

ACTEON

S2S

THE ACTEON CUSTOMER MAGAZINE

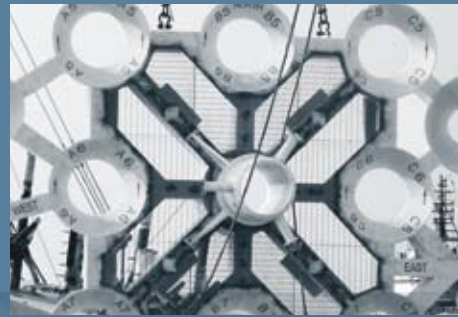
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LDD DELIVERS SOLUTIONS DEEP IN THE JUNGLE OF PAPUA NEW GUINEA

INTERACT BUILDS RELATIONSHIPS IN THE WORLD OF PROCESS, PROCEDURES AND REPORTING

2H SHOWS HOW INSPECTION AND CONDITION MONITORING GO HAND IN HAND



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COMMENT



RICHARD HIGHAM
GROUP CHIEF EXECUTIVE, ACTEON

To survive, businesses need to be innovative – and be able to demonstrate it. When choosing companies to work with, we put a lot of emphasis on their creativity, their ability to make a difference. But despite this focus on innovation, it is sometimes easy to lose sight of the true nature of the process, which can take all kinds of forms.

The underwater drilling and pinning machine developed jointly by Acteon companies Claxton and Mirage (page 17) is a perfect example of classic innovation: a new piece of equipment that enabled us to do something that had not been attempted before. This work gave us great satisfaction and certainly made a difference to our customer.

The process of innovation is not always so obvious. The article on page 18 looks at how 2H is taking integrity management techniques that were developed for critical riser systems and applying them to subsea infrastructure. The point here is that much information is already available to help us develop new ways of working that could make a real difference at a time when the integrity of offshore systems is under the spotlight.

The main article in this issue (page 8) describes how InterAct is seeking to apply its vast knowledge and experience of the regulatory issues in California to oil and gas provinces in other parts of the world. It requires a reinvention of the offer: a change in the way the company thinks, a degree of innovation again. On page 7, we have a story with a similar theme: how LDD is applying expertise acquired in the offshore environment to help an operator working in the remote highlands of Papua New Guinea. It may not actually be new technology but it certainly requires fresh thinking to take an existing capability into this challenging new environment.

Innovation is vital. And, equally, we need to embrace it in all its forms. It has to be integral to the culture within an organisation, a constant part of a company's fabric.



TEAM SEES UPTURN IN SKILLS MARKET

TEAM Energy Resources is seeing an increase in enquiries this year, especially for people with backgrounds in drilling and well construction, following the levelling out of demand for manpower in 2009. The company believes this is a prelude to increased recruitment activity across the wider spectrum of oil and gas activities. This mirrors the results of recent research.

Reports from both Ernst & Young and Deloitte have identified human capital deficit as one of the key operating risks facing the oil and gas industry, with certain sectors predicted to lose over 50% of their experienced talent.

“WE ARE SEEING REQUESTS FOR PEOPLE TO WORK IN, FOR EXAMPLE, BRAZIL, THE MIDDLE EAST AND SOUTH AFRICA.”

TEAM's move within Aberdeen to offices in Acteon's Tern Place headquarters aims to strengthen its ability to provide such top-quality personnel. According to Nab Kalsi, TEAM general manager, “The move has brought us directly alongside several Acteon service companies, which will enhance our outlook on the market and its needs. It is an ideal working environment for a business like ours.”

Investment in the offshore industry is also predicted to grow from around \$230 billion in 2010 to over \$330 billion in 2013, according to industry analyst Douglas-Westwood: a significant proportion being likely to come from the Middle East, where the pressures on manpower will be keenly felt.

Kalsi adds, “Our Aberdeen office naturally deals with skilled personnel placements in the North Sea, but, because many international projects are managed from the city, we are frequently asked to provide people for projects much further afield. We are seeing requests for people to work in, for example, Brazil, the Middle East and South Africa.”

REINFORCING ACTEON'S MOORING SERVICE CAPABILITY

In a move to broaden its mooring services, Acteon has acquired IOS Holding AS and its subsidiary IOS Offshore AS from Norse Cutting & Abandonment AS.

Established in 1986, IOS Offshore, now renamed IOS InterMoor AS, is a leading supplier of mooring equipment and services to the Norwegian offshore oil and gas industry. The company has its headquarters and principal storage and workshop base in Stavanger, and additional operational facilities at locations along the Norwegian coast.

Managing director David Smith will continue to head IOS InterMoor, and will report to Tom Fulton, president of Acteon's global mooring business, InterMoor.

Smith said, “The moorings market is developing rapidly in terms of product innovation and also for cross-border business opportunities. Becoming part of Acteon means we can offer our existing customers an enhanced service; it also immediately exposes IOS to the global marketplace and expands the opportunities available for our people.”

The company has already been awarded a global three-year mooring frame agreement, with the option to extend the agreement for up to two periods of a year, by Statoil Petroleum AS. IOS Offshore has supplied moorings to Statoil for nearly 25 years.

The scope of work includes providing high-quality mooring equipment, personnel and technical support for offshore operations to Statoil's rig fleet in Norway and internationally. “IOS InterMoor is very proud to sign this frame agreement with Statoil, which will give both parties an excellent basis to work together for continuing mutual success,” said Smith.

STRATEGIC GROWTH IN CLAXTON'S MIDDLE EAST RENTAL INVENTORY

Claxton now has a range of rental equipment available for rapid call-off directly from the company's Dubai base. The company has been expanding in the Middle East since opening a 370-m² regional base in the Jebel Ali Free Zone in 2008.

The new equipment on offer includes riser tension rings and tension systems, flushing and brushing tools, hot tapping equipment from 2 to 36 in., cold cutting equipment from 7 to 30 in. and Claxton's industry-leading subsea and inspection cameras. Tools and

personnel to support wellhead maintenance are also available.

