transocean DW Nautilus to successfully drill several wells in water depth greater than 9000 ft.

This paper summarizes the key learning based on the Shell's experience in the Pre-installed Mooring System since 1997, and on the performance results of the Second Generation PIMS using polyester ropes since 2001. The findings based on the experience and test results of mooring hardware after Hurricane Lili in 2002 and Hurricane Ivan in 2004 provide a solid basis for us to improve our design, handling and installation of future polyester mooring systems for both mobile and permanent floating platforms.

Introduction

In the mid 1990s, Shell (US) faced challenges to drill some of Company's prospects in water depth nearly twice as deep as the existing water depth rating of rigs on contract. Another challenge in exploring deepwater prospects is to virtually eliminate the risk of drive-off, drift-off or emergency disconnect of a DP rig without significant increase of capex or opex. Extending the water depth capability of a moored MODU on Shell's contract would address both challenges.

A cost-effective upgrade to a rig's maximum water depth rating requires upgrading both drilling and stationkeeping capabilities within the platform's variable deck load capacity. In terms of stationkeeping, Shell with support from contractors developed an effective Pre-Installed Mooring (PIM) System to supplement a MODU's on-board mooring system in the mid 1990s. The first generation PIM system typically includes suction-pile-anchor/subsea-connector/wire/buoys. The top end of Pre-Installed Mooring lines would be connected to rig wires upon a MODU's arrival at a well site. This solution was successfully applied to enable Transocean Marianas to drill many wells, such as NaKika and Coulomb fields, in water depth from 5000ft to 8000ft, even though the rig had marginal variable deck load capacity to drill in 4500ft of water. The Pre-Installed Mooring concept typically utilizes two sets of mooring lines so that the second set of mooring lines could be preset at the next well site. By pre-investing in two sets of PIM lines, a MODU could be quickly put under tow to the next well site by disconnecting and buoying-off PIM lines rather than wait for the entire mooring system to be retrieved. Since another set of PIM lines have been preset and buoyed off waiting to be hooked-up at the new site, a MODU could typically spud a well within 24 hours upon arrival at the next site. On average, the rig idle time during each rig move (excluding time in tow) is reduced from 7-8 days to 1-2 days. The other benefits of reduced time for mooring disconnect and hook-up include less exposure to weather related down time in rig move and reduced time for a MODU to be storm safe upon arrival at a new site. The higher initial capex of investing in more than one set of PIM lines would be more than offset by the benefit of drilling opex savings in a couple of years. Obviously, the opex saving varies with the frequency of rig moves and a MODU's day-rate.

The PIM system also improves a MODU's stationkeeping performance. In any given operational condition, it was found that the semi-taut-leg steel PIM lines improved a rig's uptime by reducing rig offset in comparison with a typical MODU's on-board catenary system. Suction pile anchors allow higher uplifting angle and precision installation. That leads to smaller mooring footprint, and much greater flexibility in dealing with interference concerns when the mooring system needs to be deployed in fields congested by sea floor infrastructures.

While the first generation PIM system achieved our initial design targets in the water depths that set new mooring records, there was room for improvement. When designing the second generation PIM system, we targeted to reduce the PIM system's capex and opex at the same time to further reduce the radius of the system's watch circle in both operational and survival conditions. To that end, the emerging lightweight and corrosion-free polyester ropes appeared to be the ideal candidate to replace most of the heavy steel wires and expensive submersible buoys. A polyester rope based PIM system has the potential of reducing the system capex and the installation opex. Our initial design studies indicated that the