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Cover Story

Global Deepwater Review

Encouraged by attractive oil prices, companies are ramping up deep and ultra-deepwater exploration. New developments are underway off Africa, Asia Pacific, Europe, Middle East, and North and South America. Jeannie Stell showcases projects beyond 1500ft.

ON THE COVER

The offshore oil & gas industry uses massive equipment to reach deep into the ocean to develop reservoirs. Clockwise from lower left: *Pieter Schelte* a twin-hull, heavy-lift pipelay vessel under construction, source: Allseas; Saipem FDS, source: Saipem; Sevan Brasil, source: Sevan Drilling; Rambiz, source: Scaldis-SMC; Platform decommissioning, source: Perenco.

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Departments & Columns

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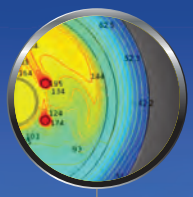
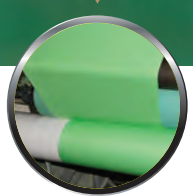


Engineering Services

Pipe and Joint Coating Design

Coating System Validation

Logistics Management



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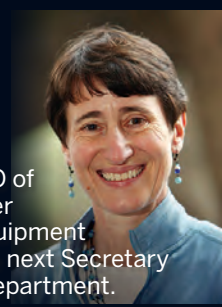
Atlantic hurricane outlook

Wilkens Weather provides details on its latest forecast for the 2013 Atlantic Hurricane Season. The company predicts another active summer.

Image: NASA GOES PROJECT

People



Jewell wins confirmation

The US Senate confirmed Sally Jewell, CEO of US-based retailer Recreational Equipment Inc. (REI), as the next Secretary of the Interior department.

What's trending

ConocoPhillips suspends Arctic program

Citing unease over changing US regulations, ConocoPhillips paused plans for its 2014 Alaska Chukchi Sea drilling program.

Drilling to start on Dunquin

ExxonMobil readies a $140 million drilling program off Ireland.

Expert Access

New Drilling Fluid Offer Environment Advantages

Join us on 29 May 2013 at 11:00 CST for a live presentation and Q&A with Dr. James Gaertner, director of research and development at ViChem Specialty Products, as he discusses a new water-based mud that balances performance and compliance.

To register, go to www.oedigital.com

Managing Offshore Assets: Taking on the Information Challenge

Join us on 12 June 2013 at 10:00 CST as we host a live presentation and Q&A with Gonzalo Merchan, director of the Global Energy Sector Information Intelligence Group, EMC Corp. on how to manage and share asset information in a real-time environment.

To register, go to www.oedigital.com

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INCEPTION

THE BEGINNING OF AN IDEA

REACH

The way we communicate today is completely different than ever before. Through the internet, social media, email, cell phones and other technological advances, our messages are delivered instantly anywhere in the world. Edyta Skrajna reads ***OE*** to keep up to date with industry news on the Warsaw Tram, and Stephanie Teo does the same at the Singapore Botanic Gardens. Meanwhile, a copy of the March issue of ***OE*** was on hand at a PEMEX site in Villahermosa, Mexico. Tell us how you prefer to read ***OE.*** Post a picture while reading the print magazine, the digital edition, or when staying up to date on our web pages (OEdigital.com or AOGdigital.com).

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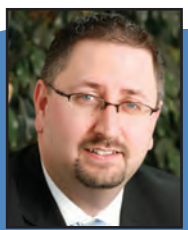
Voices

Deep thoughts. Working in deepwater is no easy task. OE asked, "What is the biggest challenge with working in deepwater?" Here's what our sampling had to say:



The quality, strength and geometry of line pipe are all crucial components of collapse resistance for deepwater pipeline design. The challenge is to optimize manufacturing processes to most tightly control these features. Tight tolerance control and confirmed compressive strength enables us to reduce wall thickness without affecting the integrity of the pipeline, reducing the overall submerged weight of the line pipe and enabling pipe lay in even deeper waters.

Martin Connelly, Technical Manager – Tubes, Tata Steel Europe International, Inc.

Aside from the inevitable technology challenges, one of the biggest challenges in managing deepwater projects today is the complexity – not just at the commissioning and construction stage, but through to operations. From a supply chain that can stretch to hundreds of vendors around the world through to the sheer amount of documentation, unwieldy review processes and the constant scrutiny of the regulator, deepwater oil and gas projects today bring with them communication and document control challenges that have never been witnessed before.

Paul Muir, CEO, McLaren Software

The biggest problem facing the offshore wind industry as it goes into deeper waters is finding economically viable foundation solutions. Technical solutions already exist but offshore wind farms today can contain upwards of 300 turbines, all requiring foundations that solve the problems of site specific seabed geology, wave loadings and turbine forces. As monopiles struggle to cope with depths over 30m, more expensive steel jackets are being utilized with concrete gravity bases and suction buckets now also in the planning stage. For depths over 50m, floating turbines come into play but the tension leg and ballast solutions are still at feasibility/testing phase. The industry challenge, to make deployment in deepwater possible, continues to be, 'find deep water foundation solutions at a lower cost.'

John Sturman, Chairman of the IMarEST Offshore Renewables Special Interest Group

The availability and competence of people to support deepwater operations is a major challenge our industry will face in the next few years. Deepwater activity will continue to increase significantly fueled by the development of recent discoveries around the globe. Highly trained and competent technical people will be required to deal with the ever more complex deepwater operating environments – such as high pressure/high temperature reservoirs, frontier developments in the Arctic and similar areas – and to support increasingly sophisticated technologies, while continuing to focus on well safety.

Eric Carre, Senior Vice President, Drilling and Exploration, Halliburton

With greater depths come greater challenges. Through innovating technologies, we help our clients to push back subsea frontiers. Beyond difficult reservoirs and complex subsea architectures, safety has to come first; safety for our people, of course, but also safety for life-of-field operations. In this context, Asset Integrity Management will play a key role in the future.

Alain Marion, Senior Vice President, Subsea Assets and Technologies, Technip

The main challenge for both mooring and riser systems in deepwater is one of maximizing strength whilst minimizing the overall weight of the systems themselves, in order to aid installation and improve the through-life characteristics of the systems. Increasingly, clients now understand that installation considerations need to be tackled very early in the design process for deepwater systems. The number of specialized vessels for deepwater installations available in the marketplace is growing, however the day-rate charges commanded by these vessels remains high. As a result, design optimization to reduce installation complexity is essential, in order to ensure that costs are kept to a minimum.

Tim Wood, Director, London Marine Consultants

Go to OEDIGITAL.COM and give us your opinion on this month's topic!

Deeper!

Brion Palmer

It is no secret the offshore industry is focused on going deeper. So is ***OE.***

We are passionate about our readers being able to forge a deeper relationship with our brand, content, sources and customers. We have approached this objective in some traditional ways and via new product innovation and development.

We have dramatically increased the number of editorial pages in our flagship product – ***OE***. This commitment to increase our ongoing coverage of the offshore industry doesn't stop with the magazine.

Our new website – OEDIGITAL.COM – has empowered us to provide oil and gas professionals worldwide with daily updates and web exclusives along with all the great content you find in ***OE***.

We have even introduced a new program – Expert Access – that offers readers real-time accessibility with subject matter experts featured in that month's issue.

We have two Expert Access sessions available to readers over the next several weeks : 1) Dr. James "Buddy" Gaertner, director of research and development for ViChem Specialty Products, will present "New Drilling Fluid Offers Environment Advantages" at 11 AM CST on May 29th, and 2) On June 12th, Gonzalo Merchan, director of global energy sector for EMC Corporation, will present 'Managing Offshore Assets: Taking on the Information Challenge' at 10 AM CST.

Lastly, our newest initiative is our new publication, ***OE Review***. Our first issue Of ***OE Review*** is included with your May issue of ***OE***.

OE Review gives our editorial team the opportunity to exhaustively cover a critically important topic, segment, or geography by presenting multiple articles for your reading pleasure. The intent is for readers to gain a thorough and deep perspective on the subject to make better informed decisions.

Our first issue focuses on Offshore Automation and how technology can help oil and gas companies not only better manage their data for increased productivity but improve safety and security practices. This is a critical business issue impacting all companies within the oil and gas industry.