Nick Dale, base manager, Claxton Dubai, said, “Clients have been very clear in telling us that they need equipment that can be mobilised quickly from within the Middle East, and it is our goal to meet this need with an ever-growing stock of equipment. We are convinced that Middle Eastern customers will see genuine value in our high-quality rental tools and engineering services that will enhance their projects.”



OIS MULTI-OPERATOR WELL ABANDONMENT CAMPAIGN CONCLUDES WITHOUT A HITCH

OIS's latest suspended well abandonment campaign in the UK North Sea involved four individual operators.

Six wells in categories 1, 2.1 and 2.2 were abandoned: three for Nexen Petroleum U.K. and one each for Dana Petroleum, Premier Oil and a fourth operator. The operation to abandon the Premier Oil Category 1 well was unusual in that the tree was still in place.

OIS planned and organised all aspects of the work on behalf of the operators. This encompassed the initial approvals process; formulating the contracting strategy; developing detailed procedures; procurement; appointing specialist service providers; and the overall logistics, including recycling and disposing of the recovered wellheads.

Qualified and experienced teams from OIS provided the offshore supervision and onshore support.

The campaign used a DP2-class, light construction vessel, the *Island Valiant*, which made two trips between 20 July and 16 August. During the first trip, sister company Claxton's proprietary suspended well abandonment tool, SWAT®, deployed through the vessel's moon pool undertook the light intervention work, which involved setting cement plugs across all the casing annuli in accordance with North Sea legislation. During this exercise, four of the suspended wells were completely plugged and abandoned in 10 days. The second trip was for severing the wellheads beneath the seabed and removing the tree from the Premier Oil well.

Vic Morrell, president of OIS, says, "Multi-operator abandonment campaigns provide significant cost savings for the individual operators. But serious attention needs paying to the various overlapping contracts with each of the operators, notably in terms of the reasonable division of cost and risk."

Feedback from the operators was positive. Chris Kelly, technology and performance team leader at Nexen, summed things up when he said, "The organisation of the various different service companies, along with the cooperation and proactive input of the *Island Valiant* crew, ensured that the campaign was a total success. The whole operation was successfully completed without any health and safety issues, or impact on the environment."

INTERMOOR DEVELOPS NEW MULTI-MOORING SWIVEL

InterMoor has developed a new multi-mooring swivel called the Inter-M™ Swivel. This multipurpose mooring swivel joins the same size or differently sized chains together to provide 360° rotational freedom while under tension.

The Inter-M was developed to reduce the overall number of connectors required in a mooring system while offering a more robust swivel mechanism designed with longer term mooring in mind.

The Inter-M Swivel does not require kenter or joining shackles because it connects directly into studless or common stud-link

chain. This saves costs and time during mooring equipment assembly by reducing the number of connections in the system while still providing rotational freedom.

Each Inter-M Swivel is proof-load tested to 4731 kN, and 1 in every 25 is taken to extreme break loads to ensure that the swivel can withstand loads up to 8000 kN.

Alan Duncan, managing director, InterMoor UK, said, "These technological advances make the Inter-M Swivel a cutting-edge, deeper-water, longer-term mooring swivel that complements the chain grades currently being installed or recovered."

THE INTER-M SWIVEL COMBINES TECHNOLOGIES THAT HAVE BEEN INTRODUCED ON DEEPWATER AND GENERAL CHAIN-TO-CHAIN CONNECTORS.



SENSE OF COMMUNITY MAKING HEADWAY ON THE TOP ISSUES

Acteon has set out to promote debate and, hopefully, find solutions to some of the most pressing challenges facing the oil and gas industry. Under what it has called its Subsea Communities initiative, the group is seeking to create a series of regular forums made up of representatives from all sides of the industry. The sole membership requirement is a willingness to share ideas and experience in some key areas of common concern. The idea is to create an environment in which people can take part in open and frank discussions of the issues high on the industry's agenda – and make some real headway on solving them.

Communities have been identified and are being phased in:

- HPHT seabed-to-surface
- FPSO redeployment
- Decommissioning
- Offshore renewable energy
- Brazil.

The HPHT seabed-to-surface community held its first meeting in Aberdeen in September. The meeting kicked off with short presentations from three Acteon specialists. Dannie Claxton, technical director of Claxton Engineering, provided an overview of 5,000- and 10,000-psi riser systems; Steve Hatton, vice president of Acteon's riser division, outlined the challenges posed by HPHT reservoirs in deep water; and Simon Luffrum, managing director of Subsea Riser Products (SRP), talked about HPHT riser design with the focus on the issues surrounding material specification.

Most of the ensuing discussions centred on the prime technical considerations surrounding pressure containment and the fact that the general response of engineers to elevated pressures is to increase the wall thickness of whatever it is they are designing. Oilfield drilling risers are no exception. The trouble is that higher wall thicknesses ultimately lead to fabrication difficulties and risers that are too heavy to handle easily.

Claxton, 2H and SRP together recently overcame this problem when they designed and built a 12,200-psi riser from high-tensile steel using a novel shrink-fit process to attach the flanges to the individual pipe sections [S2S, Issue 5, December 2008]. The riser represents a remarkable step forward. Unfortunately, it does little to allay popular concern, raised afresh after the BP Macondo disaster, that drilling risers offer only a single barrier between the high-pressure oil and gas in the reservoir and the fragile natural environment.

“WE LOOK FORWARD TO THE SUBSEA COMMUNITIES INITIATIVE EVOLVING INTO A FAR-REACHING ENGAGEMENT WITHIN THE INDUSTRY. OUR AIM IS TO CREATE PLATFORMS FOR OUR CLIENTS AND PARTNERS TO SHARE THEIR INSIGHTS INTO THE ISSUES THAT AFFECT US ALL. WE ARE DELIGHTED WITH THE POSITIVE RESPONSE TO THE FIRST MEETING OF THE HPHT SEABED-TO-SURFACE COMMUNITY – IT BODES WELL FOR THE OTHER COMMUNITIES THAT ARE COMING SOON.”

