

ACTEON

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**SEATRONICS' TREASURE
HUNT IN US WATERS
STRIKES GOLD**

**INTERMOOR'S
PERFORMANCE PLEASES
COOEC IN ASIA PACIFIC**

**UNLOCKING NEW SUBSEA
SERVICES OPPORTUNITIES**

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Challenging assumptions and daring to do things differently”

The oil and gas sector has experienced a significant downturn over the past 12 months. The sustained low in oil prices has led many operators to seek improved cost and value in their project work scopes. At a time when the market is focusing on increased value and efficiency, Acteon companies are responding by seeking to use innovation and collaboration between their extensive skill sets. With a broader knowledge base incorporating design, manufacture, installation and operations aspects, we aim to achieve additional value to meet our clients’ expectations.

The benchmark tripod platform design we developed for Dubai Petroleum [page 6] shows that it is possible to innovate and to overcome technical challenges while delivering a solution that is both cost-effective and flexible enough to meet changing client needs.

The article on page 8 illustrates how Acteon companies work with clients to understand their project requirements and thus deliver solutions that add the greatest value. The splash-zone centralisers that Claxton developed for Total E&P Norge have a simple, proven design and a substantially lower cost than the solution defined in the original brief.

Creative thinking and the application of available assets are crucial parts of Acteon’s solution-based approach. The article on page 14 shows how InterMoor adapted a traditional anchor-handling vessel to enable the installation of a large, permanent mooring system for LLOG Exploration, which helped to deliver significant value to the company.

By working with clients in an open, collaborative way, we are playing an important role in correcting the cost base of our industry through influencing the standardisation of equipment, methodologies and processes. Our focus has always been on adding value and we believe that Acteon does that by challenging assumptions and daring to do things differently.



UNLOCKING NEW OPPORTUNITIES THROUGH THE CYCLE

PAUL ALCOCK, EXECUTIVE VICE PRESIDENT, ACTEON, SPOKE TO S2S ABOUT CHALLENGES AND OPPORTUNITIES FOR THE SUBSEA SERVICES SECTOR IN THE CURRENT ECONOMIC CLIMATE

As the offshore sector again endures the downside of a traditionally cyclic industry, there are several differentiated and structural changes at play that may go unnoticed within the daily operational challenges of business. For most of the past 20 years and through three previous cycles, subsea and deepwater activities were viewed as the next logical steps to delivering greater and more efficient production. The dramatic rise of unconventional onshore production accompanied by a ruthless efficiency drive that has seen incremental unconventional production costs fall below offshore costs is now challenging that premise. The offshore industry now has a virulent competitor and appears to be failing in various key aspects.

Through a combination of technical challenges and inherent inefficient processes, the industry now has a model of subsea development delivery that at best is suboptimal, particularly in mature basins, and at worst fails to deliver any value in the current market. The standard reaction of operators to this market is to look at cutting costs within the supply chain. This has materialised as demands for rate and material cost reductions of 15% and more. This still falls noticeably short of the widely acknowledged 30–50% cost reduction that most operators regard as necessary for the subsea industry to be competitive and to regain its position as the engine of offshore production growth.

The challenge to deliver such a paradigm shift in costs and increased value within the supply chain does offer opportunities, and Acteon, among others, continues to push to provide these at a pace that repositions the sector to move forward. Of particular note are the efforts in

- **increased collaboration**
- **a focus on solution-based services**

- **greater standardisation**
- **improved asset utilisation**
- **more efficient and effective personnel skills management.**

INCREASED COLLABORATION

The past few months have seen the announcement of a growing number of collaborative ventures across the subsea sector from loose alliances to full joint ventures covering a range of different propositions: front-end-engineering design and construction; subsea equipment and installation; engineering and equipment, etc. On the surface, these collaborations offer shared value for the partners but underneath they offer greater potential value for working with operators to unlock value that cuts across traditional activities and silos.

The opportunity to bring different perspectives to bear and to challenge traditional processes can and does deliver the value increase clients demand. The truism of working with clients with alignment of purpose and clarity of objectives is the real value of the trend for increased collaboration. As operators more-widely recognise the value collaboration delivers, there are likely to be larger and different groupings. In targeting BG for acquisition, for example, Shell noted some of its differentiated practices when working with collaborative ventures and the considerable value this could unlock if applied on a larger scale.

At Acteon, we have an active culture of collaboration within our own operating companies that aligns with clients' demands for added value. One example of this is the floating production, storage and offloading facility relocation project described in this issue (page 16). Active collaboration in different combinations also enables us to approach things differently and to challenge convention to deliver results.

FOCUS ON SOLUTION-BASED SERVICES

Acteon is not alone in advocating the value of solution-based services and our operating companies offer a solid track record in delivering such projects. What is different about our perspective, and that is becoming more widely accepted across the industry and highlighted as delivering true added value, is a practical and cautious approach that underpins a real service mentality.

Most “solutions” draw on a limited pool of internal assets and resources; we routinely utilise competitors’ technology and clients’ existing committed assets, such as chartered vessels or existing equipment, within a genuine solution-based approach. By applying our deep-domain knowledge and selected specialist equipment, we can work back from the optimal solution, understand the technical challenges and define the way forward that adds most value. By focusing on the optimum output and applying a service mentality and a cautious approach that cut across traditional boundaries, a true solution-based service can deliver considerable client value.

GREATER STANDARDISATION

The subsea industry has long discussed the value of greater standardisation. Various assessments by operators, consultants and academia have attributed considerable cost increases and lost value to tailored or one-off projects and equipment. This issue is traditionally seen as an operator and equipment supplier issue in which the services sector is left trying to adapt after the fact. Beyond the fact that Acteon supports all efforts to increase standardisation in major subsea equipment, there is a wide range of areas, such as equipment interfaces, subsea communications and remotely operated vehicle tooling, where minor consideration of standardisation can deliver real service benefits. Where standardisation can deliver further enhanced value is within the context of asset utilisation.

IMPROVED ASSET UTILISATION

As Acteon is one of the subsea industry’s leading providers of rental equipment, it is inherent to our operations to build and invest in equipment for long-term recurrent use. Within this process, we strive to maximise efficiency by standardisation. We can and do go further than the obvious provision of equipment by also working closely with clients to note the indirect value that is achievable through a more standard approach. For example, minor layout or design changes could facilitate the use of a smaller variety of equipment and thus lead to reduced mobilisation and demobilisation or deployment requirements and, potentially, even to lower-cost vessels to deliver cost reductions.

One area of growth for further potential is the collaborative use of a client’s own equipment, up to and including us managing the inventory on their behalf. The direct benefits of this include improved utilisation, increased efficiency and a shared alignment towards reducing costs and maximising value. Indirectly, this can enable clients to have a renewed focus on core activities knowing that they have a large and capable strategic partner. This model is already delivering value across areas as diverse as remotely operated vehicle tooling, installation reels and subsea hammers.

