Claxton Engineering Services Limited
Bureside House
North River Road
Great Yarmouth
Norfolk NR30 1TA
UK

T: +44 (0)1493 744500
F: +44 (0)1493 744501
E: sales@claxtonengineering.com
W: www.claxtonengineering.com

Press release

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The world's highest-pressure large-bore drilling riser

Acteon companies Claxton Engineering, 2H Offshore (2H) and Subsea Riser Products (SRP) have received an order from Venture Production plc to provide an ultra-high-pressure riser for use during a high-pressure, high-temperature (HP/HT) drilling campaign in the North Sea, which is scheduled for the fourth quarter of 2009.

The riser is of a unique design. It will be the world's first full-bore access (18¾-in.) riser capable of working at pressures in excess of 12,000 psi. Linked to this, the flanges used to connect the individual pipe sections will be attached using a shrink-fit process – the first time this technology has been used in this application.

The riser will enable Venture to drill and complete HP/HT subsea wells from a jackup drilling rig employing a surface blowout preventer (BOP), which will provide significant cost benefits and operational efficiencies. Venture has already contracted the Noble Scott Marks, which is currently under construction in China, for the HP/HT campaign.

Alistair Montgomery, senior drilling engineer, Venture Production, said, "With HP/HT drilling on the increase across the industry, and given the tight rig market, a solution that allows us to use a jackup rig and have the full-bore access necessary to carry out subsea completions is highly significant. The contract award is the result of months of collaboration with the three Acteon companies, as well as tree supplier FMC and drilling contractor Noble Drilling. During this process safety, operational efficiency and ensuring effective systems interfaces were among our top concerns."

Designing a riser of this large diameter for use at such high pressures poses considerable challenges. Engineers are forced to use either high wall-thickness or high-strength steel, both of which are very difficult to weld, especially in cases, such as the current one, where NACE sour service requirements are cited. The proposed solution, shrink fitting the flanges to the pipes, is the key to this entire project. Shrink fitting eliminates the need for welding; high strength and fatigue-resistant connections can be made in essentially non-weldable materials.

2H and SRP have undertaken an exhaustive development and testing programme to qualify this technology, which is likely to find broad application for both shallow and deepwater riser systems in the future. (For an explanation of this aspect of the project, see the attached technical note.)

Dannie Claxton, engineering director, Claxton Engineering, said, “We have worked closely with our Acteon colleagues to offer Venture this very practical solution to the challenges of drilling high-pressure wells. The first of its type in the world, the riser is important because it gives Venture the opportunity to make a cost-effective step-out in drilling practice – one we expect others to follow.”

As well as acting as the lead contractor, equipment integrator and offshore service supplier, Claxton will provide a range of ancillary equipment, including an umbilical, wellhead and BOP connectors, a tensioning ring, and a hydraulic power and control system. A team from Claxton will be responsible for running and pulling the riser on the rig, and for its inspection and maintenance.

2H carried out the initial riser design and analysis work, and SRP has led the development of the new shrink-fit technology. SRP is ultimately responsible for supplying the riser, which has 13 main sections plus fatigue-critical, tapered stress and tension joints.

Forging the main pipe sections has already commenced at two plants in France and Italy. The flanges will be forged once the main pipes are finished, and then extensive machining will be required before the flanges are shrink fitted. Once the riser is complete, a detailed testing programme will be carried out before delivery to Venture in September 2009.

Venture expects to begin using the riser immediately thereafter to drill HP/HT development and appraisal wells in several of its Central North Sea assets in water depths to 120 m.

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For more information, please contact
Paul Alcock, vice president, Acteon
Tel +44 1603 227012, or mobile +44 7765 883925

Claxton, an Acteon company, is the leading supplier of engineering and services for shallow water, jack up depth markets. The company draws on over two decades of industry experience to provide services for well systems, structures and pipelines across the lifetime of the field – from pre-drilling to drilling, production and decommissioning. Claxton provides first-class tailored engineering and holds a large ‘on-call’ rental inventory. A hallmark of Claxton is the responsive service that, alongside numerous field-proven innovations has built the company an enviable reputation.