Laura Claxton, managing director of Claxton Engineering and chair of the Acteon HPHT seabed-to-surface community

Will Rowley, Acteon group analyst, who chaired the discussion, commented, “This was the single most significant concern to emerge from the first meeting. It was what most of the operators present felt we needed to concentrate on. Consequently, the community has a real agenda now, which should help to attract more members to the next meeting in six months time.”

One of those who attended the meeting was Richard Selwa, chief operating officer, R&A Energy, whose views seemed to reflect the general feeling of the meeting: “The event was notable for providing a comprehensive overview of the current state of play regarding HPHT risers, one of the most important subjects for the industry at this time. The organisers managed to avoid it becoming a product seminar, concentrating instead on pure technology matters. We do not often see good, frank technical debates like this these days held under the kind of rules that apply in Chatham House meetings. Acteon can take credit for this initiative, which deserves to attract more support.”

Will Rowley, who has been a leading force behind the Subsea Communities initiative, was buoyed by several responses like that from Selwa. “There was a lot of commitment and energy on show at this first meeting, which we aim to build on at the next one,” he said. “By then we should also have the other three communities up and running and be moving towards a position from where we stand a chance of making a real contribution to the industry's future.”

PILEDIVING FOR ENERGY INFRASTRUCTURE

LDD HAS DELIVERED ROBUST SOLUTIONS TO A SERIES OF TECHNICAL AND GEOGRAPHICAL CHALLENGES IN A MAJOR PILE INSTALLATION PROGRAMME DEEP IN THE JUNGLE OF PAPUA NEW GUINEA.

Specialist marine construction and drilling services company LDD has secured a major contract with the Clough Curtain joint venture to install about 150 marine foundation steel piles for the PNG LNG upstream infrastructure project. This work supports Esso Highlands' (an ExxonMobil subsidiary) plans for a world-class operation to commercialise Papua New Guinea's undeveloped petroleum and gas resources in the Southern Highlands and Western provinces.

Along with fellow Acteon company CIS, LDD is providing a complete pile installation service. It developed the bespoke pile installation methodology and is operating all the drilling and piling equipment, which includes two pile-top, reverse circulation, large-diameter drilling rigs; a specially adapted Diamec® 262 geotechnical coring rig with a twin Cat mud mix and pump unit; two large-diameter under-reaming units; two hydraulic hammers with data loggers, handling and lifting equipment; and a vibratory hammer.

Some sixty 48-in. and ninety 18-in. steel foundation piles are being installed for two wharfs and three river crossings. The country's geography, which is mostly mountains with coastal lowlands and foothills, and its tropical climate, fast-flowing rivers and lack of infrastructure have placed special demands on the crews delivering the project. All had to undergo extensive medical checks.

The project's remote location presented some of the toughest challenges, though. For instance, because the sites are deep in the jungle, the client could not perform geotechnical investigations ahead of the project. Nevertheless, LDD adjusted its procedures and custom built a pile-top platform so that a rock coring drill could be mounted on top of the piles to proof-core the rock socket before piling.

From this geotechnical coring, LDD and its client can determine the best sequence and energy requirements for driving and drilling to safely install a pile to the required depth.

"This analysis is performed in real time and provides appreciable cost and schedule savings compared with the drilled and grouted installations originally planned," says Jason Clark, managing director, LDD. "Instead, we use our specialist drive-drill-drive (3D) installation technique. Material inside and ahead of the pile is drilled out, and an under-reamer removes more material below the toe of the pile. As well as facilitating on-the-fly geotechnical analysis, this enables standard piles to be driven into harder rock than would otherwise be possible."

The LDD-designed under-reaming bit offers infinite variation on drill bit diameter, which, coupled with up-to-date pile driving information from the CIS data loggers, enables the piling system to be further evaluated and refined.

Moreover, the 3D approach is up to three times quicker than the conventional drill-and-grout approach. This saves time and incurs fewer costs for materials such as grout and temporary casing.

Flexibility such as this is essential, according to Clark. "We are working out in the jungle where there is no infrastructure support whatsoever, so the ability to adapt procedures to the current conditions is key to a successful project."

“MATERIAL INSIDE AND AHEAD OF THE PILE IS DRILLED OUT, AND AN UNDER-REAMER REMOVES MORE MATERIAL BELOW THE TOE OF THE PILE.”

A low-angle, blue-tinted photograph of an oil pumpjack against a clear sky. The pumpjack's long, dark arm extends from the left towards the top right, ending in a large, curved counterweight. The structure is made of metal beams and ladders, creating a complex geometric pattern. The lighting is bright, suggesting a clear day.

**“THE JOB IS ABOUT BUILDING
RELATIONSHIPS, REACHING
WORKABLE AGREEMENTS AND
STREAMLINING THE PROCESS TO THE
BENEFIT OF EVERYONE CONCERNED.”**



MICHELLE PASINI
President, InterAct

BUILDING RELATIONSHIPS

IN A WORLD OF PROCESS, PROCEDURES AND REPORTING, INTERACT SHOWS HOW REACHING WORKABLE AGREEMENTS IS MORE IMPORTANT THAN A FORMULAIC APPROACH.

Recent events in the Gulf of Mexico have served to illustrate the challenges facing the oil industry in seeking to meet our long-term energy needs. The environmental damage caused by the blowout of BP's ill-fated Macondo well, and the resulting government and public reaction, can only increase the pressure on an industry that is already, and rightly, one of the most heavily regulated at local, national and international levels.

Even before this high-profile setback, dealing with the relevant agencies to gain official approval for a project or production operation could be extremely resource- and time-consuming. Further, the penalties for getting this key part of any oil and gas venture wrong can be severe: withheld permits, project delays, cost overruns and, ultimately, the possibility of having to abandon development or production plans altogether.

The environmental and regulatory services group within InterAct was set up to help operators get this part of their business right. Based in InterAct's office in Ventura, California, the group provides support to operators not only within the USA but also, increasingly since InterAct became part of Acteon in 2007, in other parts of the world.

