

OFFICIAL MAGAZINE OF THE INTERNATIONAL ASSOCIATION OF DRILLING CONTRACTORS

DRILLING CONTRACTOR

MAY/JUNE 2014

WWW.DRILLINGCONTRACTOR.ORG



OFFSHORE DRILLING REPORT

Shallow water remains strong; project delays dampen deepwater, but long term stays positive – p.20

ALL DRILLING • ALL COMPLETIONS • ALL THE TIME

THE BOOM DOWN UNDER

Australian LNG projects drive thriving coal seam gas market as shale exploration steps up – p.126

ONSHORE DRILLING BACK ON THE UPSWING

Permian draws increasing attention in the US; global markets resilient as Middle East, Russia, Europe seek modern, fit-for-purpose rigs – p.64

Certification of 1st DGD drillship paves path for ultra-deepwater drilling

System design review focused on ensuring component compatibility

BY LESLEY ALBRECHT, OMO OIBOH AND CHARLES HE, ABS; KEN SMITH AND DAVID DOWELL, CHEVRON

Drilling to deeper depths in the Gulf of Mexico (GOM) has increased the geometric complexity of sub-sea well designs. Deepwater drillers must contend with challenges such as narrowing pore pressure and fracture gradient (PP/FG) margins and higher equivalent circulating densities (ECD), resulting in tight tolerance casings that could lead to lost circulation and poor cementing while drilling and casing the wellbore.

Enhanced drilling technologies are proving the economic viability of deep-water drilling, and Lower Tertiary reservoirs are revealing the enormous oil potential of the ultra-deepwater GOM.

Modern-day mobile offshore drilling units (MODUs) are capable of operating in more than 10,000-ft water depth and reaching 40,000-ft true vertical depth. The advanced technologies that make deepwater, deep-well drilling possible have the potential to significantly impact future deepwater drilling operations.

Dual-gradient drilling (DGD) is one such technology. DGD can alter the way wells are designed and drilled, regardless of water depth. Following 15 years of R&D, the world's first full DGD system was installed onboard an ultra-deepwater drillship that began commissioning tests in the GOM in 2013.

In the case of DGD, as with any new offshore technology application, independent verification and certification played a critical role in facilitating guidance and compliance with the applicable rules and regulatory requirements. Class societies are an integral part of the verification process for offshore facilities because of their focus on safety.

FIRST INTEGRATED DGD DRILLSHIP DESIGN

As a non-governmental organization, ABS establishes and maintains technical standards for constructing and maintaining offshore vessels and facilities through routine surveys that validate that these structures meet applicable rules and specifications. Owners and operators elect to maintain offshore vessels and facilities in class as part of asset integrity management. The class process helps them to keep units in compliance with technical and regulatory requirements.

Companies operating on the US Outer Continental Shelf must comply with regulations established by the Bureau of Safety and Environmental Enforcement (BSEE).

A sixth-generation DP, ultra-deepwater drillship, the Pacific Santa Ana is equipped for single- or dual-gradient drilling modes in up to 12,000 ft of water.

Image courtesy of Pacific Drilling Ltd





neering practices, identifying potential hazard and assessing risk in all key areas of the project.

In addition to performing verification activities for the DGD system, ABS was selected to class the Pacific Santa Ana drillship, which was the vessel being outfitted with the DGD system. **Pacific Drilling's** rig, which is under a five-year contract in the deepwater GOM, was classed in accordance with the ABS Guide for the Certification of Drilling Systems (CDS Guide).

Because the ultra-deepwater drillship was the first vessel to employ DGD technology in a commercial application, it also was the first integrated DGD drillship design evaluated and certified by a classification society.

■ SYSTEM DESIGN REVIEW

The DGD system is designed to maintain two fluids in the wellbore at all times. A seawater density fluid is maintained in the drilling riser, and another fluid with a density that is higher than would be used conventionally is maintained from the seafloor to the bottom of the well. This combination of fluids maintains the same bottomhole pressure as conventional, single-gradient drilling, but it achieves that objective in a way that is much more in harmony with the natural pressures of the wellbore by placing seawater density fluid adjacent to the seawater column and a higher-density fluid adjacent to the sediments below the seafloor.