PERSONNEL SKILLS MANAGEMENT

Alongside increased standardisation and asset utilisation, Acteon is striving to offer further value to clients through an active programme of personnel skill development. This goes beyond increasing the level of skills of our offshore technicians and looks proactively at opportunities to cross-train and package skill sets within teams to reduce the overall number of offshore personnel, thus improving safety and reducing accommodation requirements. This directly cuts costs and increases value. It also indirectly reduces expenditure by enabling the use of smaller fit-for purpose vessels to undertake the necessary work. We have successfully delivered multi-skilled personnel across a variety of activities covering reels, hammers, seabed drilling and grouting, among others, and continue to push to deliver more value to clients.

UNLOCKING FUTURE VALUE

Over recent years, Acteon has seen notable growth in subsea life-of-field services (LoFS) supporting operational fields. In line with the changes already noted, the LoFS market is undergoing considerable changes in its efforts to be more flexible and responsive in its service delivery. Following a similar trend experienced over a decade ago within drilling service companies, the LoFS segment is moving from the disparate provision of select specialist services towards an integrated model with fewer interfaces and alignment with the production objectives of the operator. In effect, this means larger organisations and groupings (including joint ventures and alliances) offering substantial and more diverse packages of services to accommodate the complexity and technical demands of ageing assets.

The current subsea sector still has many smaller specialist companies, so the greater focus on operational assets married with the challenges of LoFS is likely to lead to further consolidation as a precursor to delivering increased value and reduced costs.

The long-term business model for Acteon combines organic growth and acquisitions that focus on service consolidation and an appropriate regional footprint. By moving beyond discrete services, we intend to unlock greater value through collaboration, a focus on asset utilisation, increased standardisation and a sustainable approach to cost reduction.



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PUSHING THE TECHNOLOGY ENVELOPE

A BENCHMARK TRIPOD PLATFORM DESIGN FROM 2H OFFSHORE

A project that started out as a feasibility study for a freestanding exploration well is now a fully installed structure with the deepest well drilled to date in Dubai and a benchmark project for 2H Offshore.

Dubai Petroleum Establishment had planned to drill a single exploration well in Fateh oilfield, offshore Dubai, and was keen to explore methods of preserving it for future re-entry, stimulation and long-term production testing. “They knew that drilling would require a large investment and were reluctant to abandon the well only to return and drill another well in the future,” says Graham Nicholson, engineering team leader, 2H Offshore.

Dubai Petroleum required a platform solution for a high-pressure, high-temperature exploration well in 50 m of water suitable for installation using a jackup drilling rig. Under a long-standing master services agreement with Dubai Petroleum, which covers a range of technical studies, 2H Offshore was tasked with investigating a range of cost-effective solutions. After the initial assessment, the company developed the preferred option through feasibility and front-end engineering and design studies before delivering a detailed design package, which included fabrication drawings and outline installation procedures.

The solution involved installing two additional conductors adjacent to the well conductor and providing a brace structure between them to create a tripod arrangement. This concept was developed in collaboration with Dubai Petroleum’s engineering team to define the most feasible solution for fabrication and installation while maintaining the technical brief to achieve the required two-and-half-year lifespan for the conductor system. “There was a lot of discussion from the outset, with different disciplines being pulled together to ensure that we reached a solution that met all Dubai Petroleum’s requirements,” says Anthony Falsetta, project engineer, 2H Offshore.

The final design was a lightweight conductor-supported platform known as T-02 that consists of three 42-in. conductors spaced 8 m apart in an equilateral triangle. A 7-m tall, 58-t subsea template, which sits on the seabed, provides structural support for the conductors. These are also braced at the surface by a 5-m tall, 20-t structure. An additional works access platform was designed to sit on top of the bracing structure. 2H Offshore checked all the structural interfaces to ensure compatibility.

“The main benefits of this design for Dubai Petroleum are that it can be installed by the drilling rig before drilling operations and the versatility it provides for future operations. Having the conductors

braced together at the top enables the addition of a work platform to provide easy personnel access and flexibility for offshore work,” says Nicholson.

“It is well-understood technology using straightforward structural fabrication to tie the conductors together with clamps and braces,” he continues. “If you compare that with some of the other options we considered, the conductor-supported platform has fewer unknowns, so the installation and performance can be planned with greater certainty.”

Using free-spanning conductors and lightweight structures did come with challenges. “This platform was the first project we looked at with a lightweight tripod arrangement that was designed specifically for supporting a single well conductor. Freestanding conductors are reasonably well understood in shallower waters of 20–30 m, but we were pushing the technology with the 50-m water depth. The highly dynamic nature of the system presented some challenges,” explains Falsetta. “We were able to work with Dubai Petroleum and its team to resolve those issues and to look at ways to constrain the conductor’s motion while they were drilling.”

Detailed design work for the project started in late January 2013 and the platform was fully installed by September 2013. The high-pressure, high-temperature well was drilled shortly after to 5562 m and is the deepest well drilled in Dubai to date. Acteon Group sister-company Claxton secured a hardware supply contract for the project to provide the running and installation tool for the template.

Since completion of the initial project, 2H Offshore has continued to work with Dubai Petroleum on several projects, including one to extend the life of the T-02 platform by up to 20 years by the addition of a mid-water brace.

“Our effective collaboration and innovative approach enabled us to develop a bespoke design to overcome the technical challenges associated with this project while delivering a cost-effective and flexible solution to Dubai Petroleum. It has become a benchmark project for several other studies involving the preservation of a freestanding well with a view to additional drilling or production operations, particularly as it is suited to installation from a drilling rig. It should also provide a good reference point for Dubai Petroleum on any future tripod platforms,” concludes Nicholson.

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BESPOKE SERVICE SAVES TOTAL 70% ON ITS CENTRALISER COSTS

UNDERSTANDING THE PROJECT ENABLES **CLAXTON** TO OFFER A SIMPLIFIED DESIGN FOR SPLASH-ZONE CENTRALISERS UNDER A NORTH SEA CONTRACT

Claxton's personal approach to project delivery has seen it provide Total E&P Norge AS with savings of up to 70% for centralisers at the splash-zone level. This contract has also helped to propel the company to the position of de-facto number-one supplier of centralisers in the North Sea: more than 5000 of its units are now installed.

Claxton officially kicked off the first phase of this major contract with Total, which covers the supply of conductor and internal centralisers, deck covers, drill bushings, support frames and associated services for the Martin Linge development on the Norwegian Continental Shelf, in June 2014. However, work to establish the best centraliser option for the project started well before that.

"We met with Total to define best practices for the centralisers," says Ann Vicens, structures product leader, Claxton. "Often, clients just think about centralisers at the end of the project and do not consider how they interface with other equipment. They are vital for conductor integrity, so it is important to get the design right during the early stages."