Working with the authorities

To the outsider, what the group does may seem dry: an activity dominated by process, procedures and reporting. According to InterAct president Michelle Pasini, an environmental specialist with experience of working as a regulator herself, the work is anything but dry. "It is all about working with the authorities to cut through the bureaucracy that can exist in these situations. The job is about building relationships, reaching workable agreements and streamlining the process to the benefit of everyone concerned," she says.

Knowledge of the regulations pertaining to a specific location and type of project or operation is a prerequisite, of course, but it is not the hardest part of the job. Pasini stresses the ability to interpret the regulations sensibly (she talks about "sorting out the grey areas") and to understand the regulator's mindset, both of which are essential to gaining the trust of the individuals involved. She also emphasises having good negotiating skills, a sense of timing and, not least, a feel for how external stakeholders (environmental interest groups and the public most affected by a project) are likely to react.

"We are involved with process and regulation, but we have to avoid taking a formulaic approach," says Pasini. "Every project is unique: the context is different each time; there are different stakeholders involved; and there are different issues and concerns to understand. The stakeholder side of the work is particularly important onshore in urban areas, where we often have to dissect the issues raised by local residents and quell any opposition by helping to communicate the benefits of what the operator is proposing."

It is an advantage to Pasini's team, all experienced, full-time professionals supported by a network of specialist environmental and regulatory consultants, to be part of a company that also provides project management, drilling and production operations services. Pasini says, "To do this job effectively, we need to be able to see projects from the standpoint of the regulator, the various stakeholders and the client. The people directly around us at InterAct help us to understand the environment in which our clients operate and the challenges that they face."

Although the environmental and regulatory services group is based in California and works extensively in its home state, Pasini is keen to stress that the skills and experience gained locally are transferable to oil and gas projects around the world. "Regulations and processes differ slightly, depending on the location, but this is actually a minor point," she claims, before adding, "The fundamental nature of the tasks related to permitting and compliance are the same wherever you go. It is all down to understanding the project, the client's objectives, the position of the regulator and the concerns expressed by the stakeholders in order to frame a workable and cost-effective outcome that is acceptable to everyone involved."

Due diligence

Whether or not companies are in compliance with all the relevant industry regulations is a key issue when assets change hands. Equally, the past environmental performance of an asset is vital information for a prospective buyer. Checking on these issues, as part of a larger due diligence exercise commonly centred on the financial health of a company, is a growing part of InterAct's business.





There are also other questions to be considered, as Tom Kennedy, past president of InterAct, explains. "Checking environmental and regulatory performance often leads to the subject of decommissioning liability, which is also regulated. Some time ago, the US Financial Accounting Standards Board issued Statement 143, which relates to so-called asset retirement obligations. Under the rules, oil company operators are forced to manage and update their decommissioning liabilities."

With this regulation in mind, the potential buyer of a major production asset in the Gulf of Mexico recently asked InterAct to estimate the cost of decommissioning the facility. "The results of our study indicated that the owner had underestimated the liability by a margin that was significant in terms of the total cost of the deal," says Kennedy. "What was satisfying from our viewpoint was that, because of our reputation and relationships with the two parties, the discrepancy that we reported was accepted by both and did not become a contentious issue in the negotiations."

Environmental and regulatory knowledge plus good engineering and project management skills are a powerful combination in work of this kind. For example, engineering and project management skill came into play when a US-based operator seeking to acquire a field producing heavy crude oil asked Kennedy's team to look at the possible benefits of introducing downhole heating to enhance production. The positive outcome of the study led to InterAct being asked to design, build and install a suitable system, work that resulted in InterAct then operating the facility for an agreed period.

"Building relationships and trust is a factor in the success of a lot of our regulatory and due diligence work," says Kennedy. "We are working at the interface between the operator and the authorities, or sometimes between two different operators. Without the confidence of the various parties, we could not hope to add the value that clients expect from us in this vital area of their operations."

REGULATION, PERMITS AND COMPLIANCE

▶ Resumption of drilling

There were deep repercussions from an unplanned release of gas, which gave a strong odour kick, at an oilfield in a residential area of Southern California in 2006. All new drilling was suspended by the authorities and a major environmental review of the operations was instigated, one that very quickly drew in local residents and community pressure groups.

The review resulted in a series of recommendations and a set of demanding new regulations aimed at reducing inherent land-use conflicts in the area. InterAct worked closely with the field operator and the regulatory agencies to examine the feasibility of the recommendations and to advance an effective and workable way forward that was acceptable to all parties. The company also helped the operator to develop numerous compliance programmes ranging from noise, odour and total hydrocarbon monitoring to safety inspection and maintenance planning, and then took part in negotiations with the regulators to get the programmes approved. Additionally, InterAct developed and led training programmes for operations and contract personnel to help them to implement the new operating regime.

Drilling resumed at the field in June this year.

Air emissions

Following the purchase by one of InterAct's clients of several separate oil leases in Ventura County, California, the local authorities called for them all to be combined for the purpose of air permitting. InterAct helped with the new permit application by pulling together all the available process information on the facilities and wells, and calculating their total emissions.

Because of the relatively high level of emissions from the combined operation, the client had to apply for air permits to satisfy both local and federal requirements, a task handed over to InterAct. As part of the work, InterAct helped the client secure emission reduction credits for several engines that have been shut down. These credits are a valuable commodity that can be used during subsequent production expansion programmes or sold to other operating companies.

The same client is in the process of abandoning facilities inherited from a previous operator near Santa Barbara, California. Very little documentation existed for the facilities, so InterAct's role was to document all the equipment, estimate its potential emissions and to re-permit the facility while it was being abandoned. Crucially, this process enabled the operator to bank the emissions from the abandoned facilities.

