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Operations

Dynamic Positioning, Dual-Activity Challenges on a Deepwater Drill Ship

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Dynamic positioning, dual-activity challenges on a deepwater drillship

Dual-activity drilling, produced crude storage/offloading and DP operations in deep water: A view from the Central Control Room of the Discoverer Enterprise

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Technical demands on drillships are increasing. As operators seek to increase efficiency by performing dual activity, well testing, the storage and offloading of produced well test fluids, and Simultaneous Operations (SIMOPS), the already significant challenges of working in deep water become compounded. Dynamic Positioning Operators (DPOs) and their colleagues are called upon to master new skills as the control-room environment becomes more complex. This presentation overviews some of the challenges faced aboard the *Discoverer Enterprise*, Transocean's first dual-activity rig, Fig. 1.

INTEGRATED AUTOMATION SYSTEMS

As automated vessel-management technology continues to evolve, unattended engine rooms on newbuild Mobile Offshore Drilling Units (MODUs) have become commonplace. The incredibly comprehensive nature of modern integrated automation places more responsibility on the DPO than ever before.

Traditionally, engine and machinery monitoring and functions were handled by licensed or rated engine room personnel. With the unattended engine room, these personnel now focus on maintenance duties and do not have to man an Engine Control Room around the clock waiting for the call to start additional engines or answer alarms. These functions are now handled by the DP operator as a normal part of duties. Other DP operator roles include, but are not limited to, power management, propulsion, machinery alarms, ballast control (on monohull vessels), and fire and gas safety systems.

Fig. 1. *Discoverer Enterprise*, dual-activity, DP drillship during refueling operation.

With addition of these new duties, it has become apparent that the words "Dynamic Position Operator" are inadequate to describe the real nature of this job. A more accurate title is "Central Control Room Operator." More than ever before, these professionals need a thorough knowledge of vessel systems. They must be able to recognize the severity and types of alarms, and know how best to address each contingency.

Although dedicated drilling and BOP safety systems are still in the hands of the drilling professionals, ship-wide safety and emergency shutdowns have evolved into a highly integrated system, marshaled from the Central Control Room (CCR). This puts an important focus on the CCR as an emergency response network command center. While the ship's Master continues to have final authority during major incidents, DPOs must apply their systems expertise, using their knowledge of emergency cause and effect functions to coordinate actions between fire and rescue teams. This places them in a critical role as first responders.

DUAL-ACTIVITY CONSTRAINTS

The *Enterprise*-class vessels were designed to push the frontiers on drilling wells and field development by using two rotaries simultaneously. Familiar practices, including acoustic positioning and environment-dependent heading, are complicated by these new subsea requirements, such as handling multiple tubular strings, tools, and commitment to multiple wells at the same time. Traditional DP drilling work has usually involved one submerged string of tubulars and one ROV (Remotely Operated Vehicle). *Enterprise*-class vessels routinely operate with two tubular strings and two ROVs in the water, all at seabed depth. This operating mode presents a significant increase in maneuvering restriction.

Multiple rotary tables mean multiple DP rotation points. While latched onto a well from one rotary, any tubular hanging from the other rotary will describe an arc around the prime rotation point. Such a situation requires use of a conservative turn rate to avoid turbulent contact of strings between the two rotary tables.

Rig offsets pose another complication for dual activity. Where an offset is required, for example, when drilling from a zero riser angle position rather than immediately over the wellhead, care must be exercised in running tubulars from the second rotary. Safe heading zones must be observed to avoid

contact between tubular strings hanging below the rotaries.

Also important is weather-dependent heading, especially the rig's ability to rapidly react to a changing weather pattern. Needless to say, dual-activity operations must be carefully planned, accounting for weather, rig offset, supply vessel operations (which often requires the drilling vessel to provide a lee to work safely), and ROV work. Such operations quickly become very complex.

It is not unusual for the *Discoverer Enterprise* to be latched to a wellhead on the forward rotary and, simultaneously, be spudding-in or performing riserless drilling on the aft rotary of another well. This is dual commitment, the most demanding type of dual activity. In these circumstances, competing technical demands of the subsea equipment and surface considerations, i.e., weather, must be carefully prioritized.

For example, since two subsea wells are rarely spaced at the same interval as the ship's rotary tables, Fig. 2, some adjustments must be made in flex joint angle of the riser system or the attitude of pipe in the wellhead during openhole drilling. When case spudding a wellhead, e.g., wellhead and 36-in. casing, a successful spud-in demands that the controlling factor be the plumb of the spud string rather than any considerations from the other rotary, such as flex joint angle.

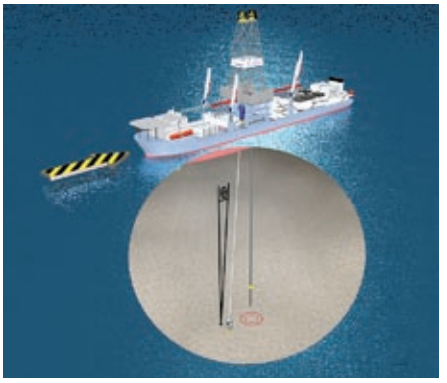

Fig. 2. That second well is not always 40 ft away from the first. Dual-activity equipment and procedures are well thought out to accommodate these circumstances.

