S2S

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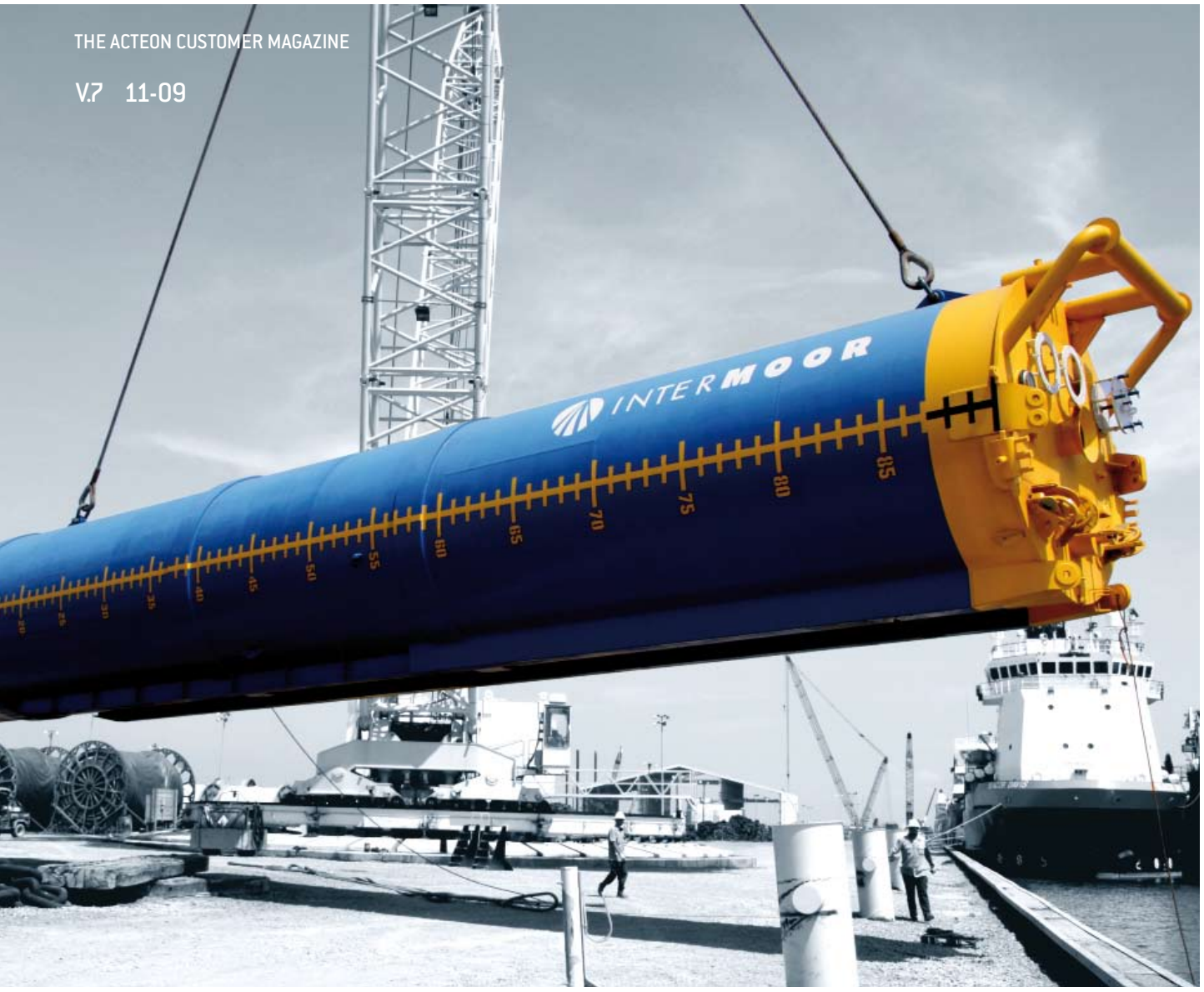
THE ACTEON CUSTOMER MAGAZINE

V.7 11-09

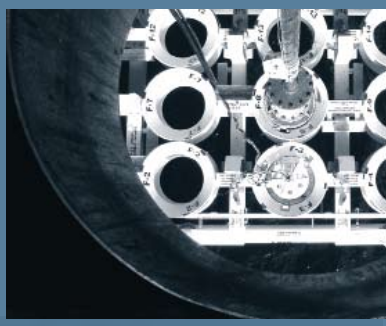


HOW THE MOORING OF RIGS IN THE DEEPWATER GULF OF MEXICO IS ATTRACTING ATTENTION

THE DRILLING TEMPLATE BEING USED IN THE NORTH SEA THAT IS REALLY QUITE SPECIAL

APPLYING OIL AND GAS EXPERTISE TO GERMANY'S FIRST OFFSHORE WIND FARM



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DIARY 2010

2–4 March	Subsea Tieback Forum & Exhibition, Galveston, Texas, USA
9–11 March	Oi10, Oceanology International, London, UK
23–25 March	Offshore West Africa, Luanda, Angola
3–6 May	OTC .10, Houston, Texas, USA

COMMENT

RICHARD HIGHAM
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For many of us, 2009 has been a difficult year, and, looking forward, 2010 seems just as uncertain and still to have limited visibility.

Under these circumstances, our priorities have to be to reduce costs and increase efficiency but in ways such that our ability to meet our clients' needs is not compromised. Staying close to customers is the best way to ensure this. Although the availability of credit and the falling demand for oil have placed severe constraints on what operators can do, there are still many opportunities; it is just that greater ingenuity is needed by all concerned to exploit them.

For now, however, we need to use our experience and innovation skills to produce efficiencies. To assist our clients in making their new projects produce acceptable returns, we should offer different ways of doing things. These alternatives might not offer a step change in technology but could involve a significant adaptation in application.

We are continuing to invest in many areas of the business: driven piles for deepwater subsea infrastructure and wells, high-pressure fullbore riser systems, and comprehensive rig move support to name but a few. Our efforts to become a truly global service company with local support move forward with growth in Asia, the Middle East and Brazil.

In *S2S*, we aim to share our experiences, ideas and technical advances with our customers. We hope that one of the articles may spark some interest or perhaps offer an opportunity to regard an old issue from a new angle.

When talking about technology, it is easy to focus on the engineering or technological aspects. It conjures up images of high-tech computers, robotics, medical engineering and the like. In the oil and gas industry, it may suggest advanced reservoir modelling, cutting-edge drilling tools or deepwater field developments. One could propose many different definitions of technology.

However, I recently came across an interesting definition: "Technology is the systematic application of intelligence to deliver a product, service or solution to the marketplace."

What this particular definition emphasises is the "application of intelligence," which implies the active and creative involvement of people. It suggests that technology is the sum total of all the things that are necessary to provide a product, service or solution to the market.
In this issue of *S2S* we talk about the application of technology in all its aspects. The articles cover our use of cutting-edge hardware and processing techniques, or they describe where we have applied experience that has been gained in one market to another or where we have developed novel solutions to practical problems. We even have an article about how we are training our people to deliver our technology safely and effectively in the field.

By applying technology in its widest sense, we can bring solutions to the table that might not appear possible or that might not have been thought about previously.

As always, we hope you will find this issue of *S2S* an interesting read. If it does stimulate your interest, please let us know, and we will see if we can help you to apply our technology for your benefit – even in these difficult financial times.

PIPELINE WELDING ON THE SEABED

Following nearly two years of development and significant investment, CAPE Group has introduced a semi-automatic, remotely controlled, orbital welding unit that can be used to repair oil and gas pipelines on the seabed.