Water injection

A renewed and rigorous enforcement of regulations by the California Department of Conservation Division of Oil, Gas and Geothermal Resources has caused substantial delays in oil and gas production for operators experiencing high water yields. Operators seeking approval for produced water injection schemes have to prove that the process will not affect adjacent wells, fresh water aquifers or surrounding formations. This involves presenting detailed wellbore diagrams for all the wells within 0.4 km of the proposed injector. Moreover, these diagrams have to cover the entire well history, which, in some cases, goes back to the 1930s. InterAct is currently working with operators affected by the regulations to document casing design and cement levels for over 2000 wells.

BY POPULAR REQUEST

AQUATIC UPGRADES ITS POWERED REEL-DRIVE CAPACITY TO 500 TE TO MEET CUSTOMER DEMANDS

As oil exploration moves into deeper waters, there is a requirement for equipment with ever-larger capacities. In response to this need, Aquatic has developed a new 500-te powered-reel drive system to support customers' projects. The 500-te reel drive system, the AQPR-02G-500, is based on existing 400-te drive units but has had substantial structural upgrades to handle the extra capacity.

David Tibbetts, vice president of engineering, Aquatic, says, "Our design team believed it was possible to increase the capacity of the 400-te drive units. We did some calculations on the capacity and proof of performance. These were verified by an external design house, which confirmed that it could be done."

However, there were several challenges for the engineering team to overcome. One of these was that the reel for the new system was 12.3 m in diameter. Tibbetts says, "Our previous reel capacity was 11.4 m. Even though the larger reel apparently represents only a 25% increase in the capacity of the system, the actual increase in loading was significantly greater.

"This is because the dynamic loadings generated offshore are multiplied by the distance from the point of action. The point of action on an 11.4-m reel is much smaller than it is on a 12.3-m reel. The further the lever is from the action point, the greater the force and the inertia and momentum generated. We needed to rework several of the functional aspects of the system, for example, by using stronger, more robust materials. We also made some subtle changes to the design and used several different processes to make it work."

The size of the central axles of the machine also had to be increased, so specialist steels were used to ensure the appropriate safety levels. "We needed a different material for the central axles, and considered a range of materials including tool steels, which can be hardened over a much larger section," says Tibbetts. "However, we discarded tool steels because they tend to be brittle, and we required the system to be particularly tough, bearing in mind the loading. Instead, we used a stainless steel that is hardened through precipitation. The metal is heated to a specific temperature at which the hardness increases chemically."

Technip was one of the first customers to use the new system. Chris Bonetti, lead engineer for Technip Norge AS, says, "We required a solution that went beyond the existing industry benchmark. Aquatic provided a comprehensive service that enabled us to install our flexible products in more challenging subsea environments. Aquatic has demonstrated that it can fully support its customers through the application of expertise to solve specific project needs."

Aquatic has also recently built a four-track 50-te tensioner to meet the deeper water and larger product requirements. The new tensioner, the AQT-10C-50, is based on Aquatic's fleet of four-track 40-te tensioners, and is already gone into service. Aquatic is confident that these two new pieces of equipment will extend its capabilities, particularly into deep water.



SHIPSHAPE IN THE GULF OF MEXICO

OVERCOMING THE CHALLENGES OF INSTALLING THE DISCONNECTABLE TRANSFER SYSTEM (DTS) OF THE *HELIX PRODUCER 1* IN PHOENIX FIELD

The *Helix Producer 1* is currently among a fleet of vessels being used by BP to help deal with the aftermath of the blowout of its Macondo well in the Gulf of Mexico.

Before its unexpected call up by BP, the *Helix Producer 1* had been about to begin producing oil from the Phoenix field, where it had replaced Chevron's Typhoon mini-tension-leg platform, which had overturned during Hurricane Rita in 2005. As reported here, the installation in the Phoenix field of the vessel's DTS posed some interesting challenges.

The arrival of the *Helix Producer 1* would probably not have caused much of a stir in many of the oil-producing regions of the world. But it certainly did in the Gulf of Mexico, simply because it is the first ship-shaped floating production unit to enter service there.

Another notable feature of the *Helix Producer 1* is that it is designed to operate without moorings: it is dynamically positioned. This enables the vessel and its crew to quickly escape from the path of any serious hurricane that passes through the Gulf, especially one directly threatening the field over which the vessel is eventually due to sit: the Phoenix field in Green Canyon Block 237.

Hydrocarbons are produced from Phoenix via a DTS, the most obvious component of which is a riser buoy held in a cage-like structure roughly midway down the *Helix Producer 1's* port side. As there will be periods when the buoy is not connected to the ship, it needs its own mooring system to prevent movement causing damage to the risers.

Engineering and installing the mooring system, and installing the DTS buoy itself, have constituted a significant project for InterMoor over the past couple of years, as staff engineer Dusty Mathus explains. "The DTS buoy, which weighs around 300 t, has a six-point chain-and-wire mooring system that was designed to be preset. In addition, there is a 68-t clump weight in the form of a spreader bar with chains attached to it suspended beneath the structure on a wire tether nearly 600 m long. The approximate water depth at the DTS's centre is 650 m.

"The magnitude of the clump weight and the length of the tether were calculated so that, when disconnected from the vessel, the DTS buoy would be drawn down to a depth of just over 50 m, so avoiding the worst of any wave forces generated by a passing hurricane. The buoyancy calculations assumed the buoy would also support the weight of its mooring system, four risers and two umbilicals. In the event, a relatively minor change to the field development schedule, certainly minor when



The *Helix Producer 1* was to have produced oil from the Phoenix field but it was called into action by BP.

compared with the vessel's move to Macondo, meant that there was a period when this assumption was invalid and things became more complicated than we had expected."

InterMoor's original workscope revolved around the installation of the preset mooring system and its subsequent hook-up to the DTS buoy. This was when the plan was to bring the *Helix Producer 1* and the buoy in at the same time, the latter already occupying its position in the port-side cage. However, InterMoor's scope expanded significantly when it was decided, based on the unexpected availability of specialist support vessels, to install the DTS buoy ahead of the *Helix Producer 1's* arrival, an undertaking described as wet-parking the buoy.