Originally, Total believed it would need a complicated design for the splash-zone centralisers owing to concerns over loads being transferred to the guides after drilling and the expected tight tolerance between the conductor, the centraliser and the guide. To meet these challenges, it originally seemed likely that an adjustable, retractable design would be required. In addition, centralisers at the splash-zone level tend to have the more-demanding specifications, as they are subjected to higher environmental loads and they are more vulnerable to corrosion because of the presence of oxygen and water.

Claxton developed two new concepts to fulfil the initial request, but also carried out some reviews of the available riser analysis reports to ensure that high-specification technology was necessary for the project. "By working together and really understanding what Total needed, we were able to simplify its requirements from a complex, new design to a design that we have used a lot in the North Sea. So, Total got tried-and-tested, more-efficient technology."



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The splash-zone centraliser that Total and Claxton agreed on is, apart from having a simpler, proven design, also 50–70% cheaper than those designed to meet the original, more-complicated brief.

Claxton was also asked to look at the problem of centralisation during spudding and to see if a design for a retrievable drill bushing compatible with the jacket conductor slots was feasible.

Claxton's previous drill bushing experience was with those that only interface with predrilling templates. The Martin Linge project presented a new challenge in that the drillstring with the drill bushing would need to go through all the upper guides and then centralise on the lower subsea guide, which meant that a retractable design was required.

Claxton worked closely with Total throughout the design of the prototype drill bushing to ensure it would fulfil the offshore requirements. Further work to hone the device will continue during Phase 2 of the Martin Linge project.

“This is another example of how an original idea develops when you work with a client and consider their needs and opinions,” says Vicens.

CENTRALISER MILESTONE

This project- and client-specific approach has been key to the Martin Linge contract, but it has also helped Claxton reach the milestone of installing more than 5000 centralisers worldwide since 1998.

“During more recent years, we have been quite successful at getting the big jobs. I think this is down to working closely with our clients and getting a better understanding of what they need. We also try to engage with them at the right time. Instead of just waiting for the requirements to come through to us, we try to understand the specific details of each project at an early stage and to ensure that clients understand the importance of getting the centraliser design right at the start.”

The need for unique designs stems from the different requirements around the world. Some existing clients may simply want “more of the same”, whereas others are looking to focus on meeting specific challenges arising from a particular development.

“That is why we create bespoke centralisers for every client. We design each one for a specific platform to maximise the protection it offers to the well conductor,” Vicens concludes.

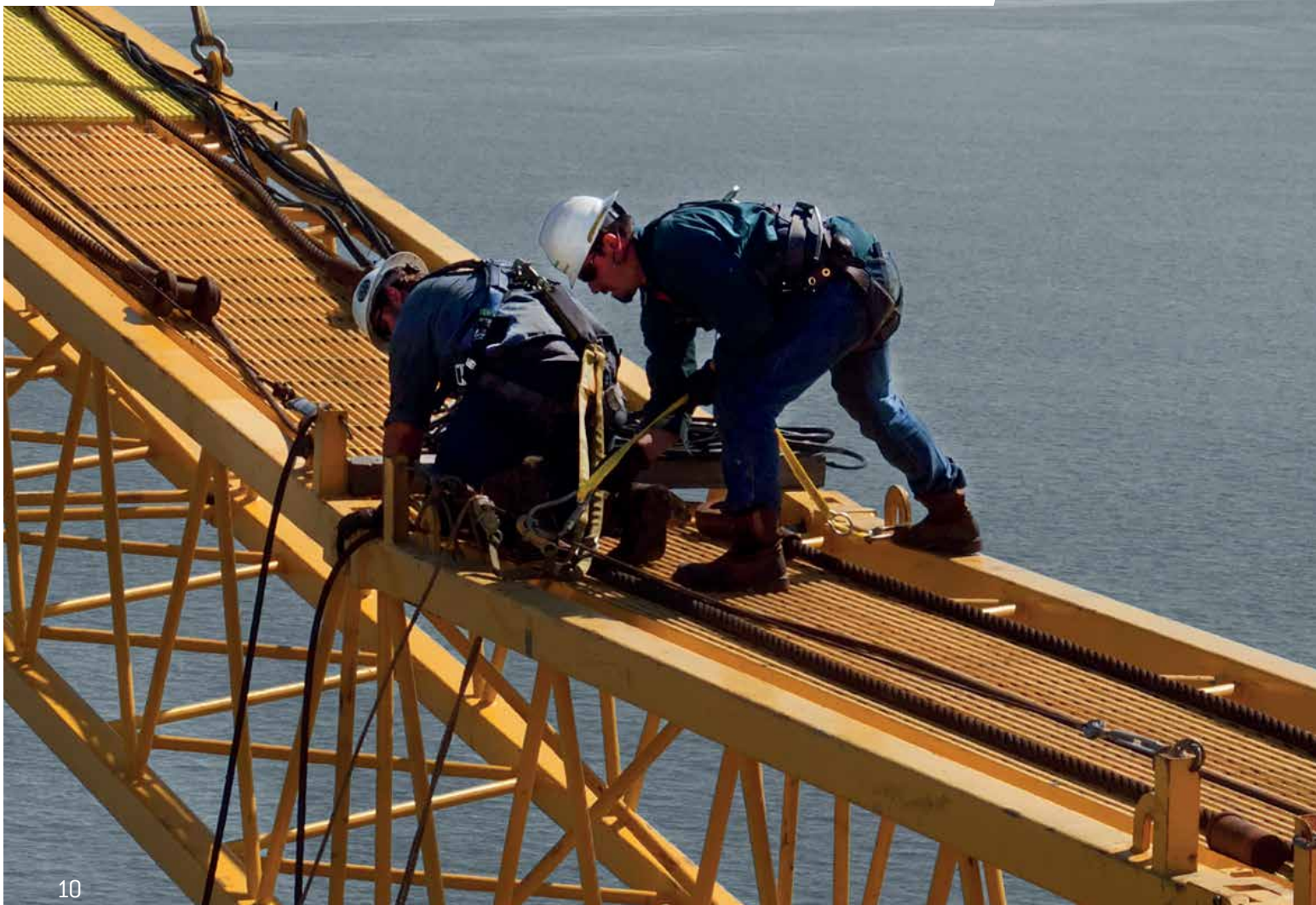


INTERACT HEADS MAJOR INFRASTRUCTURE REPLACEMENT

THE CONSTRUCTION AND ENGINEERING MANAGEMENT SPECIALIST SEES GROWING CALL FOR UPGRADES AND REPLACEMENTS OF AGEING INFRASTRUCTURE ON THE WEST COAST OF AMERICA

The need for higher-capacity cranes that also meet strict new emission standards is leading to a rise in refurbishment and replacement projects on the west coast of the USA. As a result, construction and engineering management expertise at InterAct is in high demand.