During a recent trial in Abu Dhabi, two sections of 30-in. pipe were welded underwater in a hyperbaric chamber specially designed to house the welding equipment. X-ray analysis and mechanical testing of the weld revealed excellent results.

Plans are now being made for tests on 48-in. pipeline to prequalify the technique for pipeline repairs for two major Qatari operators.

Simon Hartog, managing director of CAPE Group, said, "There have been previous attempts to introduce underwater orbital welding systems but we believe this is the world's first genuinely commercial unit. This ability significantly expands our Total Oilfield Pipeline Solutions offer, which was previously limited to mechanical repair and maintenance.

"We are excited by the prospects for this equipment, not only in the Middle East but further afield. It provides our customers with a valuable option when faced with a leaking or damaged pipeline."

Despite advances in mechanical pipeline repair systems, welding is still important, for example, when there is a need to return a damaged pipeline to its as-designed state or for repairing internally clad, sour-service lines. In order to achieve acceptable results with welding, however, it has generally been necessary to lift the damaged pipeline out of the sea.

NOVEL APPROACH TO PETROFAC WELLHEAD PLATFORM IN MALAYSIA

Through collaborative work by 2H and Offshore Installation Services (OIS), Petrofac has a viable option for the challenging second-phase development of a Malaysian oilfield in 63 m of water.

Petrofac operates the oilfield under a production-sharing contract. Currently, a mobile offshore production unit (MOPU) supports the wellhead tower of four 36-in. conductors and produces to a spread-moored floating storage unit. The company intends to replace the MOPU and the storage unit with a fixed wellhead platform and, possibly, a floating production, storage and offloading facility.

An earlier 2H analysis of the conductors had shown they are incapable of self-support, so Petrofac asked the company to design a new support structure for the conductors and the associated deck. However, the new structure must be installed before the MOPU is removed and within a few metres of the existing conductors, which makes it a particularly demanding project.

Through an integrated review of the installation process and the structural analysis, the two Acteon companies developed installation options and anchor patterns, and a methodology for handing over the conductors to the wellhead platform. This information was central to a Petrofac's hazard identification study.

"Open discussion of ideas during our work with OIS helped us to reach a solution faster, and OIS's practical installation experience gave the analysis an important dimension," said 2H global manager of conductor systems Stewart Maxwell.

Petrofac can now see that a novel approach to installation and a non-standard platform design are feasible options to enable the existing conductors to be retained after the MOPU leaves the field. 2H and OIS are currently discussing how they can best add value to developing the full front-end-engineering design for the new structure.

THE COMPANY INTENDS TO REPLACE THE MOPU AND THE STORAGE UNIT WITH A FIXED WELLHEAD PLATFORM AND, POSSIBLY, A FLOATING PRODUCTION, STORAGE AND OFFLOADING FACILITY.



IMPROVED HEAVE COMPENSATOR FOR LONGER SEAS

Following extensive research and development, InterMoor has introduced an enhanced, passive heave-compensation device for use in seas where long-period swells are common: those offshore West Africa and Brazil being good examples.

The company's existing compensated anchor-handler subsea installation method (CASIM) units work well in the Gulf of Mexico but generally prove a little too hard for use in seas outside the region. The new InterMoor enhanced CASIM system uses nitrogen over oil to achieve damping, and incorporates special features to obtain the very low effective spring stiffness necessary to achieve spring isolation in long seas. Other advantages include automatic depth compensation (elimination of the rod hydrostatic effect, which tends to close the rod at depth and thus limit performance); adjustable spring rate and damping using a remotely operated vehicle; and the ability to lock the hydraulic rod for launch and recovery. The unit is designed to operate in air or in water depths to 3000 m, and may be launched over a stern roller or the side of a vessel using a crane.

INTERMOOR HAS BUILT AND SUCCESSFULLY TESTED AN ENHANCED CASIM PROTOTYPE UNIT RATED AT 15 t AND WITH 4 m OF STROKE

InterMoor has built and successfully tested an enhanced CASIM prototype unit rated at 15 t working load and with 4 m of stroke. Engineering work on a 75-t unit is complete. This larger unit incorporates a remote acoustic control system, which removes the need to make in-service adjustments using a remotely operated vehicle.

SUCCESS FOR NOVEL SHRINK FIT

SRP has attached the first flanges to the pipe sections that will make up a unique ultra-high-pressure drilling riser for use by Venture Production in the North Sea. The flanges were joined to the pipes at SRP's premises in Sheffield, UK, using a shrink-fit process that the company developed specifically for the fabrication of such risers.

The flange is first heated using induction coils to over 400°C, which causes it to expand sufficiently to fit over the end of the 19¼-in.-inside-diameter riser pipe section. The flange and the pipe are then carefully brought together (this part of the process takes no more than 30 seconds) using a purpose-built jig to ensure their precise alignment. Simply allowing the assembly to cool creates a high-quality structural connection and a gas-tight seal.

"The development of the shrink-fit flange has been the key to this entire project. We have had much interest in the technique from other operators. Now we have proved the technique, it is likely to find application in other riser-related projects," said SRP managing director Simon Luffrum.

2H HELPS DUBAI PETROLEUM WITH WELL INTEGRITY TOOL

Dubai Petroleum Establishment is using a tool developed by 2H Offshore to assess the integrity of over 400 platform wells in shallow water off the coast of Dubai. The operator has embarked on a production enhancement exercise and needs to know whether or not individual wells, some of them more than 30 years old, are capable of supporting the mechanical loads associated with re-entry, workover and possible additional drilling.

The tool, which has a simple Excel spreadsheet interface, enables the user to input information about the way a given well is connected to the platform, the average measured wall thickness of its conductor, the weight of the hydraulic workover unit needed for the planned operation and the expected tubing overpull load. The output is either a green light for the work to go ahead, a red one to say the well is unsuitable for the intended work, or an orange light that denotes a borderline decision. (An accompanying plot of wall thickness versus overpull for a particular surface weight helps the user determine the best way forward in the latter case.)

The simplicity of the tool belies the amount of data gathering and processing plus structural analysis work that went into its development. This was led out of 2H's office in Kuala Lumpur, Malaysia. The team is already seeking to enhance the integrity tool by incorporating the effects of corrosion into its underlying methodology. Engineers from another Acteon company, InterAct, in Norwich, UK, will provide support for this extension to the work.

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TEMPLATE FOR SUCCESS

AT FIRST GLANCE, THE VOLVE FIELD DRILLING TEMPLATE IS HARDLY EXTRAORDINARY. HOWEVER, SOME OF ITS DESIGN FEATURES, THE WAY IT WAS TAKEN OFFSHORE AND ITS INSTALLATION PROCESS RENDER THE TEMPLATE REALLY QUITE SPECIAL.

The Statoil Volve field lies in the Norwegian sector of the North Sea and is, unusually, producing oil via a modified jackup rig, the Maersk Inspirer. The choice of the jackup for the drilling and then the subsequent production presented some interesting challenges, not least in relation to the drilling template, a vital component at the outset of field development.

Ann Vicens, project engineer, Claxton, was intimately involved throughout the project to design, fabricate and install the Volve template. She explains some of the issues that she and her team had to deal with: "The decision to produce the field via a modified jackup rig had serious implications for the way the wells were spaced out on the seabed. For practical reasons, the jackup had to be fixed in place before the template. This meant we were then forced to locate the template – crucially, without the help of any physical guides – very accurately on the seabed to ensure that the slots precisely reflected the layout of the well bay. Failure to achieve this would have created serious difficulties when tying back the individual wells and would also have had an impact on the fatigue life of the risers."