"Wet-parking the DTS buoy provided a series of interesting challenges," says Mathus. "Although we did not anticipate too many problems installing the buoy together with its clump weight, it was clear that without the moorings and risers we had insufficient ballast to set it down at its safe depth. Working with Helix Energy Solutions' engineers, we came up with the idea of a temporary ballast system in the form of four chains weighing a total of 110 t that could be attached directly to the underside of the structure."

Mathus worked out the details for wet-parking the buoy with its temporary ballast system. These involved using the Q4000 semisubmersible to lift the buoy into the sea and an anchor-handling vessel, the *Kevin Gras*, to handle the clump weight and temporary ballast system.



InterMoor work scope summary

1. Development of procedures for the installation of the DTS buoy. The design of the preset mooring system for the buoy was also carried out by InterMoor's Dusty Mathus, but at a previous company
2. Supervision and supply of the deck crew for the preset mooring installation
3. Concept selection, development of procedures and supervision of the wet-parking of the DTS buoy
4. Development of procedures for hooking up the DTS buoy's moorings
5. Supervision of the mooring hook-up and ballast management throughout the riser pull-in and the mooring hook-up operations.

Mathus is proud to report that the novel operation was performed without incident in just two days. This was during November 2009. The moorings were preset at about the same time. In January 2010, the four risers were laid down on the sea floor. During March and April, the risers and two umbilicals were pulled into the DTS buoy and then the moorings were hooked up, with ballast being progressively removed throughout the two processes. Finally, in late April, the *Helix Producer 1* took up position in the field and claimed its entry in the industry's history books as the first ship-shaped production unit to enter service in the Gulf of Mexico.

Events since then have rather overshadowed the Phoenix story. However, the DTS buoy remains moored at Phoenix awaiting the vessel's return. (A second temporary DTS was quickly fabricated for use on the Macondo well; InterMoor was also involved in this mooring exercise.) At the time of writing, a date for the return of the *Helix Producer 1* to the Phoenix field has not been set.



This shot makes the process of getting the 300-t DTS buoy into the sea look easy. In fact, the rigging necessary to get the structure overboard and the process of attaching the various permanent and temporary weights to it were far from straightforward. Wreckage from the loss of the Typhoon mini-tension-leg platform still litters the seabed. This, together with the presence of substantial underwater production infrastructure, complicated the task of mooring the DTS buoy.



KEY CONTRIBUTIONS

CLAXTON HELPS ENSURE FIRST OIL FROM TOMBUA—LANDANA AT THE EARLIEST OPPORTUNITY

The first of two Claxton contributions to the giant Tombua—Landana project is not that easy to spot, even though it is fundamental to this world-class project. Production facilities weighing 36,500 t are supported on a compliant tower weighing 56,400 t. This stands on a tower-base template of 3,000 t, which, in turn, rests on a levelling-pile template. Under this, right on the seabed, there is a 12-slot predrilled template providing nine well and three docking slots designed, supplied and installed by Claxton.

Weighing just 30 t, the small but perfectly formed template provided the pattern for the first wells drilled before the giant platform was installed. It also determines the location of the platform and all 38 wells that will eventually be needed to complete the development.

Claxton won the job of providing the template for the development's operator, Cabinda Gulf Oil Company Ltd (CABGOC), on the back of lessons learned during the installation of a similar template for the Benguela—Belize platform. Then, the company was called in late in the day to help install the template, which had been provided by another supplier. "We got the chance to demonstrate our expertise in this area on Benguela—Belize and, consequently, were awarded the contract to supply and install the predrilling template on this project," explains Rowan Patterson, Claxton's business development director.

The template was installed in two stages. It was initially lowered onto the seabed from an anchor-handling vessel. The Pride Venezuela semisubmersible drilling rig then picked up the template on drillpipe fitted with a Claxton-supplied, overshot, double-J running tool and carefully located it over a single well already drilled in the seabed. It was then correctly oriented, landed and locked onto the well's 30-in. wellhead housing. A further slot was then drilled through the template and a second 30-in. conductor installed, at which point the orientation of the template was effectively fixed.

In all, four wells were predrilled through the Claxton template (of nine possible), each furnished with a 30-in., low-pressure subsea wellhead and an 18 3/4-in., high-pressure wellhead on 20-in. casing. A docking

pile was also installed through an outer, purpose-designed slot on the template before drilling was suspended and the rig was moved away.

This also marked a pause in Claxton's involvement, during which time some serious construction work was undertaken. A levelling-pile template was fitted over the well template, followed by four levelling piles, their correct alignment being ensured using two guide pin slots in the Claxton template. The main tower-base template was then added and 12 foundation piles were installed; thereafter, there was just the issue of adding the tower itself and then the topsides.

Claxton then returned to carry out another pivotal task in the development: tying back two of the first four wells to the platform. [CABGOC decided to delay tying back the other two wells in favour of drilling further platform wells.] Claxton prepared all the procedures for a process that began with removing the corrosion caps from the 18 3/4-in., high-pressure wellheads and landing 26-in. conductors on both wells to provide conduits back to the platform's well deck. "The challenge was to ensure the correct space-out of the 14 conductor centralisers spread along the nearly 40 conductor pipe joints," says Patterson. "Accurate measurement and careful calculations ensured that, with the conductors locked onto their subsea wellheads, all the centralisers engaged perfectly in the guides situated between the bottom of the tower and the platform."

For each well, following the installation of the conductor, 13 3/8-in. and 10 3/4-in. casings were landed and locked into the subsea wellhead. A high-pressure wellhead was fitted to the former at the platform well deck ready to accommodate the production tree.

"There is great satisfaction from being involved in complex projects like this one," says Patterson, "when everyone is required to play their part to the very best of their ability to ensure the overall success of the venture." In this case, Claxton's contributions were essential to the timely completion of the project, both firmly on the critical path to first oil from Tombua—Landana.

Claxton designed the Tombua—Landana predrilling well template at its offices in Great Yarmouth, UK. The structure was part-fabricated at fellow Acteon company Interroom's facility in Amelia, Louisiana, USA, and shipped to Angola for final assembly.