Acteon provides the international offshore oil industry with specialised engineering services focused on linking subsea services. Acteon companies are 2H Offshore, Aquatic, CAPE Group Ltd, ChainCo, Claxton Engineering Services Ltd, Conductor Installation Services Ltd (CIS), Fluke Engenharia Ltda, InterAct PMTI, InterMoor, International Mooring Systems (IMS), Large Diameter Drilling (LDD), Mirage Machines Ltd, MENCK GmbH, Seatronics Ltd, Subsea Riser Products (SRP), TEAM Energy Resources Ltd, Trident Offshore Ltd and WellCut Decommissioning Services.

Technology brief

Shrink-fit technology for high-pressure risers

As far as the riser is concerned, Venture has two key requirements for its 2009 HP/HT drilling campaign. The company needs a full-bore (18¾-in.) riser with a pressure rating to 12,200 psi. Individually, these are not uncommon requirements. However, when taken together they pose a considerable manufacturing challenge.

If a weldable grade, say 65 ksi, of steel were to be used for the riser, a wall thickness of up to 75 mm would be required. Apart from the problems of manufacturing pipes of this type, the weight of the riser string would be enormous. Moreover, welding connectors of any type to pipe of this thickness is not straightforward and would probably result in a poor weld-fatigue performance classification. Selecting a high-strength steel would reduce the wall thickness needed (using 110-ksi steel would mean a wall thickness of about 30 mm), but such steels cannot be welded successfully; it is difficult to achieve the required physical properties in the weld.

This problem has been resolved by using a shrink-fit process to attach the flange connectors to the pipe sections. It was Steve Hatton, founder of 2H Offshore and a vice-president of parent company Acteon, who had the idea of shrink fitting to avoid the problems typically encountered with high-integrity riser fabrication. Shrink fitting is not an unusual process in other industries but it had never been proposed for an application such as this.

Hatton said, “The industry has been seeking a solution to the problem of welding high-strength riser joints for years, and with the current increase in HP/HT applications, the problem has become critical. Shrink fitting is an excellent solution, we believe, and this has been well understood by Venture; the company has supported the technology and fast-tracked our qualification process. There is significant potential in this technology to enable the manufacture of higher-strength, lighter-weight risers with improved fatigue performance.”

Development and testing

Shrink fitting is a simple process in principle. However, there are still several issues that have to be understood in order to guarantee repeatable performance to the level demanded by the offshore industry, particularly for critical HP/HT riser applications. In view of this, a thorough testing programme has been conducted in Sheffield, UK, to prove the process and confirm the earlier, extensive finite element analysis work.

When making the joints, the machining of component profiles and finishes is tightly controlled, as is the heating of the flange body during the assembly process. Mating the two components is a further practical challenge requiring precise alignment at the instant the two are stabbed together. Simply allowing the mated assembly to cool generates a high-quality structural connection and a gas-tight seal to complete the assembly process.

Rigorous load and pressure testing, witnessed by Bureau Veritas, has been conducted on a series of joints made using the 80-ksi steel chosen for this project. (There is no reason, however, why the same process cannot be used for steels in excess of 110 ksi.)

The joints have successfully completed hydrostatic pressure testing up to 13,500 psi (equal to 90% of pipe body yield strength) under various external tension and bending loads. In addition, gas testing has been conducted to 12,200 psi.

The integrity of a shrink-fit joint relies primarily on the radial contact force generated as the connection cools and shrinks onto the pipe end. The friction generated at the interface is further enhanced by geometrical and mechanical features that 2H has incorporated into the design. The resulting connection capacity is demonstrated to be as strong as the pipe.

Other applications

2H believes that shrink fitting will become increasingly used in the riser industry to provide an effective alternative to welding. The process constitutes an important enabling technology that opens up the use of high-quality and ultra-high-strength steels, which previously could not be used owing to welding limitations.

The company is already focused on HP/HT applications in deep water in the Gulf of Mexico, such as the BP Kaskida development, which may require risers capable of working at even higher pressures than the Venture system. Shrink-fit technology can be easily extrapolated for use at much higher pressures than the current system and is only limited by the availability of suitable pipe. It is believed that configurations up to 18¾-in. bore and 20,000 psi are possible through this approach.

The technology, on which 2H has patents pending, has wider applications. SRP is proposing the process as a solution for reducing the cost of manufacturing forged taper joints and riser joints with complex non-ferrous metallurgy such as titanium and aluminium.