In fact, it was determined that the template had to be installed such that the centres of the outermost slots were within 200 mm of a reference point provided by the location of the corresponding well centres on the rig. Obviously, the template also had to have the same heading as the well bay; it was calculated that a 1° error would reduce the tolerance for the template's position from 200 to 120 mm.

The installation solution that Claxton proposed involved slinging the template beneath the jackup well bay for its journey out to the field, which meant the template would be submerged and subject to considerable drag. To overcome this loading, a robust sea-fastening arrangement was devised whereby upstanding beams on the template were bolted to the underside of the well bay.

Once at the required field location and after the jackup was raised, the template was run to the seabed on a drillstring secured within the central slot. Two optical gyros, rather than the usual one, were used to monitor the template as it was lowered to the seabed; one was mounted on the drillstring and the other on the template itself. By comparing the data from the two gyros, it was possible to detect any bend in the drillstring and so obtain an accurate indication of the template's heading, pitch and roll, and also any displacement relative to the well bay throughout the installation process. Calm weather and a slack tide during the installation combined with a remotely operated vehicle (ROV) that was big enough to be able to nudge the structure into place, as well as a good deal of patience, helped to ensure that the template was ultimately set down in exactly the required position and orientation.

"We take great pride in our role in this challenging project," says Vicens. "This was one of the biggest templates that UWG, now part of Claxton, had designed, and we supplied it on time and within budget. We also developed the installation procedures, and had two of our engineers on the rig to oversee what turned out to be a highly successful offshore operation. I think the greatest benefit to the client, however, was the ability to tie back the Volve wells to the production jackup rig without any undue difficulties."

The Volve template has enabled Maersk to employ the Inspirer jackup rig in a role for which it was not originally designed. It has also defined a new option for field developers; Claxton has received expressions of interest in the technology from at least one other operator. In conclusion, it could be said that Volve itself has provided a valuable template for further applications of this nature.

Central to the development

The Volve template was designed and built by Acteon company UWG, now part of Claxton. It has 15 slots in three banks of five; the central slot was used to run the template as well as for drilling. The template was approved by DNV, whose representatives witnessed all the pre-delivery tests. Weighing in at 50 t, the structure was built in five parts in Great Yarmouth, UK. It was then transported to Haugesund in Norway for assembly before being sea-fastened to the Maersk Inspirer for the journey to the field.

A key feature of the template is the mechanism used to centralise the conductors within the slots during the primary cementing operations. It was a condition of the design that point loading on the production risers through the template during well construction and throughout the life of the field should be eliminated. There was to be no contact between the conductors and the template after the conductors had been cemented in place. This meant having centralisers that could be withdrawn from the slots once they had performed their important role.

Claxton's solution was to build three retractable hydraulic cylinders into each slot. Activated by the ROV, these were extended to hold the 30-in. conductors in place during cementing, and were later retracted. The cylinders, each rated at 2100 psi, were grouped in five banks of nine and were powered from the ROV using the same environmentally acceptable hydraulic fluid used to control the ROV's other mechanical functions. It is believed that this is the first use of such a conductor centralising system.

PRESETTING THE STANDARD FOR RIGS IN THE GULF OF MEXICO

THE MOORING OF RIGS IN CONGESTED, DEEPWATER AREAS OF THE GULF OF MEXICO IS ATTRACTING GREATER ATTENTION NOW THAT VIOLENT STORMS HAVE BECOME MORE COMMON.

Preset mooring systems for drilling rigs have been around for almost two decades. However, they have grown in favour over the past couple of years among oil companies operating in the Gulf of Mexico. Many see them as the best way of optimising the operation and movement of these costly assets, especially in congested and ultra-deepwater areas.

In this article, we examine some of the factors behind the current trend toward preset systems with the help of Todd Veselis, project manager with InterMoor. For the past three years, Veselis has been deeply involved with the mooring and frequent moving of the Transocean Marianas, a Sedco-700-type semisubmersible drilling rig designed for harsh environments and water depths to 2130 m. Under a contract between Transocean Offshore Deepwater Drilling (Transocean) and BP, the Marianas is involved in a mixture of exploration and development drilling plus well intervention work. BP prefers the rig to be secured with polyester preset mooring lines rather than the rig's own wire-and-chain mooring system.

BP has moved the Transocean Marianas at least eight times over the past three years between six different locations in the Gulf of Mexico – three times in quick succession during one particularly busy six-month period. Each time the rig has been moored with 8 or 12 preset lines, the latter during the hurricane season and as consequence of risk-assessment studies demanded by both the American Petroleum Institute and the Minerals Management Service.

InterMoor leases BP polyester rope, enough to make up as many as 24 mooring lines, and up to 24 suction-embedded plate anchors, or SEPLAs, as they have become known. Obviously, this means the rig can be moved from one location to another, even during the hurricane season, without having to transfer the moorings with it.

At first sight it might seem extreme to have two complete sets of moorings in addition to the rig's own system, so what exactly lies behind this mode of operating the Transocean Marianas?

Well, time has something to do with it, though the thinking is a little more involved, as Veselis explains: "The complete rig move cycle using the preset system is unlikely to be shorter than using the rig's own wire and chain. It takes several weeks to preset the anchors and lines, and then to pick them up after the rig has moved on. However, the rig can still be working during these periods; essentially, the time needed to preset and pick up the moorings is off the critical path. This gives us some flexibility; we can organise this work to fit with

THE TRANSOCEAN MARIANAS'S MOVE CYCLE

A Transocean Marianas move begins when InterMoor is given the new rig location by BP. Engineers carry out a site investigation focused on the water depth, the seabed conditions, the metocean data and any existing oil and gas infrastructure in the area. Then, taking into account the design criteria, they conduct a mooring analysis to determine the optimum mooring layout at the site. Detailed procedures are written for presetting the anchors and the polyester lines, and for hooking up the rig to the moorings. These go to Transocean and BP before being submitted to the Minerals Management Service for approval.

InterMoor crews preset the anchors at the new location; each takes about 12–18 hours. The time for the whole operation depends on the weather, the nature of the seabed and, naturally, the number of anchors to be set (8 or 12) and the anchor-handling vessels used. A single boat can typically sail with six to eight SEPLAs. The polyester lines are then preset and left on the seabed; it is normally possible to lay two lines per day. This exercise is far less weather-dependent than anchor installation.

The rig is disconnected at the old location, moved and hooked up to the preset moorings at the new one. The times for these operations depend on the number of boats available, but three or four days at each end is not unusual, especially if there are 12 lines involved. An InterMoor rig-move coordinator and a mooring engineer are present on the rig throughout the process.

The abandoned moorings are picked up. The polyester lines can be retrieved in roughly the time it took to set them; SEPLAs can be recovered in as few as four hours each. Assuming good weather, the whole pick-up generally takes one to two weeks with a single boat.

The mooring system, lines, anchors and associated hardware are taken to InterMoor's Fourchon yard for inspection and any repair and maintenance.

the available boat and crew schedules. Although there is a downside: we can lose the boat at short notice if there is a pressing call from somebody else for its services."

Veselis also does not claim that the core time to disconnect the rig from one lot of preset moorings, move it, and hook it up to the next set will necessarily always be shorter than the corresponding exercise using the rig's own mooring system. The weather, the number of available boats, the seabed conditions and the existing infrastructure influence both types of move. However, this is where the preset mooring system starts to look attractive: setting the moorings before the rig arrives enables them to be positioned in the vicinity of any seabed infrastructure relatively easily

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Todd Veselis: "Using a preset system, the move can be planned more thoroughly and with more confidence."

and generally with less chance of damaging it, when compared with setting the rig's own system at the time of the move.