Future issues of ***OE Review*** will focus on variety of topics including Deepwater Intervention, Oil & Gas's Human Capital Shortage, the Emerging Latin America Market, and more in our series on automation technology.

OE is committed to helping you go deeper with us.

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1635 W. Alabama
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OE (Offshore Engineer) is published monthly by AtComedia LCC, a company wholly owned by IEI, Houston. AtComedia also publishes **Asian Oil & Gas**, the **Gulf Coast Oil Directory**, the **Houston/Texas Oil Directory** and the web-based industry sources **OilOnline.com** and **OEDigital.com.**

US POSTAL INFORMATION
Offshore Engineer (USPS 017-058) (ISSN 0305-876X) is published monthly by AtComedia LLC, 1635 W. Alabama, Houston, TX 77006-4196.
Periodicals postage paid at Houston, TX and additional offices.
Postmaster: send address changes to Offshore Engineer, AtComedia, PO Box 2126, Skokie, IL 60076-7826

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Nina Rach

Colloquy

Changes loom in Mexico

The structure of the Mexican oil industry is on the verge of change, driven by a need to increase revenues and build reserves. The consensus is that Mexican fields are aging, production is declining, and although Petróleos Mexicanos (Pemex) has a monopoly in the business, it is hamstrung by years of under investment in long-term development projects.

Pemex is designated as the exclusive operator in Mexico, forbidden by the Mexican constitution and constrained by other laws from forming joint ventures or equity contracts with foreign firms, so it is effectively cut off from the expertise of IOCs.

Mexico's petroleum production is declining. The most prolific field, Cantarell, produces almost two million bo/d. The estimated peak output of the five next-largest fields, combined, do not equal Cantarell's output. They are:

- Ku-Maloob-Zapp (KMZ) ~794bo/d.
- Chicontepec 393bo/d.
- Crudo Ligero Marino 230bo/d.
- Agua Fria 173bo/d.
- Antonio J. Bermudez 161bo/d.

All of the major Mexican fields are mature or declining, except for KMZ, which, along with Cantarell, produces predominantly heavy oil. Mexico used to export light oil, and its refineries are geared for light oil. The country must now import light oil to blend with the local heavy oil production.

Hopes were pegged on development of the Chicontepec field, but plans have been criticized because the extra-heavy crude will be difficult to produce and market. The field does contain some areas of light and superlight crude. Production volumes are still small, reported as 68,000bo/d in May 2012. The field has probable recoverable reserves of 17.6 billion bbl, but could require 20,000 wells to exploit.

At the PECOM conference in Villahermosa in April, discussion suggested that the new government might pull the plug and decide against fully funding Chicontepec development.

> "We must make hydrocarbon extraction more efficient… This is a business, not a sport."
>
> Ing. Jose Luis Fong, PEP

Historic US partner

Mexico is an important energy partner with the US. According to the US Energy Information Administration (EIA, February 2013), Mexican fields produced 3.2MMbo/d in 2008, but dropped nearly 10%, to 2.9MMbo/d in 2012, still ranking eighth among the world's oil-producing countries. The country remains a net exporter of oil, but has become a net importer of natural gas, mostly from the US via pipeline. Mexico has been increasing the use of natural gas for power generation.

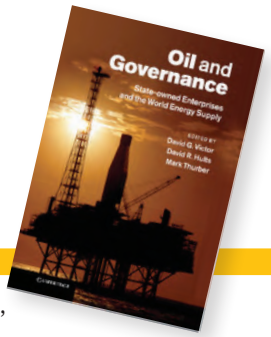
The US supplies the vast majority of gas to Mexico, but the country also imports LNG from Nigeria, Qatar, Indonesia, Peru, and Yemen. US natural gas exports to Mexico reached a record high in 2012, to 1.69Bcf/d, a 24% increase from the year before, coming from Texas, California, and Arizona.

75 years

Earlier this spring, Mexico marked the 75th anniversary of the nationalization of its petroleum industry. Since they were unceremoniously exiled in the March 18, 1938 nationalization of Mexico's oil fields, international oil companies have been unwelcome in the country. And companies whose investments have been expropriated have been loath to reinvest, especially without a large, upside potential. IOCs want to be able to share production and book reserves.

Several PECOM speakers noted that there is still strong social and political opposition to working with international oil companies. The reasons include the ostensibly popular desire to protect national patrimony, government reliance on PEMEX tax revenues and largesse, unionized oil workers, and gasoline price subsidies benefitting Mexican consumers. Perhaps there is a lingering sensitivity to Spanish imperialism, as well.

These circumstances don't naturally promise success, but there is already a shift in government rhetoric. Mexico's new president, Enrique Peña Nieto, of the Institutional Revo-



lutionary Party, may have new proposal by September. He has vowed to modernize Pemex by permitting greater foreign investment, although it is likely that foreign investment will only be allowed offshore and in shale development.

PEMEX

The mission of Pemex Exploracion y Produccion (PEP) is "to maximize the reserves of the country, both in crude and natural gas economic value, on [a] long-term basis." PEP is divided into four regions: North, South, Northeast Offshore and Southeast Offshore.

Ing. Jose Luis Fong, subdirector of production for the South region, shared strategies at PECOM. "60% of our production is offshore and the South region is important," producing 508Mbo/d and 1652MMscf/d natural gas in 2012. Crude from the South region varies from 20°API to 60°API, and comprises three main streams: Maya (3%), Istmo (64%), and Olmeca (33%). The region employees 27% of Pemex's 15,896 workers.

Fong characterized extraction costs as relatively low, and said artificial lift systems were in place. The logistics challenge is to incorporate more coiled tubing and nitrogen operations, and attempt to double, or even triple the efficiency. He mentioned a continuing problem with downhole centrifugal pump failures, and stressed the need to improve response times.

It's important for companies to be flexible, Fong said. Small and medium-sized companies must be more efficient and more competitive: "We must make hydrocarbon extraction more efficient…This is a business, not a sport."

When bidding for Pemex contracts, companies are expected to generate local employment, and capital projects should have at least 40% national content. Operations must respect local customs and residents: "They are part of us and we are part of them," Fong said.

He stressed social and environmental responsibility, and mentioned the creation of buffer zones around industrial activities. There was a big effort in the 1990s to clean up past drilling damage, he said. "Activities need to be done better than they were before. No company is going to do work here and leave the land and water in poor condition."

Ognen Stojanovski, a Research Fellow at Stanford University's Program on Energy and Sustainable Development, says that Pemex's economic efficiency "does not compare favorably" with other large operators. Stojanovski is an engineer and attorney, and recently penned a lengthy chapter about Pemex in: *Oil and Governance: State-owned Enterprises and the World Energy Supply* (Cambridge University Press, 1036p., published January 2012). The editors contend that NOCs produce most of the world's oil and bankroll governments across the globe. Stojanovski's analysis, "Handcuffed: an assessment of Pemex's performance and strategy," is among the NOC case studies in the volume.

Is Pemex even an NOC? PECOM speakers challenged this, pointing to Pemex's lack of financial autonomy. According to the Mexican Constitution Section 90, Pemex is a government office, not a company. It is regulated by the State and is non-competitive.

Pemex does not have an independent board of directors. A truly autonomous company would be able to set its own budget, but Pemex has to negotiate its budget with the Mexican government each year. Capital expenditures are reviewed by the finance ministry. Hydrocarbons are regulated by myriad arms of the government:

- SENER – Secretaria de Energia.
- CNH – Comision Nacional de Hidrocarbures.
- CRE- Comisión Reguladora de Energía.
- IMP – Instituto Mexicano del Petroleo.

The upshot is that the Mexican government has becomes too dependent on short-term revenues from Pemex and has not diversified its tax base.

Future potential

US drilling has surged in the Eagle Ford shale and in the Gulf of Mexico. But Mexico has not developed the shale south of the US border, and the Mexican Gulf waters are relatively untapped. There is substantial potential in both areas.

The future of oil development in Mexico is about secondary, enhanced oil recovery, shale exploration and offshore development.