The company recently managed a \$15 million crane removal and replacement project on an oil platform in Alaska for a major international oil and gas client. The project involved completely replacing one crane pedestal and two ageing, pedestal-mounted, diesel cranes. The new diesel-powered, hydraulic cranes have 30-m booms with capacities at 23-m radius that are 56 and 140% higher: the north crane's static capacity jumped from 7.3 to 11.3 t, and the south crane's rose from 11.3 to 27.2 t.



“The client was looking to replace the cranes because of safety and capacity reasons. The old north crane had mechanical controls, not hydraulic, which have a history of dropped loads and damaged components because the mechanical clutches could not engage,” explains Jeff Hall, construction manager, InterAct.

“The original cranes’ limited capacity would also have required a lot of disassembly of wireline units or other drilling components to support drilling, well interventions or well workovers. Therefore, putting bigger cranes in meant a lot of possible cost savings, as the client could mobilise single units without disassembly and reassembly. This need to replace old cranes is occurring across the west coast as diesel-engine emission standards become stricter. Clients are choosing electric-powered hydraulic cranes as cost-effective solutions with lower maintenance requirements and zero emissions,” Hall concludes.

InterAct’s competitive rates, safety-conscious approach, previous experience and independence from other oil and gas projects in Alaska made it the ideal choice for the overall project management of the crane replacement work. The client awarded InterAct a significant contract to secure two construction managers to oversee the entire job and two crane-rigging specialists to help ensure adherence to a strict behaviour-based safety initiative.

InterAct’s lead construction manager, who had rotational back-up from a colleague, was charged with coordinating all the project activities and the other contractors, which included CH2M Hill, Hopper Engineering and Sparrows.

CH2M Hill worked closely with InterAct to maintain the schedule, while Hopper Engineering provided all the structural work for the project and Sparrows manufactured the cranes, supplied a temporary crane and provided the installation crew for the job.

The 32-t capacity, 36.5-m boom, temporary rental crane was transported from Louisiana to Alaska by truck, barge and boat, and then assembled on the drill deck of the platform so it could remove and install both new cranes and the new pedestal.

BMT Tank fabricated the new pedestal for the south crane in Elma, Washington, and shipped it by barge to Cook Inlet, where it was welded to the platform at the drill deck and production deck elevations. Deck reinforcement was completed beforehand so it could handle the new, higher-load-capacity crane. The original 18-t pedestal was removed in a single lift. The north crane installation involved removing the upper 2 m of the existing pedestal and welding a new transition pedestal with flange onto the remainder.

SAFETY

The client had originally planned to use a barge crane to carry out the work, but InterAct, in conjunction with the client and its marine adviser, devised an alternative solution using a temporary, platform-based crane, which meant substantial cost savings.

For this option to work, however, the team had to secure a dedicated work vessel for the project. Previously, the client was getting support twice a month from a workboat that was shared among all the platforms in the area.

After several months of reviews, the client agreed to the new plan and secured a work vessel from the Gulf. “It provided a major advance in their logistics, as they now have a dedicated workboat that they can use for their platform. It was also much safer and more flexible for this project, as we did not have to make dynamic lifts from the moving ocean to a fixed platform,” says Hall.

Safety was of paramount importance throughout the project, as the client would have considered the project a failure had there been just one lost-time injury. InterAct therefore enforced strict protocols to ensure safety and the whole project team managed to clock up 23,000 work-hours without an incident.

One mechanical engineer stopped work when he felt the bolts he was adjusting on the crane were not tightening properly. “Stopping a job costs money, but I backed the mechanic’s decision and the next day I was very glad I did,” says Hall. After taking the bolts apart, the team discovered that they had stretched and were not the bolts that had been ordered.

OVERCOMING CHALLENGES

Working with such large pieces of equipment can present other challenges. One big technical challenge InterAct faced was how to move the old pedestal from vertical to horizontal safely, and likewise how to get the new pedestal from its horizontal position on the ship to the vertical.

InterAct’s rigging specialists came up with the idea of welding a padeye onto the pedestal and having two padeyes on the deck to form a clevis into which the team could put a pin to create a pivot point. Sparrows was then tasked with designing a jig rated to take the force of the pedestal.

“This was a good example of collaboration. We had InterAct guys developing the initial concept, a design by Sparrows, the pedestal fabricator installing the padeye on the new pedestal and a fabricator in Alaska making the jig that went on the deck,” says Hall. “It was a technical challenge that worked out really well.”

The offshore work for the replacement project was completed on schedule. InterAct’s performance has since led to further contracts from the client. The company has also been contracted by several offshore operators in California to assess crane removal and upgrading options.

BRIDGING THE GAP

INTERACT SUPPORTS OPERATORS TRYING TO NEGOTIATE THE MANY HURDLES FACING OIL AND GAS PROJECTS

Exploration and production operators are continually having to comply with more and ever changing regulations; to keep up with changing technology; and to adjust to the unstable economic climate of today's oil and gas industry. Responding to these market drivers can be challenging for personnel who need to maintain a strong focus on operations.

InterAct's experience in field development, permitting and regulatory compliance, drilling, workovers and abandonments has enabled the company to provide the multidisciplinary support needed by operators across the life of field services, particularly on the west coast of America.

DEVELOPMENT

On one development project, a California-based independent producer needed outside expertise for drilling and completion engineering to help implement its plans for optimising waterflooding and improving production in the unconsolidated sands of a Long Beach oilfield.

InterAct was contracted to design well casings, develop sand control and completion procedures, prepare drilling permit applications and provide daily operational engineering and drill site management during the three-month drilling campaign. The drilling work added three producing wells, one injector well and one water source well to the field.

CONSTRUCTION MANAGEMENT

InterAct also provides ongoing, tailored construction support services for a major oil and gas exploration and production company in California. This work kicked off in 2011 when InterAct performed rig inspection and initial repair work for the client.

"As the project progressed and we continued to build our relationship with the client and were responsive to its needs, our role expanded to provide additional engineering, facility upgrades, crane operations and construction management support," explains Clay Graves, project manager for InterAct. "InterAct performed the work successfully, with no lost-time injuries and met the critical spud date in autumn 2013. Consequently, the client has come to recognise the value that InterAct's integrated services provide and has called on us for continuing support on new projects."

This support ranges from conceptual to detailed engineering services (drilling, reservoir and facilities), construction planning, project management, process safety studies and audits, health and safety services, regulatory permitting support, interactions and liaisons with state and federal agencies, crane operations and quality assurance and control documentation.

Recent offshore platform modification, repair and upgrade projects for this customer have included crane refurbishment, power cable replacement, facility modifications, break area installation, deck extensions, switchgear upgrades, procedures and plans required for regulatory agencies, drilling rig moves and new well support.