One of the major hurdles overcome by ABS was gaining a basic understanding of how the DGD equipment works and the demands that would be placed on each system component. This understanding was critical to competently carrying out independent evaluation of the suitability of each piece of equipment for its intended task. Chevron and ABS worked together closely, devoting a significant amount of time to understanding the DGD concepts and loads.

The DGD system's major subsea components are the mud lift pump (MLP), subsea rotating device (SRD) and solids processing unit (SPU). The DGD equipment installed onboard the Pacific Santa Ana can be used in single- or dual-gradient drilling modes. Although by industry definition, DGD is a form of managed pressure drilling (MPD), this system configuration also allows for subsea constant bottomhole pressure MPD while remain-

During the system safety review, verifications were made of the interfaces between each DGD component and the interconnection between the DGD components and the existing BOP stack. Clockwise from top are the solids processing unit, the MaxLift 1800 Pump and the subsea rotating device.

Images courtesy of Weatherford International, RTI Energy Systems and GE Oil & Gas



While BSEE has clear regulations for equipment such as subsea BOPs, no specific requirements exist for the DGD system concept. As part of the acceptance process, BSEE requested the DGD system be verified independently by a certified verification agent (CVA), which would provide a safety review for the

primary system components. The CVA activities followed the guidelines outlined in 30 CFR 250.912. **Chevron** enlisted ABS as the CVA.

Certification/verification subsequently became a project requirement in developing and implementing the DGD technology. CVA included applying sound engi-

2007 to 2014: GOM went from 6 to 20 active drillships

By **STEPHEN GORDON, CLARKSON RESEARCH**

After two years of relatively muted exploration news from the US Gulf of Mexico (GOM), 2013 was a much more positive year, with 15 discoveries made in the area. Of these discoveries, 53% were in ultra-deep water in water depths of 1,500 m (4,921 ft) or greater. Historically, offshore exploration and development in the US GOM has concentrated in shallower water. In fact, 69% of the region's producing fields are in depths of 200 m (656 ft) or less. With the ongoing depletion of older fields, however, operators have moved into deeper water, both in terms of exploration and, increasingly, development. Of the 10 fields under development in the GOM, seven are in ultra-deepwater, with the remaining

three in depths of 500 m to 1,499 m (1,640 ft to 4,918 ft).

Efforts to explore and produce in the deepwater GOM have resulted in greater deployment of deepwater-capable floaters. As of early February, 20 drillships were active in the US GOM, compared with just six in February 2007. At the same time, there were 20 semisubmersibles capable of operating in depths of 5,000 ft (1,524 m) active in the region. In February 2007, this number stood at only 15. At the beginning of February 2014, there were 44 active floaters in the US GOM out of a total supply of 46 units, representing a utilization rate of 96%. **Clarkson Research** data indicates that 59% of these units are classed by ABS.

ing overbalanced to formation pressures, while circulating and while static in both a single-gradient and a dual-gradient configuration.

Two modular units provide system power distribution and control through an integrated shipboard system. The power cabin houses all of the power distribution system equipment, while the controls cabin houses all of the electronic equipment used to operate, control and monitor the DGD system. Many shipboard modifications were made to the Pacific Santa Ana so the DGD system would function and integrate with current drilling systems.

ABS engineers used the CDS Guide, MODU Rules and industry standards to verify DGD system design and construction. ABS engineers and surveyors engaged with the Chevron DGD team to gain an in-depth understanding of how the system should operate and what the loads would be during various operations. Knowledge-sharing provided a foundation for performing the CVA scope of work and classification. It also allowed ABS and Chevron to establish a minimum standard that must be met by acting CVAs while certifying new technology and ultimately aided in the development of new classification requirements/rules for this type of technology.

The system design review focused on ensuring component compatibility. Verifications were made of the interfaces between the DGD components and the interconnection between the DGD components and the existing BOP stack.