PECOM 2013
19th Exposicion y Conferencia del Petroleo de Mexico
9-11 April 2013
Parque Tabasco, Villahermosa, Mexico

A recurring theme of discussion at PECOM was when, where, and how foreign involvement will be allowed to speed up Mexican oil and gas development. In the meantime, proven reserves are being consumed. OE

ThoughtStream

Steve Wisely, Subsea 7 S.A.

Identifying deepwater challenges

As subsea projects continue to increase in size and complexity, they are also more frequently executed in deepwater and harsh environments. As well as having the vessels and ROVs with the capabilities to execute the scopes, and the expert people to develop the technologies and to manage larger and more complex projects at greater depths, new technologies are required to be introduced to meet these challenges.

Deepwater surface-to-seabed projects today are typically at depths of 1,500-2,000m and an increasing number are at depths of up to 3,000m. HPHT wells, the composition of the hydrocarbons and the harsh environments require new technologies to be developed to meet the challenges of operating at these depths. At the same time, these technologies must enhance safety, improve productivity, and achieve cost reductions.

As well as extending the high-end capability of vessels to deploy pipelines and associated seabed infrastructure at such depths, these advances range across many enabling and production technologies, including pipelines, risers, welding and remote intervention.

To develop new fields in ever deeper water, pipeline technology is required to meet the challenges of longer tie-backs, flow assurance and corrosive products. These advances also call for compatible advances in welding technology.

That's why Subsea 7 has an extensive welding R&D program to enhance fatigue life and improve the quality of performance across a range of pipeline materials. Subsea 7 has recently extended its global pipeline development center in Glasgow to help support Subsea 7's full range of pipeline installation methods and the procedures required to meet the exacting standards of deepwater.

> The bouy supported riser offers the advantage of being able to accommodate a large number of risers into a single FPSO facility.

To meet a wide range of field characteristics such as water depth, environmental conditions and hydrocarbon composition a range of technologies is required for risers. Hybrid, single, grouped SLOR and steel catenary risers have all been developed by Subsea 7 in recent years.

The latest riser development, the Buoy Supported Riser (BSR) concept, was developed in partnership with Petrobras and will be deployed for the first time in the Brazilian pre-salt Guara and Lula fields. The BSR offers the advantage of being able to accommodate a large number of risers into a single FPSO facility by gathering these initially through a series of sub-surface buoys before being hooked-up to the FPSO.

Looking to the future, composite materials such as carbon fiber are being considered as an alternative material to conventional carbon steel for risers, offering both strength and weight savings.

Finally, the challenges posed by deepwater subsea system architecture and the need for life-of-field maintenance demand reliable, high-technology remote intervention solutions. There have been many pioneering developments of ROVs and remote intervention technology over the last 30 years. Our most recent innovation is the development of the advanced hovering autonomous inspection vehicle (AIV). This vehicle, and the associated inspection and monitoring sensor technology, will provide an industry step-change for future underwater operations.

***Steve Wisely** has served as Subsea 7's Executive VP of Commercial since January 2011. Wisely has held multiple positions within Subsea 7 and its predecessor companies including Regional Vice President for Asia Pacific and later VP of Global Business Acquisition. He holds a degree in Quantity Surveying from the Robert Gordon Institute of Technology in Aberdeen.*

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Security Solution for Offshore Platforms

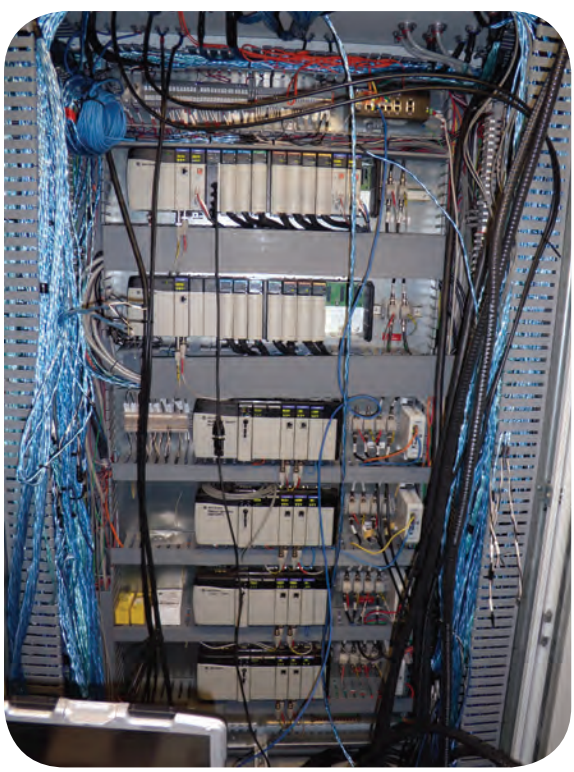
Eric Byres

Over the past few years, the need to protect industrial control systems (ICS) from cyber threats has greatly increased. The integration of industrial Ethernet infrastructure with business networks (and the outside world) has exposed once proprietary systems to attacks no one ever thought they would have to withstand.

At the same time, the cyber threat level, especially threats aimed at the energy industry, has increased dramatically. Control systems have become a key target for security researchers, hackers, and government spy agencies, resulting in exponential growth in security alerts for supervisory control and data acquisition (SCADA) and ICS products.

Add it up: vital networks with large numbers of hard-to-secure nodes, integrated with business systems and operating 24 hours a day – it's a significant security challenge. Combine this with the heavily regulated environment and safety concerns of offshore processing platforms, and the task is even harder.

DIN rail-mounted security appliances.



Project: improve reliability, security, availability

This was the situation facing one fixed natural gas and oil gathering and processing platform, located on the US continental shelf. Designed to process a large volume of natural gas and oil from multiple wells, its operating company placed a heavy emphasis on reliability. Any downtime, whether caused by accidental or malicious forces, interrupts field production and is costly.

Complicating matters, the platform is both MTSA (Maritime Transportation Security Act) and TWIC (Transportation Worker Identity Credential) regulated, due to its large production volumes.

This meant that the required level of security was significantly more stringent on this platform. Physical security included card readers, closed circuit TV and local/remote monitoring. The company wanted to extend this level of security to include cyber-related risks.

So with the goal of maximizing the reliability and uptime, the operating company embarked on a project to improve cyber security on the platform.

Securing platform control systems

The network on the platform spanned across business, operations, and safety systems. As is common on offshore facilities, a wireless backbone connected the platform to the office and control facilities "on the beach."

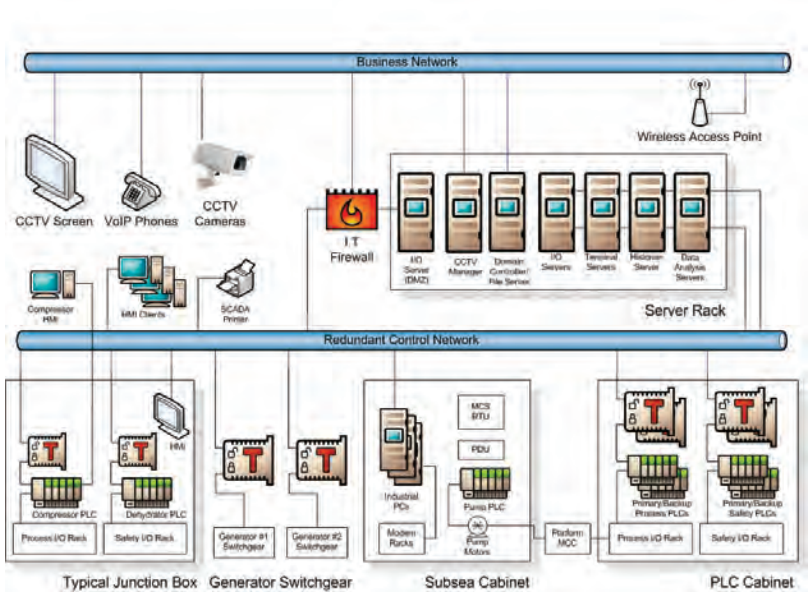
Control system networks interconnected a large quantity of programmable logic controllers (PLCs), instrumentation, "smart" automated equipment, and packaged process control equipment. Additionally, the facility communicated with subsea systems and virtual flow meters using the OPC protocol.

Consequently, there was the potential for large amounts of network traffic and crosstalk. Some PLCs used a UDP broadcast/multicast protocol, which further increased the volume of network traffic. Since many automation devices cannot ignore or filter out extraneous network messages, it was necessary to protect those devices from excessive traffic.