Fig. 3. Crude oil tandem offloading.

A final area of interest is the effect of additional subsea operations on acoustic noise. In deep water, this becomes critical, since hydroacoustic positioning may be the sole positioning complement to DGPS (Differential Global Positioning System). Not having either function would result in an intolerable loss of DP Class. The *Enterprise* mitigates this risk by using a hydroacoustic array spread a significant distance from the subsea work site and drill center. Any additional noise from suspended tubulars or ROVs will typically not affect the transmission path between hull transducer and transponder. There is no critical transponder or beacon located at the BOP or near the well, where noise typically occurs.

WELL COMPLETIONS, PRODUCED WELL FLUID STORAGE AND OFFLOADING

Well completion operations are not unknown on drillships. Yet, the double-hulled *Discoverer Enterprise* has the relatively unusual capacity of storing large amounts of crude oil and other well fluids, as well as tandem offloading, in a manner similar to a Floating Production, Storage and Offloading vessel (FPSO), Fig. 3. As before, with central control and integrated automation, the DPO is the designated responsible person for much of this work.

The integrated control room demands two operators around the clock, but the crude oil operation requires the DPOs to master many routine tasks on deck. The *Enterprise* handles these requirements by having additional qualified DPOs to rotate as needed. Therefore, the ships' Captain and Mate may share cargo lineup tasks with the full-time DPO, and the DPO shares station-keeping duties with the Captain or Mate. Depth of knowledge is crucial.

Well completion workovers result in the storage of produced well fluids in the form of dry crude oil, wet crude and off-spec water, all of which becomes the "property" of the DPO. Custody of these fluids effectively renders the DP team as underway tankermen. Regular deck rounds are observed, manual tank soundings taken to verify the automated readings, and inert gas systems are controlled and monitored to maintain a safe blanket of non-explosive atmosphere over the combustible vapors.

The end result of successful well completions is having an amount of commercial grade crude oil to offload for eventual shipment to a refinery facility. Of all the well completion operations, this is the most complex for the DPOs. During a typical offload, a two-person DPO team may be performing the following operations simultaneously:

- Crude oil control (pump/valve operation, fluid transfer, inert gas operation)
- Crude oil wash/hot water wash tank cleaning
- Supervision of personnel at the hose manifold, tank deck, cargo pump room and receiving vessel
- Bridge watch (vessel is underway but not making way while offloading)
- Traffic control for up to five attending vessels (such as a shuttle vessel to tug/barge, spill-response vessel and hose-installation vessel)
- Command of all machinery alarms (unmanned engine room)
- Ballasting
- Station-keeping duties (vessel may be technically underway but remains on three-axis automatic DP mode to minimize extraneous forces on the moored shuttle.

Adding a shuttle barge and floating transfer hose brings a whole new dimension to the station-keeping formula, Fig. 3. The barge, which is attached to the stern via hawser, is itself tensioned by a non-DP tug opposite the drillship. Working in tandem, the drillship and tug carefully keep the entire string oriented as necessary. Needless to say, this introduces additional forces and propulsion burdens to the ship model.

TRAINING AND EXPERIENCE

Along with expanding job duties comes a corresponding increase in training requirements. On the *Discoverer Enterprise*, many advantages have been found by hiring licensed merchant deck officers as DPO trainees, since those mariners are already familiar with ship systems and navigation. Indeed, MODU manning requirements often demand such hiring practices, and the location of the control room adjacent to the ship's bridge makes this a natural arrangement. Licensed mariners are also likely to have tankship PIC (Person In Charge) qualifications, which are mandatory for crude oil transfers between vessels. Finally, some trainees from other specializations, especially within drilling, provide a good complement to professional seamen.

Ironically, the drillship DPO training scheme is complicated

by the nature of drillship work itself. Depending on the vessel's contracts or modes of operation, many critical DPO tasks may actually be infrequent. For example, hydroacoustic position reference or riser angle instrument setups may be rarely observable, a problem which is compounded by the two-person relief nature of offshore work. This means that the successful DPO must be able to master theoretical concepts and "what-if" contingencies. Repetition, taken for granted as a training tool in many professions, is often virtually nonexistent in the Central Control Room. Good simulation and drills are essential tools.

A LOOK AT THE FUTURE

To realize the full potential of high-specification drilling rigs, such as the *Enterprise*-class vessels, highly trained professionals are needed in the control room environment. As the frontier for drilling and exploration moves into deeper and deeper waters, additional challenges, such as J-laying pipe and simultaneous operations with multiple in-field vessels and activities, will be met and dealt with by these individuals. Those on the front line of these advances will continue to look forward to them and be a part of finding the solutions to manage the risks involved. **DWT**

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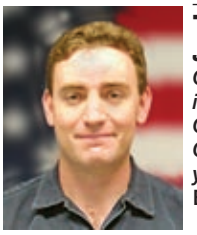

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