"Using the preset system, the move can be planned more thoroughly and with more confidence," says Veselis. "And because the main mooring components are already installed and the polyester ropes are lighter and easier to handle than chain, the move is more straightforward and simpler to control. Further, there is much greater assurance that the preset system will provide a dependable mooring for the rig because it can be checked beforehand. What it amounts to is that you are faced with fewer potential hazards; the risk of the rig being exposed to the weather for longer than necessary is reduced; and the chances of incurring costly delays are diminished."

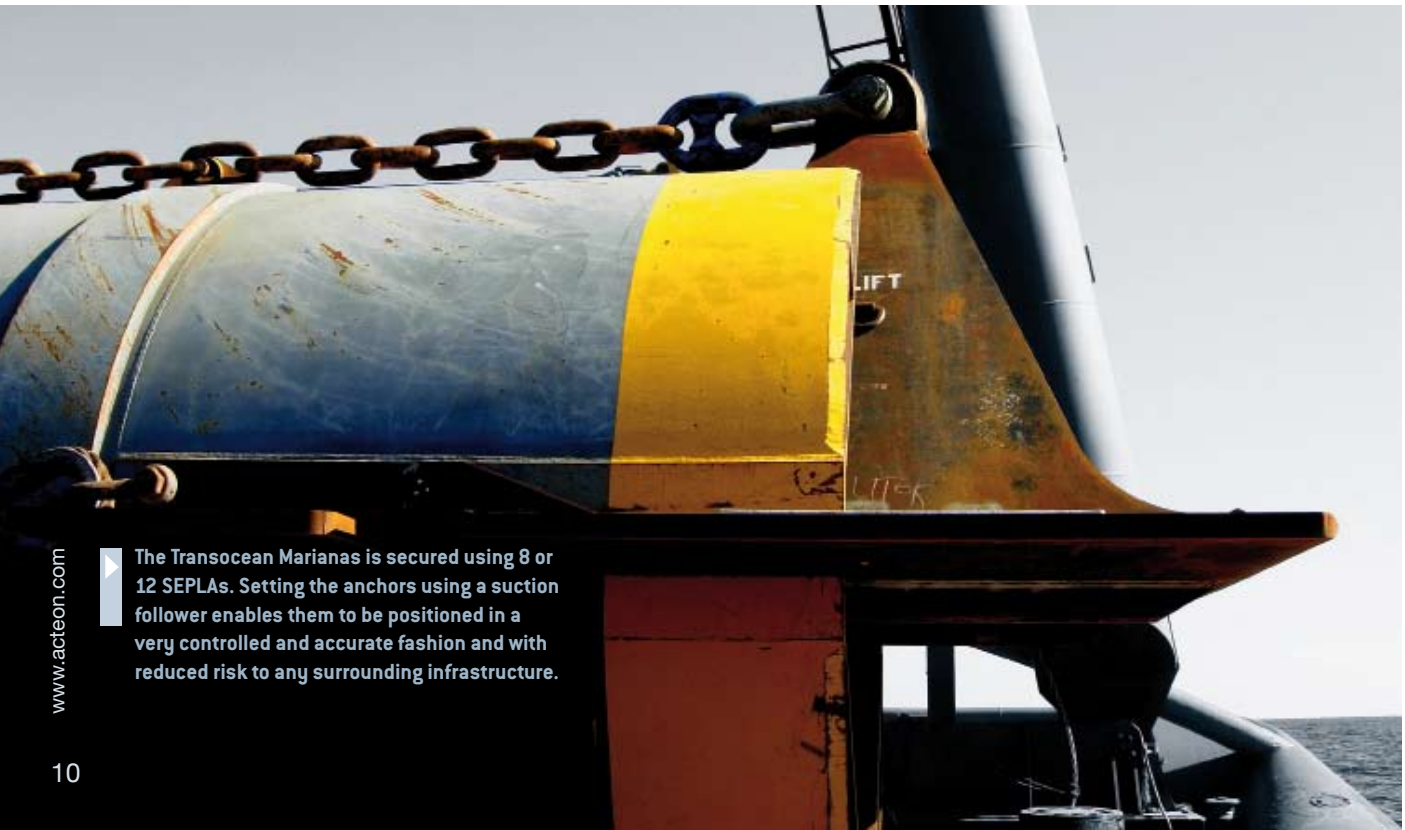
Veselis also points out that the polyester lines and SEPLAs provide a lighter, more reliable mooring, and that by presetting them you can more easily customise the layout to the location, hence providing the optimum restraint for the rig – the best basis for its efficient operation. If any further arguments needed to be made for the preset system, he asserts that presetting 12 mooring lines and attaching them to a rig designed with an eight-point wire-and-chain system is far more straightforward than upgrading the rig and expanding its eight-point system to enable it to set 12 wire-and-chain mooring lines.

It is clear that opting for preset moorings for drilling rigs is not simply about time and equipment costs. As is often the case offshore, risk is the central issue: to schedules, safety and the asset and its smooth operation. When these factors are taken into account, even without a formal analysis, the case for preset moorings for drilling rigs seems compelling.

For InterMoor, what is essentially an ongoing project surrounding the moving of the Transocean Marianas is undoubtedly good business – though hard work. Veselis says there has been hardly a moment over the past three years when his engineering team has not been considering or planning a move; the operations people have not been gearing up to set or pick up moorings; and those responsible for the overall logistics have not had to be on their toes to respond to BP's operational and schedule needs, which can change at short notice.

"It calls for a close relationship between ourselves and our customer, and a good deal of flexibility," says Veselis. "It is satisfying to know that our work with the preset mooring system has contributed to the safe and efficient operation of the Transocean Marianas. We have developed a deep sense of responsibility for the rig over the three years we have spent moving it about – you could say we have become strongly attached to it."

IT IS CLEAR THAT OPTING FOR PRESET MOORINGS FOR DRILLING RIGS IS NOT SIMPLY ABOUT TIME AND EQUIPMENT COSTS. AS IS OFTEN THE CASE OFFSHORE, RISK IS THE CENTRAL ISSUE: TO SCHEDULES, SAFETY AND THE ASSET AND ITS SMOOTH OPERATION.



The Transocean Marianas is secured using 8 or 12 SEPLAs. Setting the anchors using a suction follower enables them to be positioned in a very controlled and accurate fashion and with reduced risk to any surrounding infrastructure.

TOPPLING SOLUTION FOR EAST CAMERON

END-TO-END MANAGEMENT AND CAREFUL PLANNING DELIVER SAFE AND COST-EFFECTIVE PLATFORM ABANDONMENT IN THE GULF OF MEXICO

Hurricanes Katrina and Rita left a trail of destruction as they raged through the southern part of the USA in August and September 2005; before making landfall, they had already wreaked havoc among the oilfields of the Gulf of Mexico.

The damage suffered by one small independent oil company's facilities in the East Cameron field is typical of the problems faced by numerous operators. The facilities originally comprised two bridge-linked platforms: one dedicated to production and accommodation, and the other to supporting the wellheads. The former managed to survive both hurricanes. However, the wellhead platform was overturned by the second hurricane, Rita, and deposited on the seabed 45 m below the waterline.

Although the production and accommodation platform survived in sound condition and there was no pressure from the authorities, the operator felt, in 2008, that it was the right decision to reduce any future liability and remove the platform.

"The operator was looking for a third-party project management company to take on the abandonment work, one that had not only the necessary technical skills and experience but also a good understanding of the regulatory requirements," says Tom Kennedy, president of InterAct. "Naturally, they also wanted the work done safely and in the most cost-effective manner.