The cyber security solution thus had to protect systems from malware and excessive/malformed network traffic to minimize the possibility of unintended network or automation system shutdowns.

Cyber Security Solution

A "defense in depth" network architecture was developed, in accordance with guidelines recommended by the Department of Homeland Security and the ISA/IEC62443 standards. This architecture separated layers of the business and process control network, using firewalls to permit only necessary traffic between



Simplified network diagram.

these layers.

The first step was to install an IT firewall to protect the entire platform. However, this would do little to defend against problems such as worms introduced via laptops or USB drives. So the automation and business networks were next separated using managed switches and firewalls. Demilitarized zones (DMZ) were there to protect the process control system from the Internet and the business network.

After careful review of available security products, the engineering team selected an industrial security solution for the control system firewalls. The reasons for this decision included:

- The security appliances can be DIN rail mounted, the standard for offshore industrial cabinets.
- The security appliances are rated for Class 1, Division 2 hazardous areas (important on offshore facilities).
- The system uses a central management strategy, making the configuration of multiple security appliances efficient.
- Users can install automation-specific, loadable security modules as needed.
- The solution is simple to install and maintain by operations and maintenance staff.

Design and Installation

The PLCs at Level 1 in the process control network (PCN), as well as switchgear and various packaged process units, were protected with security appliances loaded with a SCADA specific firewall module. Only the necessary operating protocols were allowed through the firewalls, determined by a data exchange strategy.

Reliability of the system was a core requirement. Redundant security appliances were installed in front of redundant Allen-Bradley PLCs. The security appliances were then configured and tested to assure that the failover of the primary PLC processor to the backup processer would not impact control communications, and that the security appliances in turn would maintain security functionality, regardless of the switchover state of the PLCs.

In total, 12 security appliances were used on the platform. All were loaded with a firewall-loadable security module. The central management platform, which manages all of the security appliances from a central location, was installed on a server in the facility.

Challenges and Outcomes

As with many IT devices deployed into an automation environment, a challenge during the project was the perception that firewalls make the job of operations and maintenance more difficult. Initially staff had a "knee jerk" reaction to blame the firewalls any time there were network problems. With a thorough testing regime, however, it was shown that the proper protocols were enabled to accommodate all operations.

The cyber security solution has now been in operation for five years. The result has been increased reliability and availability of the platform. A virus outbreak (introduced by a contractor) was contained by the separation strategy. The project is widely seen as a good example of how a well-designed security solution can actually reduce costs and improve productivity on offshore platforms. OE

Eric Byres *is a leading expert in the field of critical infrastructure security. He is CTO and VP Engineering at Tofino Security, a Belden brand. His email is eric.byres@belden.com*

Global Briefs

A Shell halts Arctic program

Royal Dutch Shell announced it will pause its exploration drilling activity for 2013 in Alaska's Beaufort and Chukchi Seas to prepare equipment and plans for a resumption of activity at a later stage.

"We've made progress in Alaska, but this is a long-term program that we are pursuing in a safe and measured way," said Marvin Odum, director, Upstream Americas. "Our decision to pause in 2013 will give us time to ensure the readiness of all our equipment and people following the drilling season in 2012."

Shell completed top-hole drilling on two wells in 2012 in the Beaufort and Chukchi Seas, marking the industry's return to offshore drilling in the Alaskan Arctic after more than a decade. This drilling was completed safely, with no serious injuries or environmental impact. After the drilling season ended, however, one of Shell's drilling rigs, the *Kulluk*, was damaged in a maritime incident related to strong weather conditions.

The *Kulluk* and the second drilling rig, the *Noble Discoverer*, will be towed to locations in Asia for maintenance and repairs.

B Sea ice loss

Current measurements of the ESA ice thickness satellite CryoSat-2 have shown that the total mass of the Arctic sea ice was 36% smaller last autumn than during the same period from 2003 to 2008. This conclusion

was reached by an international research team after comparing the CryoSat data of the past two years with measurements of a former NASA satellite and with the results of sea ice investigations of the Alfred Wegener Institute, Helmholtz Centre for Polar & Marine Research.

C Gulf of Mexico Lease Sale 227

, held in this past March in New Orleans, drew US$1.2 billion in high bids for tracts spanning the coasts of Louisiana, Mississippi, and Alabama. Statoil was the highest bidder on 15 leases, while Apache acquired nine shallow water and five deepwater leases.

D Chevron hits Coronado pay

Chevron encountered more than 400ft of net oil pay at its deepwater Coronado well No. 1 in the US Gulf of Mexico. Coronado comprises Walker Ridge Block 98. The No. 1 well is located approximately 190 miles off the Louisiana coast in 6,127ft of water. The well was drilled using a dual-gradient system to a depth of 31,866 ft by the drillship Pacific Santa Ana.

Global Briefs

Contracts

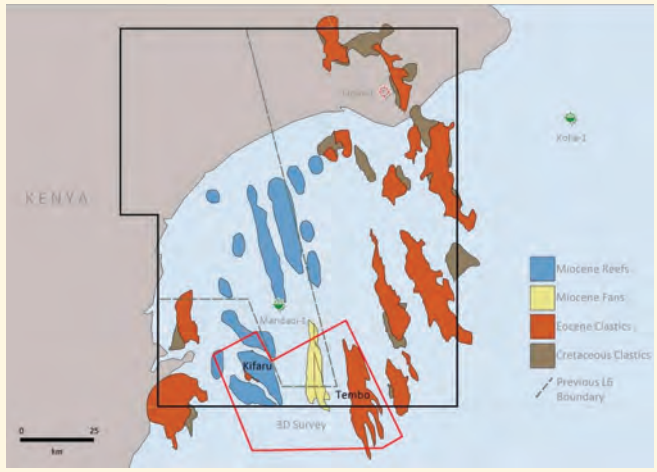
2H Offshore wins LLOG project 2H Offshore, an Acteon company, was recently awarded a steel catenary riser (SCR) detailed design project from LLOG Exploration. The scope of work includes detailed design of the production and export SCRs tied back to the Exmar *OPTI- 11000* semisubmersible for the Delta House field development in MC block 254 in about 4500ft of water.

Petrofac wins EPIC project Petrofac has been awarded an engineering, procurement, installation and commissioning (EPIC) contract by Abu Dhabi Marine Operating Company (ADMA-OPCO) for Satah Al Razboot (SARB) package 3 project, offshore Abu Dhabi. The US$500 million competitively tendered contract will begin shortly and will be delivered by April 2016.
The SARB Project is a high priority and new field development off the northwest coast of Abu Dhabi. Drilling will be conducted from two artificial islands (SARB1 and SARB2) with the well fluid sent by subsea pipeline to a facility on Zirku Island for processing, storage and export.
Petrofac will deliver 200km of subsea pipelines for well fluid, water injection, gas injection, flare and export, along with three kilometers of onshore pipeline and 55km of subsea power and communication cables. Further scope includes two riser platforms and four flare platforms with four

E Neftegaz America Shelf LP (Neftegaz), an indirect independent subsidiary of Rosneft, acquired 30% interest in 20 ExxonMobil exploration blocks in the deepwater Gulf of Mexico (GOM). ExxonMobil remains operator with 70%. The blocks are about 111,600 acres (450sq km) in area in water depths from 2100-6800ft (640-2070m). Three blocks are in the Central GOM and 17 are in the Western GOM. The agreement was signed by Igor I. Sechin, president of Rosneft, and Stephen M. Greenlee, president of ExxonMobil Exploration Company.

F PetroJunín, a joint venture formed between PDVSA (60%) and Eni (40%), achieved first oil from the Junín-5 heavy oil field, located in the Faja del Orinoco, off Venezuela. The block is located around 550 km southeast of Caracas and covers an area of approximately 425 sq km. The Junín-5 block holds 35 billion boe of certified oil in place. PDVSA and Eni plan to increase production to approximately 15,000 b/d by the end of 2013. The partnership intends to achieve 75,000 b/d by early 2015, through the drilling of approximately 180 wells.