REGULATORY SUPPORT

As regulations governing major projects tighten or change, operators find they have to spend more time ensuring that their projects are compliant. One major oil and gas exploration and production company with oilfield operations throughout California tasked InterAct with taking the lead in developing and implementing a strategic plan to address the new General Permit for Industrial Storm Water Discharges.

"As part of this work, InterAct developed a fast, cost-effective method of analysis that significantly reduce compliance costs," says Uliana Micovic, InterAct's environmental services manager.

"By using our GIS data and Google Earth online tool to perform preliminary screening of the oil and gas fields that are covered by the new regulation, along with our vast well database covering most of their fields, we drastically cut costs for the client yet provided them with the same information as costly site visits.

"In this way, we quickly determined the locations where compliance was significantly reduced and those where a more complex permit application was unnecessary," she concludes.

InterAct has also developed a tool to accelerate injection well permitting for exploration and production companies. Injection well permits (Underground Injection Control permits) require operators to perform well history reviews and produce graphical representations of wells within a quarter-mile (400-m) radius of the proposed injection well's location. Cement calculations must be made to determine the isolation integrity of the well inside and outside the casing, particularly across hydrocarbon-bearing and freshwater-bearing sands. Diagrams must be made for all the wells within the quarter-mile radius, regardless of well owner. InterAct's wellbore diagramming database enables entry of the well's history and mechanical condition into a database, which then generates a graphical representation of the well for easy review. The database is easily imported into other platforms and can also be used for purposes such as asset management and drilling and abandonment planning.

InterAct has performed well integrity reviews and prepared more than 8000 wellbore diagrams for exploration and production operators. In addition to satisfying permit requirements, these diagrams can be used

to design workover and/or abandonment programmes. They are easy to update, which gives them widespread application over the life of a well.

DECOMMISSIONING

InterAct also assists operators with planning and developing cost estimates and procedures for decommissioning projects. One customer had to abandon and re-abandon more than 35 land-based wells when it was asked to clear land it was operating on for redevelopment work in the Port of Long Beach, California.

The customer contracted InterAct to carry out a complete package spanning initial well work and developing abandonment strategies through to providing operations engineering support during the plugging-and-abandonment operations.

As well as developing cost estimates for the plugging-and-abandonment work, InterAct's engineers wrote the work programmes and developed schematics of the wellbores. These illustrated the proposed plugging-and-abandonment strategies and the client used them to secure the necessary permits from the California Division of Oil, Gas and Geothermal Resources.

While the abandonment operations were happening, InterAct represented the operating company, liaised between the government department, the client's superintendent and project manager as required, and managed any instances of change that affected the programme or the conditions of the permit.



InterAct's experience in field development, permitting and regulatory compliance, drilling, workovers and abandonments has enabled the company to provide the multidisciplinary support needed by operators across the life of field services, particularly on the west coast of America."



CREATIVE PROCEDURES

INSTALLING THE MOORINGS FOR THE DELTA HOUSE PRODUCTION UNIT PUSHED AN ANCHOR-HANDLING VESSEL TO THE LIMIT AND INTERMOOR ENGINEERS TO A NEW LEVEL OF CREATIVITY

“Permanent mooring systems for floating production units are becoming ever more substantial, and using traditional anchor-handling vessels to install them is proving increasingly challenging. Flexibility and innovation are needed to extend the capabilities of the existing fleet of anchor handlers if we are to continue to deliver projects on time and within tight budget constraints.”

This was Todd Veselis, general manager of permanent moorings at InterMoor, speaking in 2014 just after the company had safely installed the mooring system for LLOG Exploration’s Delta House semisubmersible production facility in 1350 m of water, 210 km south-east of New Orleans in the Gulf of Mexico. But let us go back to the beginning, about a year earlier.

The mooring system for the Delta House semisubmersible was already largely designed and its key components were on order when LLOG Exploration appointed InterMoor to carry out its installation. On the face of it, this was a reasonably straightforward project for InterMoor, except that on this occasion there was a rider – in reality, an opportunity. For good economic reasons, LLOG Exploration wanted to explore the use of an anchor-handling vessel, the *Joshua Chouest*, which it already had on long-term charter. Although basically suitable for the task, the vessel would have to operate at the upper limit of its handling capabilities, so extremely thorough planning and preparations would be necessary.

CLEAR RESPONSIBILITY

The Delta House semisubmersible is designed to produce continuously for 25 years and to survive a 100-year storm. It has 12 taut-leg mooring lines, three at each corner. The lines comprise mainly 365 m of the semisubmersible’s own chain at the top, then 2000 m (in two sections) of 240-mm-diameter polyester rope and finally a 230-m section of anchor chain at the bottom. In addition to these main elements, each line has short polyester inserts and mid-water chains, which increased the total number of connections that had to be made on deck. Each line is connected to a seabed suction pile nearly 5 m in diameter, 26 m long and weighing about 150 t. This connection is the only one for each line that has to be made subsea; an SMC Type III automatic connector joins the lower anchor chain to a 40-m forerunner chain on the pile.

InterMoor was responsible for supplying the suction piles (which it produced at its Morgan City fabrication facility in Louisiana, USA), developing the installation procedures, the installation engineering and modifications to the vessel, and the work offshore, i.e., presetting the moorings and then hooking them up to the semisubmersible. The

semisubmersible’s own chains were included in the preset mooring lines to reduce the weight of the structure during its transfer to the field.

Veselis is keen to emphasise three key features of the work: the deck tooling and vessel modifications for ensuring safe operations and avoiding damage to the various mooring components; the measures for deploying the moorings without twisting or unduly loading the polyester rope sections; and the overall creativity necessary to devise procedures to make full and efficient use of the *Joshua Chouest*’s available deck space and equipment.

CREATIVITY NECESSARY

Chain diameters of 137 mm mean that each link is about 0.9 m long and 0.45 m across, and weighs almost 220 kg. The pins used in the connecting shackles are 230 mm in diameter and nearly 1 m long, and also weigh nearly 325 kg. Assembling moorings of this kind on deck required unusual care and special handling and lifting equipment. This included an A-frame with a pair of 1.8-t chain hoists, which were of great benefit to the deck crew.

Given the size of the links, the chain chutes on the *Joshua Chouest* needed modifying to accommodate the chain safely. Naturally, the vessel’s shark jaws were also designed to accommodate the large links; however, the need to deploy smaller work chains at various stages in the process, for example, a messenger chain from the semisubmersible during the hook-up, called for an insert for the shark jaws so that their spacing could be altered easily and quickly.

The weight of the mooring chains and the subsequent possibility of twisting or unduly loading the rope sections during deployment and damaging their protective covers led to InterMoor using a custom-designed lowering line. This was made from high-modulus polyethylene fibre, which is very strong and has little tendency to stretch. The same material was used for the slings required to deploy and recover the mooring lines from the seabed at various stages during installation and hook-up.