The Tombua and Landana oilfields lie in Angola's Block 14 in roughly 365 m of water. They are being developed by the Chevron subsidiary CABGOC. The fields' combined production facilities are an integrated topsides structure supported by a 474-m-tall compliant tower. The platform is very similar in concept to the neighbouring Benguela—Belize platform.

STARTING AT THE END

FIELD DECOMMISSIONING LIABILITY ESTABLISHED AT THE EARLIEST STAGE

InterAct and its Nigerian partner, PetroFlow Integrated Consultants, have completed a study of the issues surrounding the decommissioning of the Ebok oilfield, which is in 40m of water in Block OML 67 approximately 50km off the Nigerian coast. The study aimed to provide an initial estimate of the cost of this important end-of-life exercise.

The Ebok field partners, Afren and Oriental Energy Resources, commissioned the study unusually early in the field's development. At the time, the project was only just moving into the construction phase.

There were several advantages to conducting a decommissioning study at this point. The results have begun to establish the field partners' future financial liability for decommissioning the field. Further, some thought has been given to how the cost of the exercise could ultimately be minimised. Aside from these aspects, legislation is coming into force in Nigeria that will make early decommissioning studies imperative.

The Petroleum Industry Bill is making its way through the Nigerian parliament, and one of its sections calls for agreement between the authorities and field licence holders "at the commencement of production" on the measures to be taken at the end of a field's life. Significantly, it also requires licence holders to "set up and manage a fund for the decommissioning, abandonment and disposal" of fields and their facilities.

The InterAct–PetroFlow study looked at decommissioning and removing the infrastructure, much of which still has to be installed; however, the detailed Ebok field development plan gave the study team a good indication of what will ultimately be involved.

The plan is for a wellhead platform with a mobile offshore production unit (MOPU) alongside that links to a floating storage and offloading (FSO) vessel. Phase II of the development will add another wellhead platform. The understanding at this stage was that the two wellhead platforms will eventually support 15 wells.

The study used the premise that decommissioning will be a single continuous campaign. The team also assumed the complete removal of all structures and debris, and the retrieval or burial of all infield pipelines to leave a clear seabed.

Before selecting a preferred option for more detailed analysis, the team considered various ways of performing the work. They examined questions surrounding permitting, approvals, planning, project management and mobilisation, and outlined procedures for the entire decommissioning and abandonment of the field. Following this, the team put together as accurate an estimate as possible of the cost, at today's rates, of the overall exercise.

The study has provided the field partners with financial information that will be an important factor in the overall economics of the field. It has also placed them in a strong position as the authorities push decommissioning liability higher up the industry agenda.

Main activities covered by the study

1. Plugging and abandoning all the wells
2. Removing the wellhead platforms and dismantling and disposing of them onshore
3. Decommissioning the processing equipment aboard the MOPU, disconnecting all the transfer lines and umbilicals, and lowering the MOPU and towing it to a suitable port
4. Decommissioning the processing equipment aboard the FSO, disconnecting all the transfer lines and umbilicals, lifting and recovering the 12 mooring lines, and towing the FSO to a suitable port
5. Decommissioning all infield pipelines and burying or recovering them
6. Clearing the seabed, undertaking a final site survey and supplying the project report



UNDERWATER CONDUCTOR PINNING SOLUTION

A NEW DRILLING AND PINNING TECHNOLOGY OFFERS REAL ADVANTAGES FOR RECOVERING CONDUCTORS WITH INTEGRITY OR CORROSION ISSUES.

Concerns about the integrity of a redundant well conductor threatened a project for recovering a drilling slot beneath a platform in the North Sea. The question was could the conductor (its safe removal being the first step in the slot recovery process) once severed just above the seabed, support its own weight while being lifted out of the water. There had to be no possibility that the conductor, which measured over 90 m from just above the seabed to the platform's well deck, would fall to the seafloor during its removal from the platform slot.

Claxton quelled the uncertainty with a proposal to drill and pin the conductor and the various casing strings just above the severance point. This is normal practice at the top of the conductor and provides safe lifting of the conductor and the casings together. By drilling and pinning them at the bottom, the internal casings effectively bear the weight of the conductor.

The solution found favour with the platform's operator, which gave its full support to the development by Claxton and fellow Acteon company Mirage Machines of what is thought to be the world's first remotely operated, underwater drilling and pinning machine (patents apply).

In a normal drilling and pinning operation, the conductor and casings are first drilled, then the bit is withdrawn and a separate pin is inserted through the series of holes in the pipe walls. This is relatively straightforward. The development team quickly realised that withdrawing the bit and then inserting the pin would be difficult underwater and by remote control. They decided to design a drill bit that would double as the pin – an elegant idea to minimise subsea manipulation.

The combined drill bit and pin uses 4-in. diameter, high-tensile-strength steel designed to withstand 100 t of force. The cutting angle on the face of the bit is lower than normal, as, when acting as the pin, its ends need to be as flush as possible to the outside wall of the conductor.

Another question was how the bit could be easily detached from the machine's drill carriage once it had penetrated the tubulars. This uses a motorised, threaded draw bar that passes through the body of the carriage and screws into the back of the bit. Activating the motor retracts the drilling carriage to leave the bit in place. Screwing the carriage back from the bit also causes sprung gripper pins set in the side of the bit to emerge from behind the conductor wall and lock the bit in place.



The new underwater drilling and pinning machine offers the ability to secure conductors against connector failure when retrieving them. It is very similar to its surface counterpart: Claxton and Mirage marinised the surface design and added the means to control its operation remotely.

Jay Miller, the Claxton project engineer for the work, says, "We thoroughly tested the new machine in the yard before we took it offshore. Nevertheless, as with the first field use of any new technique, the operation came in for close scrutiny. In fact, the machine worked beautifully; the drilling and pinning operation, undertaken with the support of a remotely operated vehicle, took a little over eight hours and was without incident. Thereafter, removing the conductor and its casings was routine, as there was no chance the conductor would fail and drop to the seafloor.