G Subsea 7 wins contract Subsea 7 was awarded a Petrobras contract worth over US$350 million for the operation of the pipelay support vessel *Kommandor 3000* on a day rate basis for five years. *Kommandor 3000* will start operations under the contract in 2013, after a 90 day dry-dock for maintenance. The work scope includes project management, engineering, and the installation of Petrobras supplied flexible lines and equipment on a day rate basis.



V The Kenyan Government has confirmed a 60% expansion of FAR Ltd.'s L6 exploration permit off Kenya. This previously relinquished acreage increases the total permit area to 5,010sq km. The company has identified a number of play types and prospects in the L6 permit, including a Miocene carbonate reef play that extends into the newly awarded acreage.

FAR estimates that the new acreage has prospective resources of 773 MMbbls of oil or 2,141 Bcf of gas (un-risked best estimate, 100% basis). This brings the prospective resource estimate for the total L6 permit to 3,962 MMbbls oil or in a gas only success case, 10,689 Bcf (unrisked, best estimate, 100% basis).

H UK explorer Premier Oil is in the process of choosing FPSOs for both its Catcher (UK Blk 28/9) and Bream (Norway Blk 17/12) North Sea development projects. Concept select for Catcher was agreed in December and development approval is expected to be sought once tendering is complete. Premier and partners at Bream opted for an FPSO as part of a life extension project.

I Det Norske Oljeselskap ASA received authorization to develop its two North Sea fields, Ivar Aasen and Gina Krog, on the Norwegian shelf. The Ivar Aasen field, which Det Norske operates with 35% interest, is estimated to contain 150 mmboe and its development is one of the largest on the NCS. It is estimated that total investment will be NOK 24.7 billion.

First oil is expected 4Q 2016. Gina Krog, which Det Norske holds a 3.3% share, contains a gross recoverable reserve of 225 mmboe, with 7.5 mmboe net to Det Norske.

Total investments at the field will be NOK 31 billion. First oil is expected by 1Q 2017.

the heart of the matter

Allseas

J Bittern install

Ocean Installer won a contract from Shell UK for umbilical installation at the Bittern field, blocks 29/1a & 1b in the UK sector of the central North Sea, 200km east of Aberdeen. The company will install two new static umbilicals of 20.7km and 1.8km in length. This includes pre-lay engineering, survey and confirmation of all routes and subsea work, umbilical monitoring and testing, installation, burial, and post installation testing.

Deepwater Gunashli off Azerbaijan

Image: BP

P Statoil and SOCAR

signed a memorandum of understanding (MoU) to jointly explore and develop the Zafar-Mashal structures in the Azerbaijani sector of the Caspian Sea. The MoU defines the framework within which the companies will explore the opportunities, conduct negotiations and agree on key commercial principles and terms during the next 12 months.

The new agreement fits well with Statoil's exploration strategy of getting access at scale and focusing on high impact opportunities. Commenting, Statoil CEO Helge Lund said, "This MoU reflects our long term commitment to Azerbaijan. We are pleased that the State Oil Company of the Republic of Azerbaijan is working closely with us as we progress with our plans for the further development in the Caspian area."

"Statoil has been present in Azerbaijan for more than twenty years and this agreement is an illustration of the strength of cooperation that exists between SOCAR and Statoil. We look forward to developing new prospects in cooperation with SOCAR," said president for Statoil in Azerbaijan Lars Troen Sørensen.

K Total wins Cyprus blocks

Total entered two production sharing contracts with the Republic of Cyprus for blocks 10 and 11 as part of the country's second offshore exploration licensing round. The licenses, southwest of Cyprus, extend over 2572 sq km and 2958 sq km.

L Tamar production begins

Production from the Tamar field offshore Israel started in April. The field is estimated to hold nine trillion cubic feet of natural gas, and is being developed by a group that includes Noble Energy, Delek Drilling, Avner Oil Exploration and Isramco Negev 2. Noble says the Tamar project includes the world's longest subsea tieback at 93 miles and in 5,505 ft water depth. Gas from the field 80km offshore Haifa is flowing to Ashdod.

US firm Kiewit Offshore Services fabricated the 11,000-ton topsides for the Tamar field development has total production capacity of 1600MMcf/d. It also built the jacket, which sits in 800ft of water.

Image: Delek

Tamar field

M Total launches Congo development

Total reached a final investment decision for its Moho Nord development off the Republic of Congo. Located approximately 75km from Pointe-Noire and 25km west of N'Kossa in water depths ranging from 450m to 1,200m, the Moho Nord project will target additional reserves in both the sourthern and northern portions of the license.The additional reserves are estimated at approximately 485mmboe.

N HRT Wavlis spuds well

HRT's wholly-owned subsidiary HRT Walvis Petroleum Ltd., spud the Wingat-1 (2212A/07) exploration well offshore the Republic of Namibia. The Wingat-1 well, which targets the Wingat Prospect inside Petroleum Exploration License 23, is located approximately 200km northwest of Walvis Bay at a water depth of 1,034m. The semisubmersible Transocean Marianas will drill the Wingat-1 well to a total depth of 4,100m.

O ONGC Videsh Ltd.

finalized a US$1 billion purchase of Hess Corp.'s 2.72% stake in the Azeri, Chirag, and Guneshli fields (ACG), and Hess' 2.36% stake in the associated Baku-Tbilisi-Ceyhan (BTC) pipeline. The deal is worth an estimated US$884 million after tax net proceeds.

ONGC said that this is the first acquisition of a producing property made by the company in the Caspian Region. ONGC Videsh also announced it has finalized a major multi-billion dollar transaction in Kazakhstan's Caspian sector, which is under review by the host Government.

The ACG fields are in the Caspian Sea about 100km east of Baku. BP operates the fields on behalf of the AIOC coventure, formed of BP, Chevron, Devon, Statoil, SOCAR, ExxonMobil, Inpex, Itochu, and TPAO.

Q Gazprom readies Kirinskoye flow

Image: Gazprom

Kholmsk, Sakhalin Region

Natural gas production will begin this year from the Kirinskoye gas and condensate field under the Sakhalin III project, Gazprom announced. It said that for the first time in Russia's history subsea production systems will be used to produce natural gas.

The company plans to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1500ft
2250ft
3000ft
3750ft
4500ft
5250ft
6000ft
6750ft
7500ft
8250ft
9000ft
Quality that makes the difference.
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Contracts (continued) interconnecting bridges and one single point mooring (SPM) buoy located north of Zirku Island.
Onshore scope includes: drilling utilities, foundations on SARB1 and SARB2, transport, install, hook up, and assistance in commissioning accommodation modules.

BRIL wins IRM award

Bibby Remote Intervention Limited (BRIL) secured a contract with a potential seven-year commitment. Centrica Energy has awarded a three-year contract with two, two-year extension options, worth up to £40million. It is the largest Inspection, Repair & Maintenance (IRM) contract Centrica has ever awarded. BRIL will provide Centrica Energy with all onshore and offshore support functions for remotely operated vehicles (ROV) and diving support vessels (DSV). The work will include pipeline surveys and structural inspection, as well as a multitude of intervention, maintenance, and repair activities. The project will cover the Northern, Southern, Central, and East Irish Sea, Dutch regions, and potentially Trinidad.

CGG wins PRM contracts

CGG was awarded two contracts by Statoil ASA to provide long-term seismic imaging services for permanent reservoir monitoring (PRM) operations on the Snorre and Grane fields in the Norwegian sector of the North Sea. The scope of each contract also includes acquisition QC services.

The contracts are for an initial fixed term of four years for each field, with an option for Statoil to extend each contract by two further terms of two years each. The first survey is scheduled to begin in October over the Snorre field.
CGG will set up two PRM dedicated processing centers within Statoil's offices in Stavanger and Bergen. In this way, acquisition QC and imaging of the data from each repeat survey will be performed by a team of CGG specialists in close collaboration with Statoil's Snorre and Grane asset teams.