"I believe that the operator's decision to go with InterAct for this project was based on the ideas we put forward to reduce the cost of the project, particularly those for minimising expensive vessel time, our attention to detail and our determination from the outset to ensure an efficient offshore operation."

The process, which closely followed InterAct's proposed plan, involved abandoning the platform in stages. First, the topsides was decommissioned: a crew was mobilised to clean out all the production vessels, piping and so forth, and to sever any connections between the topsides and the jacket. Some of the heavier deck packages, such as the living quarters and the main compressor, were also isolated. There then followed a short, intense period when, with the help of a derrick barge, the topside packages were transferred in a series of lifts to a waiting materials barge.

InterAct's plans for the jacket were to reef it on location in 50 m of water. This was by far the most cost-effective solution, and Kennedy's environmental specialists prepared the necessary application to the Minerals Management Service (MMS). The positive response from the MMS was conditional on the jacket being placed on the seabed in a tightly specified position and orientation. Given the water depth and the weight of the jacket, and also the fact that the surrounding seabed was littered with debris from the earlier destruction of the wellhead platform, the MMS's requirements rendered the whole operation far from straightforward.

Kennedy points out that any structure abandoned on the seabed in the Gulf of Mexico has to be at least 27 m beneath the surface of the ocean. This meant that it was necessary to cut the jacket in two, move the upper section and then topple it in a controlled manner.

Divers used diamond wire saws to sever the jacket legs and bracings, which had been pre-cleaned; the bottom section was left in place with the required 27 m of clear water above it. The upper section was carefully lifted off and placed upright 50 m away at the prescribed reefing site. "Toppling the upper section of the jacket to get it to land in exactly the right spot took great care," explains Kennedy. "We undertook a thorough survey of the seabed using sonar to ensure there was no debris cluttering the site before attaching a line at the bottom of the structure and using the derrick barge to slowly tip it over. InterAct is one of only a handful of companies worldwide with experience of this kind of exercise."

Once the operation was complete, InterAct surveyed both sections of the jacket and provided the proof required by the MMS that all of the abandonment conditions had been met. Kennedy reckons that the keys to the success of the project, from the operational and economic standpoints, were a good strategy and good planning, which minimised the marine equipment needs (for a start, a project like this would normally have required a much larger derrick barge) and the length of time the equipment spread was required on-site. In fact, it has been estimated that the project was completed for about $700,000 less than the existing benchmark cost for this kind of work.

"Platform decommissioning and abandonment is like any other offshore activity: you need to be creative," says Kennedy. "There is always scope for saving time and money. It just requires you to take a fresh view of each project and then, most importantly, you plan the work meticulously."

John Bryan: “Building an ever more professional workforce.”

The InterMoor training deck measures 14 × 28 m and is equipped with a working crane; a two-drum, 15-t winch; and two 5-t hydraulic tuggers. There is also a complete toolbox (the kind that accompanies InterMoor crews carrying out anchor-handling work offshore), grappling hooks, a small buoy and a wide variety of connecting links, shackles and slings. Although scaled down, the training deck reflects the kind of surroundings that crews will encounter offshore on a real anchor-handling vessel. That the deck is some distance from the ocean in Thibodaux, Louisiana, somewhat limits the work experience, though the location takes people out of their everyday environments and enables them to focus completely on the training. There is a stretch of inland water behind the deck, and Bryan has his sights set on developing the facility further to enable trainees to practice getting equipment over a stern roller into the sea and also transferring mooring equipment from ship to ship.

A DECK IN THE COUNTRY

CONSTRUCTING THE BACK DECK OF AN ANCHOR-HANDLING VESSEL IN THE US COUNTRYSIDE OFFERS SAFETY DIVIDENDS FOR INTERMOOR.

In any discussion about anchor handling, it is the vessels used for this specialised activity that tend to take centre stage: the spotlight falling on their size, power and manoeuvrability. But just as important to the success – and safety – of any mooring project is the competence of the anchor-handling crews who perform the intensely physical and potentially hazardous work on the back decks of these boats.

The question is how to guarantee that competence, as John Bryan, InterMoor's health and safety manager, explains: "The training of anchor-handling crews is very important. A lot can be learned on the job; working alongside experienced colleagues counts for a great deal. However, people need a solid introduction to this business before they get involved. As no formal training courses are offered by the offshore industry, last year we decided to develop our own."

Responsibility for designing the course fell to InterMoor marine operations specialist Mike Carcisse, who could not have wished for more support. People from InterMoor's safety and operations teams quickly became involved, as did a group of the company's senior anchor handlers, and there was input from Keith Benoit, a vice president of leading training provider M&O Americas Inc. As a result of their combined efforts, early this year, InterMoor launched a Level 1 course aimed at teaching the basic skills needed by anyone carrying out anchor-handling operations off the back deck of a boat.

The course runs for five days and involves a mixture of classroom sessions and practical instruction on a mock anchor-handling deck constructed at M&O's facilities located, somewhat incongruously, in the heart of the Louisiana countryside. The course focuses on the common tools and principal techniques employed to move equipment around the deck. Bryan describes the course as being about "preparing people for work and instilling in them how to do things safely." The course concludes with a full-day assessment exercise, during which the trainees are tested on their ability to conduct a job safety analysis for a specified operation, plan the work and then execute it efficiently and safely.

It is now InterMoor policy that all new hires must attend the course before being allowed to work offshore. The aim is also to put all the company's existing crew members through the course. This has two advantages: it serves as a refresher for people (it is easy to fall into bad habits) and provides valuable feedback on the way the course is run and the topics covered. In the months since the course was introduced, it has already been significantly refined and improved to meet the needs of the people it is intended for. "Our operations people are enthusiastic about the course and have taken real ownership of it," says Bryan. "At their suggestion, we are looking to add Level 2 and 3 modules aimed at supervisors and marine engineers respectively."

The course has also caught the attention of the offshore operators, for whom safety is obviously a number-one concern. Several of them have expressed interest in sending staff on the course to help them understand better the challenges involved in this important aspect of offshore operations.

Finally, the deck, such an integral part of the training course, is being lined up for other uses: operations people see great advantage in using the facility to re-enact incidents, to develop solutions to selected handling problems, to test new mooring equipment and to check out fresh back-deck procedures. Bryan sums it up perfectly when he says, "This entire initiative is really all about building an ever-more professional workforce."

"THE TRAINING OF ANCHOR-HANDLING CREWS IS VERY IMPORTANT. A LOT CAN BE LEARNED ON THE JOB. HOWEVER, PEOPLE NEED A SOLID INTRODUCTION TO THIS BUSINESS BEFORE THEY GET INVOLVED."

STAYING AHEAD

OPERATORS THESE DAYS ENJOY A FAR BETTER UNDERSTANDING OF THE BEHAVIOUR OF DEEPWATER RISERS AND, CONSEQUENTLY, CAN HAVE GREATER CONFIDENCE IN THEIR FUNDAMENTAL DESIGN. THIS IS LARGELY THE RESULT OF ADVANCES IN RISER MONITORING TECHNOLOGY, A FIELD THAT HAS BEEN PIONEERED RELENTLESSLY BY 2H OFFSHORE.

Going out first is never easy. It is the same in most walks of life. Front runners generally face the greatest resistance and present a natural focus for the opposition.

It is all the more remarkable, therefore, that 2H has remained at the forefront of riser monitoring after almost single-handedly pioneering the concept in the mid-1990s. The company has done so by sticking to the principle that riser monitoring needs to be simple, or at least the basic hardware used to gather the raw data needs to be simple.