Leaving aside the various physical measures needed to install the mooring system from the *Joshua Chouest*, of which these are just some examples, the biggest influence on the success of the project was the thinking behind the development of the offshore procedures.

To give an example, careful inspection and surveying of the vessel led to the decision to deploy the ancillary lowering line from the vessel’s main winch drum and the much larger and heavier mooring line itself from one of the two on-deck storage reels (the first choice



might have been one of the two main anchor-handling drums but these could not accommodate the rope and still allow for an alternative lowering option). This was counterintuitive, but the configuration of the two winches rendered this approach far less likely to stress either of the two lines. Veselis says that it is all about having everything, the chain, rope and lowering line, in the right place at the right time.

OPPORTUNITY REALISED

By installing the Delta House's mooring system from the *Joshua Chouest*, InterMoor closed what initially appeared to be a gap between the demands of the mooring system and the vessel's capabilities. The project, although challenging, was conducted safely and effectively, and finished on time and without major incident. Moreover, the project was highly cost-effective; there was an economic opportunity for the client and InterMoor helped to realise it. It just goes to demonstrate that, with experience, a creative approach and open minds, remarkable things can often be achieved.

The *Joshua Chouest* anchor-handling vessel is approximately 106 m long, has a beam of about 22 m and is about 9.5 m high. Its deadweight is 5,193 t. Two Caterpillar diesel engines develop 16,107 kW and provide the vessel with a bollard pull of 210 t. The vessel has five winch drums: a main drum for towing and also anchor handling, two anchor-handling drums and two reels normally used to store wire or rope. These last two are on the deck above the main winch house.



FLOATING PRODUCTION

IN CHINA

INTERMOOR IMPRESSES
WITH ITS ASIA PACIFIC
RESOURCEFULNESS

The past few years have been a busy and highly rewarding period for InterMoor's Asia Pacific team. The company strengthened its presence in the region in 2012 by opening a new equipment servicing facility in Singapore and then completed an important five-month project in Lufeng field in the South China Sea. This centred on the engineering and installation of a mooring system to secure a disconnectable turret for the *Nanghai Sheng Kai* floating storage and offtake vessel.

The client, China Offshore Oil Engineering Company (COOEC), went on record with its appreciation of InterMoor's "high level of performance" on the project and said that it was looking forward to working with the group in Singapore again. And it was true to its word. In 2013, COOEC awarded InterMoor two similar projects in the Enping and Panyu fields. Engineering was largely to be done in that year, with both projects mobilising at about the same time: between Q1 and Q2 2014.

"We were delighted at COOEC's show of confidence in our organisation; our people went the extra mile on Lufeng and this helped to establish a great relationship with the COOEC engineers," says Martin Kobiela, managing director of InterMoor Pte Ltd. "The Enping field project was awarded first, and, in May 2013, we placed an experienced four-man team in COOEC's offices in Shekou, China, to help plan the work. Clearly, the guys made a strong impression because, about three months later, COOEC asked us to take on the Panyu field project as well."

PREPARING FOR A NEW FACILITY

The Enping project concerned the moorings for a submerged turret production buoy for China National Offshore Oil Corporation's newly built *Hai Yang Shi You 118* floating production, storage and offtake (FPSO) vessel. COOEC tasked InterMoor with project management, installation engineering and procedure development, and then the provision of key offshore personnel for the installation of the moorings and their hook-up. Allied to this work was installing a 12-in.-diameter production hose (made up of a 2.45-km static flowline and a 175-m dynamic riser with buoyancy modules), two power/optical umbilicals, a pipeline end manifold and two power-cable support structures.

The mooring system is set in about 90 m of water and has 12 legs made up of chain and sheathed, spiral-strand wire. The mooring legs are connected to the buoy using Balltec MoorLOK subsea connectors and anchored to the seabed by 84-in. driven piles varying in length from 38 to 49 m. It was these piles, especially the longer ones, that posed the first challenge for the InterMoor engineers, as they had to be installed using a support vessel that was not ideal for the task and only equipped with a 250-t crane of limited hook height.

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COOEC valued the fact that we could run these projects within the region but call on the resources of a genuinely global organisation when required to respond quickly and strongly to events in the field. With first the Lufeng project and now Enping and Panyu, we have demonstrated the high value that InterMoor can bring to complex mooring projects in Asia Pacific.”

The engineers developed procedures to get the piles overboard horizontally and to upend them on the seabed before positioning them through a specially designed stab frame. A scheme was also devised to deploy the pile hammer and the follower separately, thus keeping each lift within the capacity of the crane and so minimising downtime. The crane’s capacity was also an issue during the hook-up, when it was planned to add weight to the buoy to pull it down beneath the surface. This was to make it easier to connect it up and to protect it in the event of severe weather during the installation. Taking into account the size of the crane, two clump weights were designed for adding separately to the buoy.

The second challenge facing the engineering team centred on the restricted bend radius of the mooring wires, which meant that the winches on the available anchor-handling vessel needed modifying to increase their diameter. Winch adaptor/separators were also engineered to protect the wire sockets, and measures were devised to protect the wire’s sheath when held in the vessel’s shark jaws. (These same measures to protect the wire sheath were also used aboard the anchor-handling vessel used for the Panyu and Lufeng projects.)

These technical challenges aside, the biggest issue for the project, certainly in the view of the COOEC engineers, was the efficient coordination of the offshore phase of the work, which ran between April and August 2014. This involved three main vessels, the aforementioned installation support vessel, a large anchor handler and a diving support vessel, as well as various tugs and barges. The exact availability of each was unknown until quite a late stage; consequently, much of the scope had to be designed so that given vessel operations could be carried out independently when each of the vessels turned up. Having this flexibility was the key to ensuring that the project stayed on the rails and finished on time, a point COOEC formally recognised at the project closeout.

EXTENDING PRODUCTION LIFE

The project in Panyu field, also in the South China Sea, was similar in many ways to the Enping project: it involved the moorings for an FPSO vessel with a submerged production turret buoy, in this case in 105 m of water. However, the vessel, the *Hai Yang Shi You 111*, was not new and had been in the field for about 15 years. Given this situation, the aim of the project was to extend its production life by replacing the existing mooring system. COOEC asked InterMoor to engineer and install a like-for-like system and to manage the overall project, both on- and offshore.

The mooring system for the Panyu FPSO vessel’s turret buoy has nine chain and sheathed, spiral-strand wire legs, each of the upper chain sections being loaded with 8–16 clump weights. The legs are secured to the seabed by suction piles (7.5 m in diameter, 13 m long and weighing over 130 t) rather than by driven piles, as was the case on the Enping project.