ABB wins Ichthys work

ABB has won two contracts worth a combined $45 million on the Ichthys oil and gas project offshore Western Australia. The firm has been appointed as the main electrical contractor (MEC) for a new floating production, storage and offloading (FPSO) vessel for the Ichthys oil and gas field in the Timor Sea.
The order, worth $30 million, was awarded by Daewoo Shipbuilding & Marine Engineering, the engineering, procurement and construction (EPC) contractor for the FPSO.
ABB was also awarded a $15 million order by Samsung Heavy Industries to be the MEC for the Ichthys central processing facility.
The field is a joint venture between Japan-based Inpex Corp. and Total E&P Australia, and is estimated to contain 12.8 Tcf of gas and 527 MM bbl of condensate, and have an operational life of more than 40 years.

apply the experience to developing the Russian Arctic.

Currently, Gazprom is in the process of predeveloping other fields of the Sakhalin III project, saying that an action plan has been worked out as part of the project for the Yuzhno-Kirinskoye gas and condensate field development.

R WZ 6-12 first production

has begun at the CNOOC-operated Beibu Gulf Project in the South China Sea. Partner Roc Oil (19.6%) says production from two development wells, A5H and A2 on the WZ 6-12 wellhead platform, follows the successful installation, hook-up and commissioning of offshore facilities.

The trial production period will continue until the next batch of three production wells are completed and brought online. The next set of development wells will be drilled by the *HYSY 931* jack-up.

S Salamander finds gas

Salamander Energy made a gas discovery at its North Kendang-1 exploration well inside the South East Sangatta PSC off Indonesia. The company's initial test results point to wet gas. Pressure data indicates a potentially significant column height.

Salamander said that once the well reached the first Upper Micocene reservoir target at 2,533m TVDSS, the well took a significant kick from an influx of high pressure gas at a wellhead pressure of about 4,000psi.

Salamander used Diamond Offshore's Ocean General semisubmersible rig to drill the well to 2533m TVDSS.

Image: Diamond Offshore

Ocean General

T LNG project dropped

Woodside will not pursue its proposed Browse LNG development near James Price Point in northwestern Australia. Following a technical and commercial evaluation, Woodside will now work with its Browse partners: Shell, BP, Japan Australia LNG, and BHP Billiton to evaluate other development concepts.

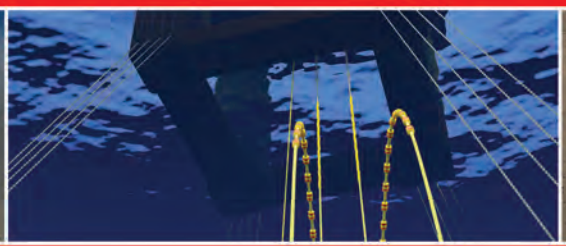
U MOPU for West Seahorse

3D Oil and partner Hibiscus Petroleum Berhad have decided on the use of a leased Mobile Offshore Production Unit (MOPU) to develop their West Seahorse oil field in VIC/P57, offshore Victoria.

Front end engineering design for the development has started with the contract awarded to Melbourne-based WorleyParsons.

3D Oil expects the joint venture to make a final investment decision immediately after it receives regulatory approval, which is expected in the 4Q 2013. First oil is scheduled for 1Q 2015.

Wood Group kenny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Analysis

OMC – a view from the Mediterranean

By Elaine Maslin

This year's OMC conference "Charting a course in a changing sea" attracted more than 560 companies from 30 countries to Ravenna, Italy, for 26 technical sessions and 120 speakers. But the changing gas market was on everyone's mind.

US shale gas, EU market liberalization and the collapse of consumption in Europe have together upended the European region's stable market in gas, ENI chief executive Paolo Scaroni told this year's Offshore Mediterranean Conference (OMC).

Gas sales fell 15% in Europe in 2012 compared to 2008, due to the area's ailing economy. Meanwhile, the potential for gas exports from the US is looming as a result of the country's unconventionals boom.

And yet, says Scaroni, global gas prices remain dislocated.

For ENI, an integrated E&P and marketing company, the result has been a decision to renegotiate its contracts with all operators, including Norway's Statoil, Libyan National Oil Corp., Algeria's Sonatrach, and Russia's Gazprom, by the end of this year, Scaroni says.

However, the Mediterranean has its own shifting market to contend with. North Africa, whose governments and IOCs were out in force at OMC, is emerging as a growing consumer to the south. The eastern Mediterranean and East Africa are also opening up new, significant gas provinces.

Both trends are challenging traditional supplier-consumer relationships, but could also create an opportunity for the Mediterranean, OMC attendees heard.

Bruno Lescoeur, chief executive of Italian oil and gas group Edison, says: "Exploration and production could be the backbone of the economy in the Mediterranean, attracting investment. Italy has an opportunity to play an important role."

Bruno Lescoeur, chief executive, Edison

Driving increased demand in the south are countries more accustomed to exporting their resources: Algeria, Libya, and Egypt. These countries are now, for various reasons, starting to struggle to meet their own, growing needs (for energy as well as receipts from exports) and are hungry for foreign investment to increase production and make new finds, Lescoeur says.

While countries in Europe will see domestic demand double between 1990 and 2030, production is expected to increase by barely 20%. Meanwhile, countries to the south, from Turkey to Algeria, will see demand for energy increase eight-fold, and production six-fold, he says.

"This complexity between north and south will increase. The pure producer versus pure consumer paradigm is no longer valid," says Lescoeur.

"One thing is certain: The Mediterranean basin can be a game changer in the EU, if you look at the recent discoveries in the region and the change in relationship between producing and consumer countries."

ENI already has a significant proportion of its upstream business in North Africa – 30% in fact, said ENI's Scaroni, both onshore and offshore.

Libya, a member of the Organization of Petroleum Exporting Countries (OPEC), holds the largest proven oil reserves in Africa, at 47 billion barrels.

Egypt has large a proved and producing offshore hydrocarbon system, highlighted by BP's current US$10 billion West Nile Delta Project, one of the largest projects in the Egyptian offshore basin, due on stream in 2014.

Algeria has an established and significant onshore exploration and production industry—a key resource for Europe—but it is now also looking offshore to increase its reserves.

However, even Scaroni admits the

The Mediterranean basin can be a game changer in the EU, if you look at recent discoveries in the region.

going is not easy for international oil companies in the region, following a series of uprisings in 2011, ongoing political instability, arguments over payments to IOCs in Egypt, and more recently, the attack on the In Amenas gas plant in Algeria.

Scaroni told OMC: "What is happening in North Africa is a cause for concern for us. I'm personally very optimistic. Algeria has not been as impacted by the upheavals. In Egypt, development of the political system is moving in the right direction.

"In Libya, production stopped but started again. I visit all the time and I see the situation is improving. I was there last week and there were fewer weapons on the streets and more willingness to jump-start the economy. I see the future of this country is bright."

For Lescoeur it is fairly simple: "The challenges are in geographic turbulence and political turmoil and are amplified by economic and environmental risk environments. The trade-off is between risk and reward, between long-term vision and short-term constraints."

It is not just North Africa that has suffered from political instability. Italy, home of OMC, only last year lifted its offshore exploration and production moratorium after ratifying Legislative Decree 83/2012, opening its formerly closed territory within 12 nautical miles of the coast to renewed activity.

The government is now taking the sector seriously. Claudio de Vincenti, undersecretary, Ministry for Economic Development, described the sector as "strategic and key" at OMC. However, a new National Energy Strategy aiming to return production to 1990s levels by 2020 failed to get through Italy's parliament before inconclusive elections in March sent the country into a political vacuum with no majority government, OMC was told.

Italy, which started exploring the Adriatic through ENI in the 1950s, has the biggest oil reserves in Europe behind the UK and Norway, according to OMC host Ravenna Chamber of Commerce. But most of it is within 12 miles of the shore – to get to this resource the country needed a new authorization system in addition to lifting the moratorium, Scaroni says.

Despite the delays on their own doorstep, Italian oil and gas service companies are not resting on their laurels. Just like North Sea or Gulf of Mexico operators, they have a global market to tap.

Innocenzo Titone, chairman of OMC 2013 and also of ENI, says the industry was also looking to the potential for it to capitalize on the major recent exploration finds in the eastern Mediterranean, in the Levant, as well as new areas such as Mozambique.

Platform and ship fabrication firm Rosetti has already been looking further afield. It opened a new yard in Kazakhstan in 2009 which now accounts for 30% of the firm's business.