It was this idea that lay behind 2H's early decision to concentrate on monitoring the way risers move as a consequence of wave action, currents and shifts in the position of the vessel or platform to which they are connected. Significantly, this motion can be recorded very easily using a combination of acceleration, angular rate and inclination sensors. These are cheap, robust, reliable and very easy to attach to the riser without removing any of the coatings or insulation around the pipe. There is also a good theoretical argument for monitoring motion. When carrying out an initial riser analysis, it is normal to set up and solve the equations that describe the riser's motion. Thus, it makes sense to want to compare the actual motion of the riser with the assumptions made during its design.

The only drawback of motion measurements is the relative complexity of the calculations necessary to translate the raw data into pipe stress values and from there to derive the fatigue performance of the riser. However, not only did 2H engineers perfect the necessary data processing methods to achieve this, they also succeeded in developing a back-analysis technique to compute the global structural response of the riser, and hence the fatigue properties along its entire length, from motion data necessarily gathered at a series of discrete locations.

Despite the advances made by 2H, the company continued to encounter resistance from sections of the industry advocating strain measurements rather than motion measurements, mainly because of their more direct relationship to fatigue. Although 2H recognised this advantage, the company had initially been reluctant to pursue this route because of the frailty and poor reliability record of the available strain sensors and the practical problems of fixing them to the pipe.

Conscious of being seen as intransigent, and by now having gained considerable experience of the practicalities of riser monitoring, 2H set out to win over those calling for strain measurements by developing its own rugged strain sensing devices. The company subsequently patented and launched the INTEGRIstick™ and, soon afterwards, a variant on the same theme, the INTEGRIcollar™ (2H had already decided to call its motion sensor range INTEGRIpod™).

The INTEGRIstick uses strain gauges fully sealed inside a corrosion-resistant metal housing to measure small changes in riser curvature in two orthogonal planes. The INTEGRIcollar uses gap sensors set within a simple steel framework to capture pipe axial and bending strains. Data from both are readily converted into pipe stress values and thence to fatigue rates. The key features of both devices are their accuracy and stability combined with excellent reliability and ruggedness. The INTEGRIstick is simply strapped to the pipe, and the INTEGRIcollar is bolted around it; both may be fitted over any coating or insulation within minutes.

The INTEGRIstick has made a strong impression on the industry and has consolidated 2H's position at the head of the field. Earlier this year, the product won a Spotlight on New Technology Award at the annual Offshore Technology Conference in Houston, USA. Previously, it had already been approved by Chevron for use in a major riser-monitoring programme centred on its deepwater Tahiti field in the Gulf of Mexico (see boxed text, *Chevron Tahiti*). Although still early days in terms of gathering and interpreting data, the project has demonstrated that it is possible to integrate an extensive riser monitoring system into a major offshore development without interfering with the normal project activities or the overall schedule.

Pei An, who manages the riser monitoring programme at 2H, sees this demonstration as crucial. "We sense a growing acceptance of the value of including monitoring as an integral part of new deepwater riser systems," he says. "We are seeing a lot of interest from operators in the Gulf of Mexico and West Africa, and Brazil is emerging as a huge potential market with the acceleration in the pace of offshore development following the new, large discoveries made over the past couple of years and the Brazilian government's decision to open up offshore developments to operators other than Petrobras.

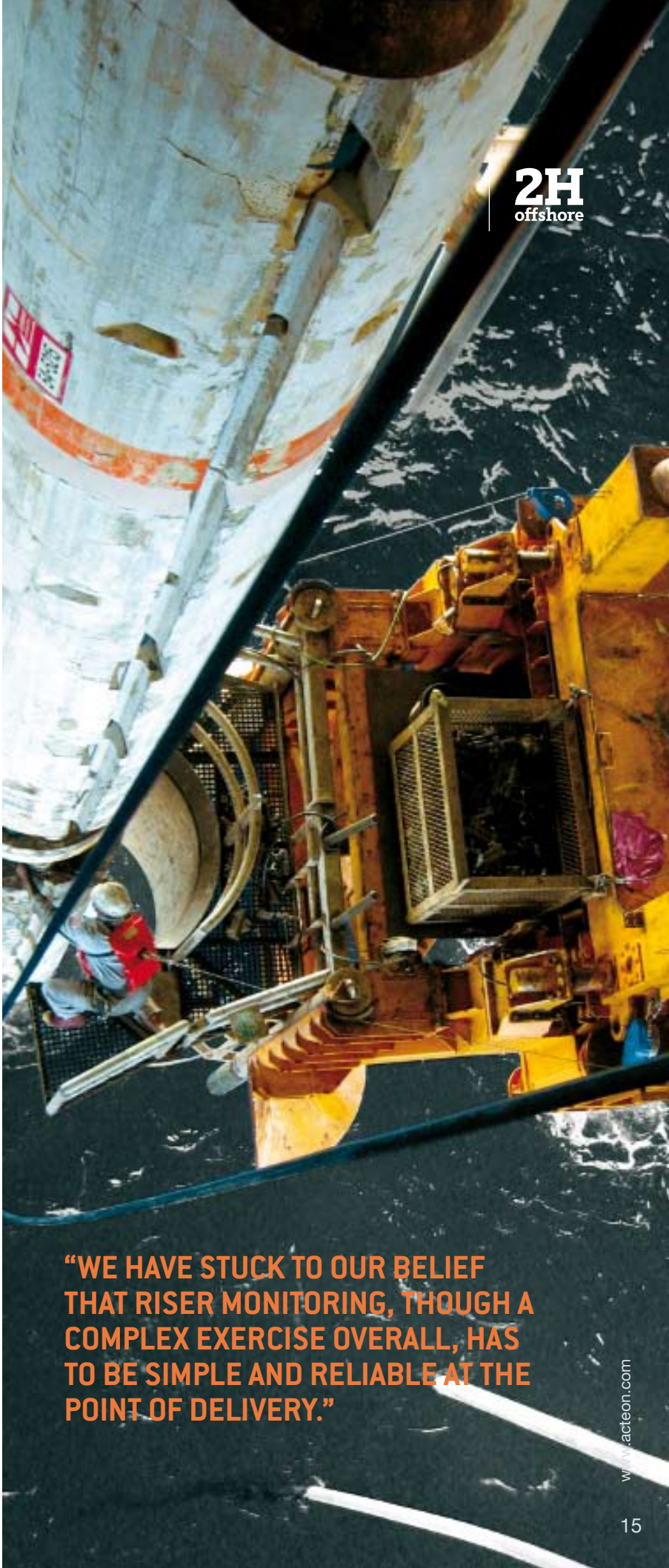
"I am proud of the role that 2H has played in proving that riser monitoring is a practical proposition. Moreover, we have shown that it does not have to be an expensive exercise. We have stuck to our belief that riser monitoring, though a complex exercise overall, has to be simple and reliable at the point of delivery. We are seeing other companies trying to move the business upmarket with high-tech, high-cost systems. In my opinion, this is not the way to go. The value comes from the way the data is treated and the interpretation put upon it, not necessarily the way it is collected."

CHEVRON TAHITI

The Chevron Tahiti riser-monitoring project is seeking to cast light on the performance of steel catenary risers: critical dynamic structures that display particularly complex fatigue behaviour. The project, which is based on a single in-field production riser, has two main objectives. The first is to capture motion and strain data, and to use them to validate the original riser design process. The second is to characterise the response of the riser to vortex-induced vibration and to the extreme loads resulting from wave action and the movement of the Tahiti truss spar platform.

The monitoring system, which was designed by 2H, concentrates the sensors in the two most critical regions of the riser: the hang-off region immediately below the platform and the touchdown region at the seabed. In all, there are 20 monitoring stations spread over roughly 100 m in the hang-off region and 220 m in the touchdown region. Four of the stations have motion sensors, six have INTEGRIsticks, and 10 have a combination of both. All the sensors are wired back to the platform so that data can be gathered continuously in real time.