The suction piles provided one of the first challenges for the InterMoor engineering team, as the crane barge COOEC secured to install them was more suited to pipelaying than to pile installation: deck space was limited and there was only one crane block with sufficient lifting capacity that could also go subsea. Following careful analysis of the deck arrangements and detailed planning, InterMoor devised procedures that enabled the deployment of up to five suction piles in a single run offshore. Further, a method was developed whereby each pile could be installed with its lower chain section and the wire section attached, which eliminated the associated subsea connections and saved time and money. InterMoor added a dedicated spooler, a tensioner, an overboarding arch and additional deck winches to the vessel at very short notice to be able to do this.

The pile installation work aside, the biggest challenge the project presented was to install the new mooring system no more than 2.5° from the existing one (a distance apart of about a metre or so), thereby avoiding the need for a new mooring analysis and, more importantly, rotating significantly the lower section of the turret and consequently twisting the riser. Furthermore, COOEC wanted to carry out the replacement without disconnecting the FPSO and so interrupting production.

Given this requirement, InterMoor engineers developed highly detailed installation procedures with comprehensive guidance on simultaneous vessel operations near the FPSO. As well as the crane barge used for pile installation and an anchor handler, there were three positioning tugs involved and the offtake tanker movements to consider. Because of the thorough preparation, the installation was completed safely and on schedule with minimum disruption, despite the last-minute changes required when the lengths of the upper chain sections were found to be different from those specified.

CONSTRUCTIVE WORKING RELATIONSHIP

According to Kobiela, that both projects were so successful is a testament to the constructive working relationship between COOEC and InterMoor and the professionalism and positive attitude that characterised the whole team. Wang Jiewen, project manager with COOEC, echoed this when he said, “We were impressed with InterMoor’s innovative approach and attention to detail, which ensured both of these challenging projects were safely completed on time. InterMoor’s project management expertise and their engineers’ ability to work closely with those on the COOEC side enabled us to manage multiple vessels and an international workforce on two complex projects being carried out concurrently.”

Kobiela is proud of the efforts of the team from InterMoor’s Singapore office but is quick to acknowledge the support InterMoor engineers in the UK and the USA provided. “COOEC valued the fact that we could run these projects within the region but call on the resources of a genuinely global organisation when required to respond quickly and strongly to events in the field. With first the Lufeng project and now Enping and Panyu, we have demonstrated the high value that InterMoor can bring to complex mooring projects in Asia Pacific,” he affirms.



ACTEON COMPANIES PROVIDED KEY INPUTS

InterMoor took the lead on the Enping and Panyu projects for COOEC but called on several other Acteon companies for practical help with key elements of both. **MENCK** provided the piledriving hammer for the Enping project and **LM Handling** supplied pile-handling tools and stab frames. **2H Offshore** gave input on the installation of the Enping riser. **Seatronics** supplied the subsea pumps for the installation of the suction piles on Panyu, and **Aquatic** provided the drive systems and wire tensioners used on both projects.

ROBUST KIT AND QUICK RESPONSE SCORE POINTS

LDD EXCEEDS EXPECTATIONS AND PROVES WHY IT WAS NOMINATED AS AN OPERATOR'S SPECIALIST FOUNDATION INSTALLATION SUPPLIER OF CHOICE, OFFSHORE AFRICA

After proving its worth on previous jacket foundation installations in the Etame Marin block, offshore Gabon, LDD managed to secure direct entry into the piling-services contract for operator VAALCO Etame (Gabon) on the third and fourth jackets.

“When VAALCO started looking at putting in these two jackets, the company contacted us directly and said it wanted us on the project. We helped them with the pile design before they went out to tender and we were written into the tender documents as their nominated supplier to ensure our involvement,” explains Jason Clark, founder and managing director, LDD Group.

This meant that the chosen main contractor, EMAS AMC, automatically awarded LDD the specialist piling work. LDD went on to provide drilling, grouting and pile handling equipment, and experienced personnel support as part of a very successful partnership.

“The LDD project team worked extremely well with the EMAS team on a very significant part of our Southeast Etame/North Tchibala platform installation. The work was executed safely and the offshore team should be commended for their work. EMAS looks forward to an opportunity to work with LDD again,” comments Tom O'Malley, project manager, EMAS.

LDD worked with EMAS AMC to install four 48-in. piles for each of the two jackets. The piles were 140 m long and penetrated about 42 m below the mudline. The teams worked off EMAS' new flagship vessel, the *Lewek Constellation*. The *Lewek Constellation* is an ice-class, high-end, multi-lay offshore construction vessel with ultra-deepwater pipelaying and lifting capabilities (3000-t crane).

LDD also contracted Acteon sister company LM Handling to provide a 24–48-in. adjustable, 600-t safe-working load internal lift tool for lifting the 1220-mm diameter pile sections and an LDD-designed 600-t jacket-levelling tool, which freed the installation vessel's main crane for other work. The levelling tool was “box fresh” for the project and “worked faultlessly” says Clark.

Other pieces of kit also used for the first time on this job included the LDD designed and built LD2500 offshore reverse-circulation piling drill and pressure grouting caps designed specifically for this project. These grouting bungs seal the top of the pile using inflatable bladder packers and allow an internal pressure of up to 450 psi to be maintained. They can help to accelerate the set-up time before grouting the pile into the rock socket. Previously, customers had to weld a big steel sealing plate into the top of the pile before grouting could begin, which could take 6 h or more per pile. With the new



bungs taking only about 30 min to install, they potentially saved about 44 h of set-up time.

The LD2500 pile-top drilling rig drilled a 1350-mm-diameter underreamed socket below the toe of the pile into which the pile could be lowered and pressure grouted in place. The equipment has a deck that tilts by up to 18.5° for safe operation on raking piles and its modular design greatly assisted with shipping in standard ISO containers.

LDD also used its designed and built HC60 StabLift passive heave compensator to help overcome the challenge of putting equipment on and off a fixed jacket from a floating platform. This heave-compensating device sits between the hook of the crane and the load that is being lifted and is used to mitigate risk for sensitive lifting operations during bottomhole assembly.

“We used this piece of equipment for the first time for VAALCO on an earlier jacket installation project and, as a result of its performance then, VAALCO stipulated in this contract that we should use it again here,” says Clark.

“After using the HC60 StabLift passive heave compensator on this latest project, EMAS was so impressed with it that they asked to keep it after our work had finished to use on their marine lifts for the placement of the topside.”

Because of the remote working environment offshore Gabon, LDD also took a large suite of spare equipment to ensure that any problem could be quickly rectified without affecting the project schedule. “We are masters in this work and fully understand all the risks of breakdown, which are particularly challenging in remote locations. A factor in our expertise is understanding the right level of spares management to bring to a project of this nature,” explains Clark. LDD took two spare power swivels, spare power packs and a spare drillstring, but did not have to use any of it, as all the original equipment worked well.