Rosetti has been moving into established markets in recent years. It was quick to step into a void in the North Sea left after the oil price slump in the 1990s. Rosetti moved in when activity started to rebound, carrying out projects for ConocoPhillips and Total, and is continuing to look at UK work, especially smaller brownfield projects.

Italian drilling firm Drillmec is currently working on three EPC contracts for complete offshore drilling packages for fixed platforms in the Gulf of Mexico and the Caspian Sea for PEMSA—Perforadora in Mexico—and Caspian Energy for Lukoil in the Russian Caspian Sea.

North Africa

The desire of North African countries to increase their reserves and production was reinforced by the numbers of delegates from Algeria, Libya and Egypt at OMC. Algeria

sent government officials and representatives from state oil firm Sonatrach, with speakers from both and a large exhibition stand. It is already a well-established onshore producer. Operations in the south of the country made it the fourth-largest crude oil producer in Africa in 2010, following Nigeria, Angola, and Libya, according to the IEA. The hydrocarbon industry accounts for about 37% of the country's gross domestic product and revenues from the sector cover two-thirds of the state budget, according to Sonatrach.

CGG will complete Algeria's 5000sq km, 3D seismic acquisition program in July.
(Images: www.pidragen.com)

However, oil production has fallen and domestic demand for gas for power has increased, so the firm is keen to attract international operators to help explore its offshore acreage –93,000sq km spread along 1200km of coastline. To this end the country says a new law has been introduced offering better fiscal terms for new projects, specifically for offshore, as well as unconventional projects. Sonatrach is itself planning to invest $80 billion between 2012 and 2016, 73% of which would be on upstream activities, OMC was told.

"Our goal is to continue production, but also further exploration to find new reserves," says Abdelhamid Zerguine, the firm's chief executive. "The challenge for Algeria is to meet domestic market needs in the long term. The rate of growth of the population has been 15%. The other challenge is to strengthen our position in supplying oil and gas to the world. We need partners."

Offshore Algeria is considered a frontier area because there has been so little exploration, says Sonatrach geophysicist Nahim Khennaf during OMC. In the past, Sonatrach has claimed that successful exploration on equivalent basins Northern Tunisia and Southern Italy confirm the existence of hydrocarbons in its offshore territory.

However, the only exploration offshore to date has been a deepwater well in the 1970s (Habibas-1, drilled in 923m of water to a total depth of 4496m in Hercynian and inconclusive), which means there is little information available for any international companies to interpret, Khannaf says.

Algeria is now looking to change this, he said. It has a large amount of 2D seismic data across the area – shot ahead of a previous attempt to attract foreign investment - but the country recently launched a major 3D seismic acquisition program using French firm CGG. It is shooting 5000sq km; 4000sq km in the eastern area, 1000sq km in the west.

Offshore data acquisition began in February and is due to finish in July. Processing has already started but is expected to take at least a year, with potential plans for exploration drilling to start in late 2014 or 2015, Sonatrach says.

"Offshore, Sonatrach is working alone," Khennaf says. "The southern (onshore) geology in the Sahara is less complex than the north and offshore, and the southern part is well explored. Only a few companies are working in the north and currently, not a single foreign company. It is thought offshore is similar to the onshore northern area where there was a discovery in the 1960s. Some believe there is some analogy with offshore Red Sea, also offshore Spain, off Valencia, and Sicily. We are hoping the new law will make it more attractive."

A report by WesternGeco in 2003, following the 2D seismic program, summarized the deepwater margin of Algeria as "potentially hosting a favorable combination of factors for the development of an effective petroleum system." OE

Quick stats

OE's at-a-glance guide to offshore hydrocarbon reserves and key offshore infrastructure globally is updated monthly using data from leading energy analysts Infield Systems (www.infield.com).

New discoveries announced

Depth range	2010	2011	2012	2013
Shallow (<500m)	93	104	71	9
Deep (500-1500m)	28	23	22	1
Ultradeep (>1500m)	30	20	34	7
Total	**151**	**147**	**127**	**17**

Note: Operators do not announce discovery dates at the time of discovery, so totals for previous years continue to change.

Reserves in the Golden Triangle

by water depth 2013-17

Water depth	Field numbers	Liquid reserves (mmbbl)	Gas reserves (bcf)
Brazil			
Shallow	25	3,236.00	1,680.00
Deep	16	3,257.00	2,555.00
Ultradeep	40	13,682.45	15,290.00
United States			
Shallow	20	94.95	1,223.50
Deep	28	2,131.87	2,280.78
Ultradeep	27	3,576.75	4,040.00
West Africa			
Shallow	151	3,411.60	18,222.81
Deep	47	5,825.00	6,540.00
Ultradeep	18	2,750.00	3,060.00
Total	**372**	**37,966.37**	**54,592.09**
(last month)	(384)	(39,556.37)	(61,662.09)

Greenfield reserves

2013-17

Water depth	Field numbers	Liquid reserves (mmbbl)	Gas reserves (bcf)
Shallow	1,358	79,677.08	840,869.86
(last month)	(1370)	(80,529.39)	(839,326.52)
Deep	172	15,008.74	87,092.48
(last month)	(178)	(15,540.74)	(98,551.48)
Ultradeep	104	20,438.2	65,907.00
(last month)	(110)	(21,248.20)	(74,957.00)
Total	**1,634**	**115,124.02**	**993,869.34**

Pipelines

(operational and 2012 onwards)

	(km)	(last month)
<8in		
Operational/ installed	42,570	(42,494)
Planned/ possible	22,133	(21,926)
	64,703	(64,420)
8-16in		
Operational/ installed	77,929	(77,854)
Planned/ possible	47,240	(46,567)
	125,169	(124,421)
>16in		
Operational/ installed	88,308	(88,086)
Planned/ possible	47,362	(47,271)
	135,670	(135,357)

Production systems worldwide

(operational and 2013 onwards)

Floaters		(last month)
Operational	272	(272)
Under development	47	(46)
Planned/possible	320	(326)
	639	(641)
Fixed platforms		
Operational	9,876	(9,828)
Under development	141	(129)
Planned/possible	1,438	(1,430)
	11,455	(11,432)
Subsea wells		
Operational	4,420	(4,401)
Under development	387	(396)
Planned/possible	5,959	(5,886)
	10,766	(10,683)

Global offshore reserves (mmboe) onstream by water depth

	2011	2012	2013	2014	2015	2016	2017
Shallow	10,431.06	6,125.23	68,939.80	31,391.27	41,138.09	32,272.94	54,548.99
(last month)	(10,462.16)	(6,259.20)	(69,222.24)	(31,671.16)	(41,312.10)	(32,349.61)	(54,316.60)
Deep	1,316.73	2,533.96	3,667.02	5,825.60	4,378.91	5,422.71	11,059.66
(last month)	(1,316.73)	(2,533.96)	(3,682.02)	(5,933.60)	(4,755.45)	(5,395.51)	(13,139.90)
Ultradeep	199.94	797.15	3,180.44	3,123.81	2,432.20	6,877.27	16,452.93
(last month)	(199.94)	(797.15)	(3,180.44)	(3,123.81)	(3,103.77)	(6,356.75)	(18,707.44)
Total	**11,947.73**	**9,456.34**	**75,787.26**	**40,340.69**	**47,949.20**	**44,572.92**	**82,061.59**

Global Deepwater Review

E&P companies are ramping up exploration of deepwater and ultra-deepwater reservoirs, encouraged by attractive oil prices. New developments spread across offshore Africa, Asia Pacific, Europe, Middle East and North and South America. Jeannie Stell showcases a few projects in water depths exceeding 1500ft.

Deepwater developments continue to increase, as operators delve into deeper and more complex formations from which to produce oil and gas. Although the sector sees significant long-term opportunities, taking on deepwater subsea challenges is not for the faint of heart.

Deepwater projects are capital-intensive, bringing economic and technical challenges along with soaring revenues for international E&P companies and oilfield service and equipment vendors. According to a February 2013 report by energy advisory firm Douglas-Westwood, more than US$232 billion will be spent on deepwater excursions between now and 2020.

Africa

For decades, developments offshore Africa provided a wealth of oil and gas reserves and production, and

the hits keep coming. The area is one of the most significant deepwater regions in the world. Nigeria and Angola lead the region with estimated reserves reaching more than 45 billion boe.