Significantly, as a part of the same programme, strain measurements are also being made on a 210-m section of flowline about 1.5 km away from the riser touchdown point, where the weight of the riser is reduced by buoyancy modules to promote controlled buckling. These measurements are being made using a sophisticated fibre-optic device not supplied by 2H.



OFFSHORE EXPERIENCE FOR WIND POWER

AS OFFSHORE WIND TURBINES BECOME LARGER, THEY REQUIRE SUPPORTING STRUCTURES SUCH AS THOSE MORE USUALLY ASSOCIATED WITH OIL AND GAS FACILITIES. IT IS NO SURPRISE THEN THAT MENCK IS INCREASINGLY BEING ASKED TO APPLY ITS OIL AND GAS EXPERTISE TO PROJECTS SUCH AS GERMANY'S FIRST OFFSHORE WIND FARM.

alpha ventus, Germany's first offshore wind farm, is groundbreaking in many ways. The project will be a fully functioning set-up supplying power to 50,000 households. However, the developers and the German government are also seizing the opportunity to run a large-scale field trial that will examine rival 5-MW turbine and foundation types in operation.

Deutsche Offshore-Testfeld und Infrastruktur GmbH (DOTI), a consortium of German utility giants EWE, E.ON and Vattenfall, is developing the wind farm, which is 45 km off the island of Borkum in the German North Sea in 35-m-deep water. The engineering, procurement, construction and installation contract for the 12 generating units has been split between two contractors, AREVA and NorWind. AREVA/PROKON Nord has installed six Multibrid M5000 turbines on tripod foundations, and NorWind has mounted six REpower M5 turbines on jacket foundations. MENCK installed the foundation piles for both companies in June–August 2009.

The offshore wind industry is still finding its feet. However, MENCK has deep-rooted experience of installing similar structures for the oil and gas sector. For this reason, both AREVA and NorWind have worked closely with MENCK from an early stage.

The combined weight of an **alpha ventus** tripod foundation, tower and nacelle is 1000 t, which makes these structures comparable with unmanned oil and gas facilities. In addition, offshore wind farms are being planned with more and larger turbines and in deeper waters. Whereas one or two foundations may be installed to support an oil and gas topside, the new breed of offshore wind farms will require hundreds of foundations and piles, which makes installation a long and continuous process. The scale of these projects increases the pressure to lower costs, enhance efficiency and extend installation windows by mitigating underwater construction noise.

"Planning is critical," says Jeremy Tygielski, director of marketing, MENCK. "The supply chain must be fast and efficient, and installation vessels cannot waste time waiting for equipment. During our work on the **alpha ventus** project, we pre-installed the piles for the six jackets, which reduced the total installation time. We also tested our 'little bubble-curtain' noise mitigation concept while installing one of the tripod piles. Techniques like these may be critical for the success of future offshore wind-power schemes."

Pre-installation efficiency

The pre-installation of piles through a template has several cost and time advantages. It removes the need for substructure pile sleeves, which make the jackets lighter, and vertical installation of the piles helps to standardise the substructure design for mass production. It also means that one vessel can focus on piling while a second installs the substructures.

Martin Ros, MENCK senior sales manager, says, "We have pre-installed many piles for the oil and gas industry. This method was decided on for the **alpha ventus** jackets during consultation with NorWind. Our initial plan was to use a follower to install each pile in a single operation through the 7-m template sleeve so that 1.2 m of it protruded above the seabed. However, we discovered that the site experiences strong currents that prevent the use of followers.

"To solve this problem, we redesigned the MHU 500T hammer so that it has a shorter pile sleeve. This creates a smaller overlap with the pile head. Optimising the space tolerance between the pile and the pile sleeve ensured that the hammer retained its vertical position.

"We also modified the installation process. Each 35-m-long pile was driven as far as possible through the template, then the template was removed and the piles were driven to their final depth. The jacket was lowered onto the pile heads and grouted in place. Although the two-stage piling sequence takes longer, it considerably reduces the cost of jacket fabrication by removing the need for pile sleeves."

MENCK also installed the piles for the tripod foundations using its MHU 500T hammer. These piles were driven through the tripod sleeves. Ros adds, "One of the many lessons the we learned from this pioneering project is that the additional use of a vibratory hammer for the initial pile stepping of pre-installed piles for tripods is advantageous. It ensures pile verticality, removes the need for levelling equipment and reduces installation time. We now recommend this process for similar work."

A bubble curtain surrounds MENCK's MHU 500T hammer during the installation of a pile for the **alpha ventus** wind-power project.

Bubble-curtain noise mitigation

Concern for marine wildlife has led to restrictions on the length of installation windows. However, the scale of offshore wind-power projects means that longer installation periods will be required to deliver projects on time.

MENCK is at the forefront of research into pile-driving noise mitigation. Ros was a co-author of the 2007 COWRIE (Collaborative Offshore Windfarm Research Into the Environment) report that assessed engineering solutions for mitigating underwater construction noise. The engineering solutions included in the study are patented MENCK designs.

Sound attenuation by creating a bubble curtain is a key mitigation measure. Ros says, "We used the 'big bubble-curtain' concept during the August 2008 installation of the FINO3 offshore wind research platform, which is mounted on a monopole 80 km west of the island of Sylt in the German North Sea. The entire construction site was surrounded by a 60-m-diameter seabed air hose that released a curtain of bubbles. Underwater construction noise during the installation was measured at a standard distance of 750 m from the pile. The big bubble curtain was effective, as it reduced the noise by 10 dB, but its installation costs make it uneconomic.

"During the **alpha ventus** construction, we teamed up with the University of Hanover to test our 'little bubble-curtain' concept during the installation of one of the tripod foundations. Instead of surrounding the whole construction site, this system creates a wall of bubbles around a single pile.

"For reasons beyond our control, the full system of eight vertically stacked bubble rings was not tested. However, three of the eight rings were tested. The results were encouraging, with a 12-dB reduction in the down-current direction. We are looking forward to measuring the full potential of the system in the near future. We also have patented mitigation concepts such as inflatable sleeves and telescopic foam-filled tubes that we are keen to test."

Wind-power work

As MENCK finished its **alpha ventus** work, it was preparing for another groundbreaking project, a BARD Tripile installation. This will complete MENCK's wind-farm piling portfolio, as the company will have driven piles for every offshore foundation type that requires piling. With over 40 years of offshore pile-driving experience, a large offshore wind-farm portfolio and many more jobs being planned, MENCK is in a good position to support this growing industry.

ELECTRONICS SUPPLIER SEEKS BETTER CONNECTIONS

MARINE ELECTRONICS EQUIPMENT IS BECOMING EVER MORE SOPHISTICATED. CARE IS NEEDED TO ENSURE THAT CABLES ARE NOT THE WEAK POINT IN ITS PERFORMANCE.

Just over a year ago, in a slight departure from its core business, Seatronics set up a cable-moulding facility at its base in Houston. Sales manager Mark Teles explains the thinking behind the move, which it seems was inspired, as the company is now doubling its moulding capacity.

According to Teles, the unit was established for a combination of reasons. "First, we saw an opportunity to save money: our spend on cable repair and maintenance was approaching $140,000 per year. We were also getting more calls from clients wanting customised cables, often at very short notice, to enable them to combine different items of electronic equipment for specific tasks. But perhaps the most important factor was our concern about the quality of the cables occasionally supplied with the marine electronics equipment that we rent or sell."