As well as providing high-performing equipment, LDD’s expertise in mobilising and organising people and tools from all over the world also proved important for this project. When another contractor accidentally damaged one of LDD’s internal lift tools, LDD was able to source another one in Singapore and charter a heavy-lift plane to take it straight to Africa. “The tool was offshore 10 days later and our client was over the moon,” says Clark.

LDD managed to install the piles ahead of schedule and without a lost-time injury, which resulted in a very happy customer. “LDD’s offshore personnel worked and behaved in a professional manner at all times and performed way beyond our expectations. I cannot praise them enough,” concludes Matthew Irick, package manager, EMAS.



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SUBSEA TREASURE HUNTING

A PREDATOR REMOTELY OPERATED VEHICLE LOOKS FOR GOLD

In 1860, a daring rescue saved all 592 passengers and the crew of the SS *Connaught* before it sank with its cargo of gold coins. One hundred and fifty five years later, Seatronics' Predator remotely operated vehicle (ROV) negotiated strong bottom currents and hazardous fishing debris to play a pivotal role in verifying the ill-fated, treasure-laden liner's resting place. It delivered considerable value for Endurance Exploration Group Inc. by performing beyond the expectations for the inspection-class ROV.

Endurance Exploration Group aims to create shareholder value by recovering valuable merchant cargoes. The search for the SS *Connaught* was the company's first offshore operation after five years of desk-based research and its first opportunity to show a return on investment. With "pay day" some way off, controlling project costs was high on its agenda.

FLOOD, FIRE AND FRUIT

The 380-ft SS *Connaught* was one of the largest and most-luxurious oceangoing mid-nineteenth-century liners. Disaster struck on 25 September 1860 when the ship sprang a leak in a sudden storm while sailing from St John's, Canada, to Boston, USA. The leak was brought under control, but a fire forced the people onto the top deck. When the lifeboats smashed on being lowered into the sea, there seemed little hope for the passengers and crew.

Fortunately, a small fruit transport ship steamed to the rescue. An escape line was secured between the vessels and, following tradition, the captain left last. Everyone squeezed onto the merchant vessel, which took them to Boston's India Warf, but more than 4500 kg of gold coins went down with the liner: money thought to have been for visiting British royalty.

The loss of the SS *Connaught* on only her second voyage was a disaster, but the courageous rescue, without a fatality, was a triumph of courage and seamanship.

PREDATOR: PUNCHING ABOVE ITS WEIGHT

The SS *Connaught* lies in 200 m of water in an area of strong, difficult-to-measure bottom currents and has collected a tangle of fishing debris over the last century and a half. The Seatronics Predator inspection-class ROV, supplied by Great Eastern Group, was selected as a cost-effective option for verifying the wreck as the SS *Connaught*.

"Given the conditions, a mid-class ROV would normally be required for such a seabed inspection, but that would have escalated costs dramatically," explains Euan Mackay, vice president, sales, Seatronics Inc. "The client would have required a much larger support vessel and team and ancillaries if a mid- or work-class vehicle had been used. The Predator ROV did a difficult job reliably and cost-effectively, considering the conditions. It proved its worth." Bruce Morris, director of engineering and operations, Great Eastern Group, coordinated the verification project. He says, "Because it is

small and light, two people can launch the vehicle. It is easier with a crane, but, in this case, we simply slid the vehicle off a ramp that was previously fabricated for the stern of the vessel.

"The Predator vehicle was easily held on station in the 2.5–3-kn. bottom currents with the powerful thrusters at 80% gain, which illustrates the current strength. Its exceptional thruster control and power output gave the vehicle a high degree of manoeuvrability in these challenging conditions. We got great feedback from the operators, who likened 'flying' the vehicle to playing a simple video game. At low speeds, it can be carefully nudged forward for great close-up images."

Mackay adds, "And that was a fly-alone Predator. Customers can also use the Predator ROV with station-keeping software from our partner SeeByte Ltd that automatically holds the ROV at the correct depth and attitude and enables it to fly on predetermined courses. Other ROV manufacturers are working on similar systems, but we have the lead and believe we have the best solution in SeeByte software, which is calibrated to the Predator vehicle for exceptional stability."

Another advantage of the Predator system is its flexibility. Morris says, "On-the-job modifications are common. When we get to a site, suddenly there is a requirement that no one anticipated, so you need to be able to recover the vehicle to the deck and customise it. Predator gives you that freedom. You can make simple modifications that can accommodate various bolt-on tools and sensors."

The ROV's first work was for the offshore wind industry and it is now used in many diverse applications, including in the oil and gas, and naval sectors. Law enforcement agencies also use it for search-and-rescue operations, and crime-scene investigations – work that otherwise places divers at risk.

Morris continues: "The Predator ROV has a network control system that uses comprehensive diagnostics to assure continuous operation in challenging conditions. High-capability diagnostic electronics more typical of work-class ROVs monitor all the vehicle's functions and identify fault sectors without loss of ROV control. Reliability is important, but so is the ability to perform on-deck maintenance. If your ROV suffers a catastrophic failure early in a job, it can be a financial disaster: a wasted trip.

"The Predator system comes with a comprehensive spares kit and is built from plug-and-play components. The SS *Connaught* project is a great example. The impellers sucked fishing lines in three times, but each time the Predator ROV freed itself thanks to the design and power of its thrusters. As a precaution, the damaged thrusters were switched out in a simple five-minute job. Less powerful ROVs might have been irrecoverable or lost, with huge financial implications for the project," he concludes.

SUCCESS

In 2013, Endurance Exploration Group performed a 1800-km² side-scan sonar search of the area where the SS *Connaught* was thought to have gone down. A year later, it teamed up with Eclipse Group Inc. to investigate an encouraging signal 160 km off the north-east US coast. Eclipse provides subsea technical solutions, which, in this case, included deploying a Seatronics Predator ROV to verify the wreck. Between them, Seatronics and Great Eastern Group provide global support.

The Predator ROV clearly identified the SS *Connaught*'s iron hull and paddle wheels, and artefacts within the debris field, including 150-year-old whisky bottles. Initially, it surveyed the wreck in the zero-visibility conditions using sonar before switching on its cameras and lights.

RECOVERING THE CARGO

Endurance Exploration Group is now seeking the legal right to salvage the cargo robotically before the wreck suffers further trawler damage. If this is granted, the company plans to return to the site in spring or summer 2015 to begin a systematic and well-documented recovery of the cargo and artefacts.

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The ROV's first work was for the offshore wind industry and it is now used in many diverse applications, including in the oil and gas, and naval sectors. Law enforcement agencies also use it for search-and-rescue operations, and crime-scene investigations – work that otherwise places divers at risk.”

In addition to recovering the valuable cargo, Endurance Exploration Group plans to make a television documentary to tell the remarkable story of the SS *Connaught* and the courageous rescue of all its passengers and crew. No doubt, Seatronics' Predator will have a starring role.



SUBSEA SERVICES

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