One of the major hurdles overcome by ABS was gaining a basic understanding of how the DGD equipment works and the demands that would be placed on each system component. This understanding was critical to competently carrying out independent evaluation of the suitability of each piece of equipment.

The structural integrity of the individual skids, machinery and components making up the DGD system were reviewed for compliance with the applicable industry standards. It is important to note that although the individual components of the system were designed to withstand prolonged contact with the reservoir and wellbore fluids, no part of the DGD system was designed as well control equipment.

ABS design reviews included attending HAZOP/HAZID reviews and risk and uncertainty management sessions con-

ducted during a period of more than a year by Chevron and the other companies involved in the project. The reviews also included power supply (electrical and hydraulic) and associated control systems, as well as DGD system integration onboard the Pacific Santa Ana.

■ FABRICATION THROUGH DELIVERY

The primary responsibility of the attending surveyors acting as CVA was to carry out surveys during fabrication/installation and to report their findings according to the requirements specified in 30 CFR 250.

Classification surveys included equipment certification in accordance with the CDS Guide and MODU Rules and modification surveys aboard Pacific Santa Ana for system installation. ABS surveyors who executed the work considered applicable provisions of the documents listed in 30 CFR 250.901(a); the alternative codes, rules, and standards approved under 30 CFR 250.901(b); and the requirements of 30 CFR Subpart I.

In 2013, the ABS design and fabrication CVA reports were submitted to BSEE for acceptance, with addendums made in early 2014. At the time of this writing, installation surveys were ongoing for the DGD system, pending final acceptance by BSEE.

■ NEW TECHNOLOGY QUALIFICATION

As DGD technology is proven in the field, there will be a growing need to



Images courtesy of Chevron Corp

The MaxLift mud lift pump is installed on the Pacific Santa Ana. The pump is one of the most important pieces of equipment differentiating a DGD system from a conventional offshore drilling system.

qualify similar systems deployed on DGD integrated floating units. The challenge for floating systems of this type in the GOM will be in developing documentation that shows the technology can be operated safely in a particular operating environment.

The ABS Guidance Notes on Review and Approval of Novel Concepts describes the process and responsibilities for review-

ing proposed new concepts, from the project concept stage through maintaining classification throughout the resulting technology's operational life. The process draws on engineering, testing and risk assessments to determine if the concept provides acceptable levels of safety in line with current offshore industry practices. The methodology relies heavily on risk assessment techniques

as a way to better understand and anticipate structural and operational issues related to the new concept.

Developing safety requirements for concepts like the DGD drillship design follows a three-stage review process comprising conceptual design and approval in principal (AIP); detailed design and construction, and issuance of class approval; and operations and maintenance of class. AIP involves a risk-based approval process, requiring submitting conceptual engineering and risk assessment studies. Final class approval requires submission of detailed risk assessments, such as failure mode effects analyses, which can be supported by additional testing to quantify the associated risk and uncertainties.

Based on the experience gained in classing the first DGD integrated floating unit and thorough understanding of the BSEE requirements, ABS is positioned to provide industry guidance for new technology qualification. The organization will release requirements this year that specify certification for MPD systems and associated subsea components to help operators that are applying DGD technology.

■ DEEPWATER BREAKTHROUGH

When the benefits are demonstrated in the field, other operators are likely to use DGD systems. The closer alignment of wellbore pressures with the pressures in the formations delivers potential benefits on a number of fronts, including safety and environmental, cost, efficiency and drilling risk mitigation. Riser margin is restored in most wells (no densified mud in the riser is needed to maintain pressure balance with the formations).

There is an increased sensitivity to and awareness of formation pressure issues, such as kicks and lost circulation. Further, there is an improved ability to react to these issues, keeping them smaller and reducing the overall risk of the operation. Additionally, DGD technology allows drilling to total depth with fewer casing strings, and its precise wellbore pressure manipulation reduces losses, avoids ballooning and facilitates better cementation. Ultimately, this will lead to an improved ability to economically develop deepwater reservoirs.

With the assistance of safety organizations, innovative concepts will continue to drive industry toward the next drilling frontier. ♠