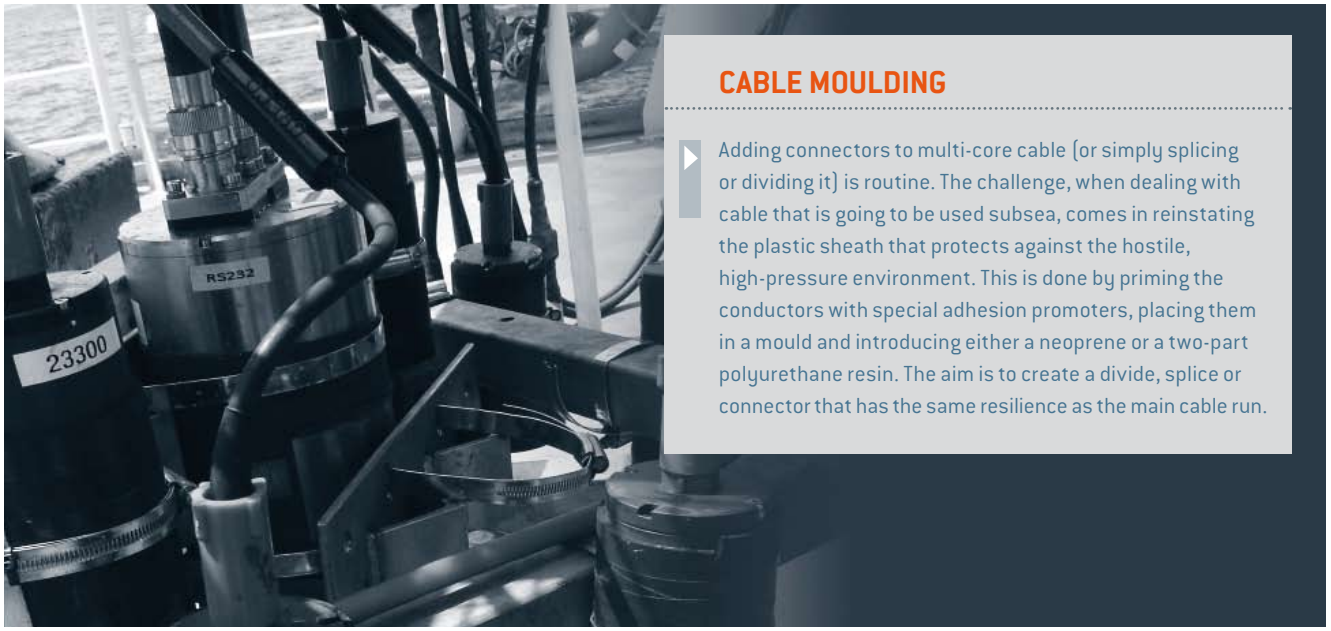
Teles believes that it does not makes sense to send out a sophisticated and often expensive item of imaging or survey equipment with an inherent weak point: the cabling that constitutes its lifeline by providing power, control and the ability to transfer data to the surface. "You hear reports of critical and costly survey operations being suspended while waiting for replacement cables to be sent offshore," he says. "It is a potential problem that costs so little to avoid."

Quality is therefore the keynote for Seatronics' cable-moulding facility. It comes through in the design, development and testing of the moulds, almost all of which is done in-house. The company has also investigated the formulation of the primers and the moulding resins with their manufacturers to optimise them for this particular application. You get a sense of quality in the written procedures that describe the way individual cables are made up, and, not least, in the rigour of the quality control process to which every piece of work is subjected.

As well as the quality ethic, Seatronics has quickly forged a reputation for the compact nature of its mouldings. This is a great advantage when, for example, connecting up equipment on board a small, complex remotely operated vehicle. And it is not trivial to design a compact moulding that does not leak at 3700 m plus in the Gulf of Mexico.

Having a superior cable-moulding facility in-house and being able to respond to customers' requests for individual cables, often within 24 hours or less, has meant a rapid rise in third-party business. Major remotely operated vehicle companies, equipment manufacturers, oceanographic surveyors and service companies have begun to view Seatronics as valuable point of contact when they have critical cabling requirements. Incidentally, the facility has also resulted in Seatronics becoming the main representative for Burton connectors in the Gulf of Mexico, and possibly in Singapore and Abu Dhabi in the future.

"It has been satisfying to see the new cable-moulding business take off in the way that it has," says Teles. "We have established a capability that is highly complementary to Seatronics' main offering and adds significant value to our customers' operations."



CABLE MOULDING

Adding connectors to multi-core cable (or simply splicing or dividing it) is routine. The challenge, when dealing with cable that is going to be used subsea, comes in reinstating the plastic sheath that protects against the hostile, high-pressure environment. This is done by priming the conductors with special adhesion promoters, placing them in a mould and introducing either a neoprene or a two-part polyurethane resin. The aim is to create a divide, splice or connector that has the same resilience as the main cable run.

CONCENTRATED POWER

CLAXTON DESIGNERS HAVE USED THEIR INGENUITY TO SUPPLY A SMALL BUT PERFECTLY FORMED HYDRAULIC POWER UNIT TO UPGRADE THE TENSIONING SYSTEM ON THE ENSCO 102 JACKUP DRILLING RIG AND SIGNIFICANTLY EXTEND ITS OPERATING ENVELOPE.

Upgrading the riser tensioning system on the Ensco 102 jackup drilling rig has meant installing a new hydraulic power unit, the specification for which posed some interesting challenges for engineers at Claxton, the company chosen to design and build it.

The new hydraulic power unit stores an unusual amount of energy to accommodate the rapid movement of the riser.

Claxton project engineer Will Robinson explains: "ConocoPhillips contracted the Ensco 102 to drill an exploration well in the North Sea and stipulated that drilling operations at the given location had to be possible under 100-year storm conditions. A riser analysis determined that to drill the required well safely, the rig would have to be capable of pulling 400 t of tension on the riser. Additionally, the hydraulic cylinders within the tensioning system would have to be able to cope with a cyclic displacement (sometimes termed a squat) of 8 in. within a four-second period."

To accommodate this degree of rapid movement, the Claxton project team had to incorporate an unusual amount of hydraulic energy storage into the system. They calculated that the unit would require 12 accumulator bottles, each with a volume of 37 L. Although this was not considered to be such a problem in itself, it did create a headache for the designers who knew the entire unit had to be small enough to fit into a space on the rig no bigger than 1.8 m wide by 2.0 m long and 2.0 m high.

In fact, packed into the frame of the unit are the 12 accumulator bottles, a 450-L fluid reservoir, four 40:1 hydropneumatic pumps (which provide the basic power for the system) and all the requisite hoses and valves, which are all roughly twice the usual bore to handle the necessarily higher fluid flow rates through the unit.

"It took quite some ingenuity to get all the equipment into the frame," says Robinson. "One of features of the design that helped significantly was the use of a flat, stainless-steel control plate for the unit in place of a normal console. This saved space and made it easier for the hydraulic fitter, as he could fit the valves and the pipework to the control plate while it was on the bench and offer it up to the unit afterwards."

The unit is also designed to last. As painting was never going to be possible after the unit was installed, it was built and tested, and then stripped down for the application of a high-performance paint system before being rebuilt: an exercise that added three weeks to the production schedule.

The unit was recently fitted to the rig on location by Claxton engineers. As there are now four Ensco jackups that benefit from Claxton riser tensioning systems, the last word should really go to the client. Speaking on behalf of Ensco, James Foreman, the Ensco 102's barge engineer, says, "The new hydraulic power unit fits well, and the crew is finding it easy to operate. The upgrade to the tensioning system is enabling us to use the jackup to drill a well that would normally have required a semisubmersible rig."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