Miller expects an underwater drilling and pinning capability to be of interest to many operators involved in well decommissioning or slot recovery when questions exist over the integrity of aged conductors. "What is, on the face of it, a simple technology advance offers significant benefits for the operators of mature fields," he concludes.

MANAGING INTEGRITY PROPERLY

TO EXTEND THE LIFE OF A SUBSEA PRODUCTION SYSTEM, 2H ENGINEERING SPECIALIST HIMANSHU MAHESHWARI ARGUES THE INSPECTION MUST BE DONE ALONG WITH CONDITION MONITORING.

All but the simplest subsea oil and gas production systems are likely to require maintenance at some point during their lives. For that maintenance to be most effective, it needs underpinning by a carefully formulated integrity management system.

Inspection will doubtless form a key element of the management system. If undertaken by well-trained, experienced personnel, inspections using remotely operated vehicles can provide valuable information about the structural health of subsea equipment. Wear, vibration damage, structural deformation, impact damage, leaks, external corrosion and the general condition of valves and other key items will all be revealed – always assuming good visibility and access around the structure, and no excessive marine growth.

Unfortunately, inspections of this kind will tell you very little about the internal health of a system. Faults in electrical systems due to water ingress, poor communications integrity, blockages or small leaks in hydraulic and chemical injection systems, and critical control valve failings will be missed. Moreover, inspection provides only a snapshot in time of the state of a system: you are essentially in the dark until the next inspection takes place.

To manage integrity properly and extend the life of a subsea production system, inspection needs to be closely coupled with condition monitoring. At least, this is the opinion of Himanshu Maheshwari, an engineering specialist with 2H Offshore.

“Subsea condition monitoring can be extremely powerful,” says Maheshwari. “This has recently been demonstrated by applications involving riser pipes of various kinds and flowlines. As yet, however, the concept has not been widely applied to subsea production equipment. There is a great opportunity here; it just needs people to be convinced of the value of the approach.”

Subsea field operators already record much of the data that can be used for condition monitoring in the normal course of their activities. It is fundamental to most production operation decisions. Temperatures, pressures and flow rates are obvious examples. Sand erosion probes, corrosion coupons and fluid sampling systems are commonplace. The recording of environmental data, such as currents, wave forces and wind conditions, is also normal, along with monitoring the motion of surface vessels, which can be important for assessing their structural impact on the subsea equipment to which they are connected.

In contrast, system-specific response monitoring, the capture of motion, strain or curvature at or near fatigue-critical locations, is less common. Monitoring of this kind has proved extremely valuable for riser pipes and could also provide useful insights into the health of some seabed equipment.

Maheshwari claims that the key to successful condition monitoring is how you handle the available data, which often involves developing suitable algorithms to provide the required insights. He points out that operators use flow pressures up- and downstream of adjustable tree-mounted flow chokes to estimate the rate of production from a well. “That same data combined with a choke position sensor reading can indicate the condition of the choke trim and provide notice of the need for a choke insert replacement,” he says.

As another example, monitoring of subsea communication efficiency can provide early warning of potential problems. Maheshwari explains: “Most subsea production control systems are programmed to monitor successful communications between the surface and subsea, and are set to indicate when the error level reaches a preset figure. This monitoring method shows a communications anomaly, but only once it has occurred.

“Further, to avoid nuisance trips, the alarm level is normally set so the system flags only when the integrity of communications is severely compromised. As an improvement it is possible, with the right algorithm, to accurately track the same communication error information, compare this with historical trends and determine if an increasing error level could be a leading indicator of incipient communication channel failure. An early warning of this type of anomaly allows time to prepare cost-effective mitigation measures before losing all communication with the subsea equipment and thereby forcing a production shut-in.”

Early warnings of all kinds of problems can also be obtained by a judicious choice of key performance indicators, defined alert levels assigned to selected parameters. The value of using key performance indicators is that they enable intervention to sort out system anomalies before unplanned shutdowns are necessary or there is the possibility of personal injury or damage to the facility or the environment.

“THE INSPECTION, REPAIR AND MAINTENANCE OF SUBSEA SYSTEMS BY THE OFFSHORE INDUSTRY HAVE ADVANCED CONSIDERABLY IN RECENT YEARS, THOUGH WE BELIEVE A STEP CHANGE IS STILL POSSIBLE.”

Maheshwari is adamant that there is immense potential for operators to improve the integrity management of their subsea production systems. The breakthrough will come, he believes, when equipment designers embrace the idea and begin to build in to equipment the means to gather specific data more suited to the intended purpose. “Over the past 20 years, the concept of designing equipment with ease of manufacture in mind has become normal. System designers, however, also need to become more aware of condition monitoring needs and respond to these when there is the opportunity, before systems are built and installed.”

To illustrate this, Maheshwari describes how a mass-balance calculation of the amount of hydraulic fluid consumed by a system during operation can indicate the hydraulic system’s condition. Additional tests can be done using valve signature information, recharge time, flow rates and reservoir levels to refine the health check and to identify specific anomalies within the hydraulic supply and distribution system of typical subsea production systems.

However, a few additional basic subsea measurements would enable more precise fault detection and source identification than is possible with most systems today. For example, more-accurate hydraulic flow rate measurements from the hydraulic power unit would improve the fluid consumption algorithms used to detect leakage. Additional pressure sensors combined with strategic isolation valves in the subsea hydraulic distribution termination assemblies would permit isolation of hydraulic anomalies associated with blockages or fluid leaks in complex subsea system architectures.

“The inspection, repair and maintenance of subsea systems by the offshore industry have advanced considerably in recent years,” says Maheshwari, “though we believe a step change is still possible. There is much we can learn about the true condition of critical subsea equipment by astute observation of data from the heart of these systems. Combining this approach with thorough inspection can provide a revelatory insight into the health of a subsea system and a means to ensuring a trouble-free production life.”





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