In addition to Africa's west coast activity, its east coast is emerging as an area of interest to E&Ps. New resources are being sought in Kenya, Tanzania, Mozambique, and Madagascar.

Total likes its chances in Africa. Total E&P Angola continues work on its CLOV find, an integrated development comprised of Cravo, Lirio, Orquidea and Violeta. There, a new purpose-built FPSO will be constructed by Daewoo Shipbuilding & Marine Engineering. Expected delivery is May 2013.

Meanwhile, Total continues to explore its options at its ultra-deep offshore Block 32. Appraisal work is continuing and first production could come from the central-southeastern portion of the block in the Kaombo project. Total is considering a pair of FPSOs for the project.

On March 22, the operator announced its final investment decision (a whopping $10 billion) and EPC contract awards for the Moho Nord development off Congo. The Moho Nord project will target additional reserves, estimated to be about 485MMboe. The project is the latest step in developing the license, following on the success of Moho Bilondo Phase 1E.

For Moho Nord, 17 subsea wells targeting Miocene reservoirs will be drilled and tied back to a new FPU and 17 more subsea wells targeting Albian reservoirs will be developed from a newbuild TLP. Before being exported by pipeline to the onshore Djeno Terminal, the new production will be processed on the FPU, which will have a capacity of 100,000b/d. Total expects first oil in 2015 with output reaching 140,000b/d in 2017. Total E&P Congo operates 10 of the 22 fields developed, accounting for nearly 60% of national output.

Offshore Nigeria, Total is working its Egina oil field and hopes to deliver first oil in 2015. In March, Total Nigeria awarded a $3.1 billion FPSO vessel contract to Samsung Heavy Industries. The vessel will be based in the Egina field, in OML130 near the Akpo field. The FPSO will measure 330m in length, 61m in width and 33.5m in depth, have a gross dry weight of 34,000 tonnes, and will store about two millionbarrels. Egina has reserve potential of more than 550MMboe, and will bring in first oil in 2015. The project is expected to show a projected peak production of 150,000b/d.

Global Deepwater Review

Offshore Ghana, Tullow Oil Plc is working its Jubilee and Tweneboa, Enyenra and Ntomme (TEN) developments. Work for Jubilee Phase 1A was approved by the government of Ghana in early 2012 and development started later that year with the spudding of the first production well. During 2013, about $1.1 billion capital spend will pay for five new producing wells, three new water injection wells and an expansion of the subsea network.

In March, Tullow signed a five-year contract with FMC Technologies for offshore and onshore technical services including maintenance, refurbishment, and inspection of equipment and tooling for the Jubilee field.

For now, the field is producing 110,000b/d. The combination of Phase 1 remediation work and additional Phase 1A wells is expected to ramp up production to more than 120,000b/d by the end of 2013.

Also offshore Ghana, Tullow is continuing development of its $4.5 billion TEN project, which is being designed with sufficient flexibility to allow both TEN resources and nearby discoveries to be tied into an FPSO.

The data from appraisal activity in 1H 2012 resulted in updated subsurface models for the TEN fields. The combined resources range is from 200MM - 600MMboe, with likely resources of 360MMboe, of which 70% is oil. First production is expected in 2015.

Asia Pacific

Malaysia continues as the go-to region for deepwater developers; Shell is working on its Gumusut-Kakap and Malikai projects.

The Gumusut-Kakap project includes joint development of two ultra-deepwater discoveries. Sabah Shell is the operator of Gumusut and Murphy Oil is the operator of the Kakap field. Field development is underway, and an average production of 135,000b/d is expected.

The oil project will be developed with 19 subsea wells tied back to a FPS that will weigh more than 40,000 tonnes and have a processing capacity of 150,000b/d. Produced crude will be exported through a pipeline to a new processing facility being built at Kimanis, Sabah province. Processed gas will go to the Petronas LNG Complex in Bintulu, Sarawak province, and some produced gas will be re-injected to

FMC Technologies delivered 10 production, injection and riser base manifolds that are currently installed at the Jubilee field, located offshore Ghana.
Source: FMC Technologies

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The project will use a modular-tree concept to enable versatility for production, water injection, and gas injection tree styles. Three production manifolds will be included with dual 8in. headers and 6in. branches for production, water injection, and gas injection configuration. The manifold valves will be controlled by a manifold-mounted subsea control module. The jumper connection systems will use connector systems with integral hydraulics and metal-to-metal gaskets.

In March, Shell Malaysia and its partners announced their final investment decision to develop the Malikai oil field. Shell Malaysia and ConocoPhillips hold 35% interest each and Petronas Carigali holds 30%. The field will be operated by Sabah Shell Petroleum Co.

Development will include 17 wells drilled from a TLP—the first of its kind to be fabricated and installed in the country. Engineering, procurement and construction contracts for the TLP have been awarded.

Technip was awarded the pipelines contract, which includes transportation, installation and pre-commissioning of an 8in.-diameter, 32mi. natural gas pipeline and a 10in.-diameter, 35mi. liquid pipeline, as well as steel catenary risers. The pipelines will connect the Malikai TLP to the Kebabangan platform. Technip's contract is scheduled to be completed by 3Q 2015. Offshore installation will be done by Technip's flagship S-Lay vessel. Dril-Quip Asia Pacific Pte Ltd. will supply subsea wellheads, tensioner systems, risers, production and injection trees, and tieback connectors through its local representative UMW Petrodril (Malaysia) Sdn. Bhd. Delivery of that equipment is scheduled to begin in 2014.

Murphy Oil is busy working to develop its Siakap North-Petai project off Malaysia. Murphy is operator with 32% interest. Its partners include Petronas with 26%, and ConocoPhillips and Shell with 21% each. The Petai-1 well was drilled in 2007 with an oil discovery and more drilling occurred in 2008. Unitization of Petai and the Siakap North Field in Block K was completed in 2011. First production is expected in third-quarter 2013.

The *Lorelay* pipe-laying vessel with support vessels work to install subsea systems at Chevron's Gorgon field. *Source: Chevron*

McDermott won the subsea contract, from Murphy Sabah Oil Co., to execute deepwater engineering, procurement, construction, transportation, installation and commissioning activities. The field is near the existing Kikeh field, northwest of Labuan Island, Malaysia, in waters 3,900ft to 4,900ft deep.

McDermott's field architecture will include two rigid, insulated, pipe-in-pipe production flowlines, one rigid water injection flowline, and one main umbilical system. The umbilicals will connect eight new manifolds and subsea distribution units to existing riser slots on the *Kikeh* FPSO. The development includes five water-injection and eight production wells, drilled from the manifolds at each of the four drill-centers.

Murphy awarded Aker Solutions the contract for the 13 subsea trees, eight manifolds, well jumpers, engineering for topside controls, and life-cycle support services.

In China, Husky Energy is focused on advancing the development of three major natural gas fields in Block 29/26 in the South China Sea. The company's deepwater Liwan 3-1 gas field is considered a cornerstone development for its Liuhua 34-2 and Liuhua 29-1 fields, which will share infrastructure. Husky partnered with CNOOC to develop the fields.

First gas production is anticipated in late 2013, ramping up through 2014 from its Liwan 3-1 natural gas project. Husky will operate the deepwater portion of the Liwan 3-1 field, including development drilling and completions, subsea equipment and controls, and subsea tie-backs to a shallow water platform. CNOOC will operate the shallow water infrastructure, including the platform, subsea pipeline to shore, and the onshore gas processing plant. Field development will include a subsea production system connected by flow lines and manifolds to a central shallow

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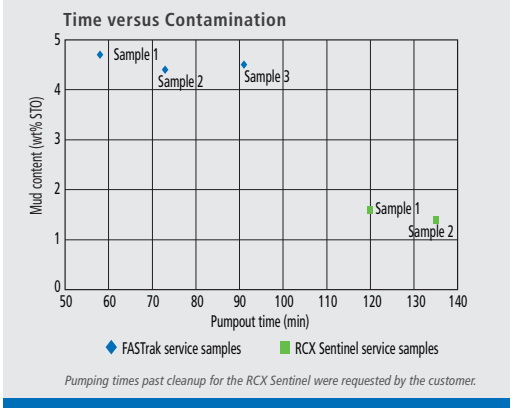

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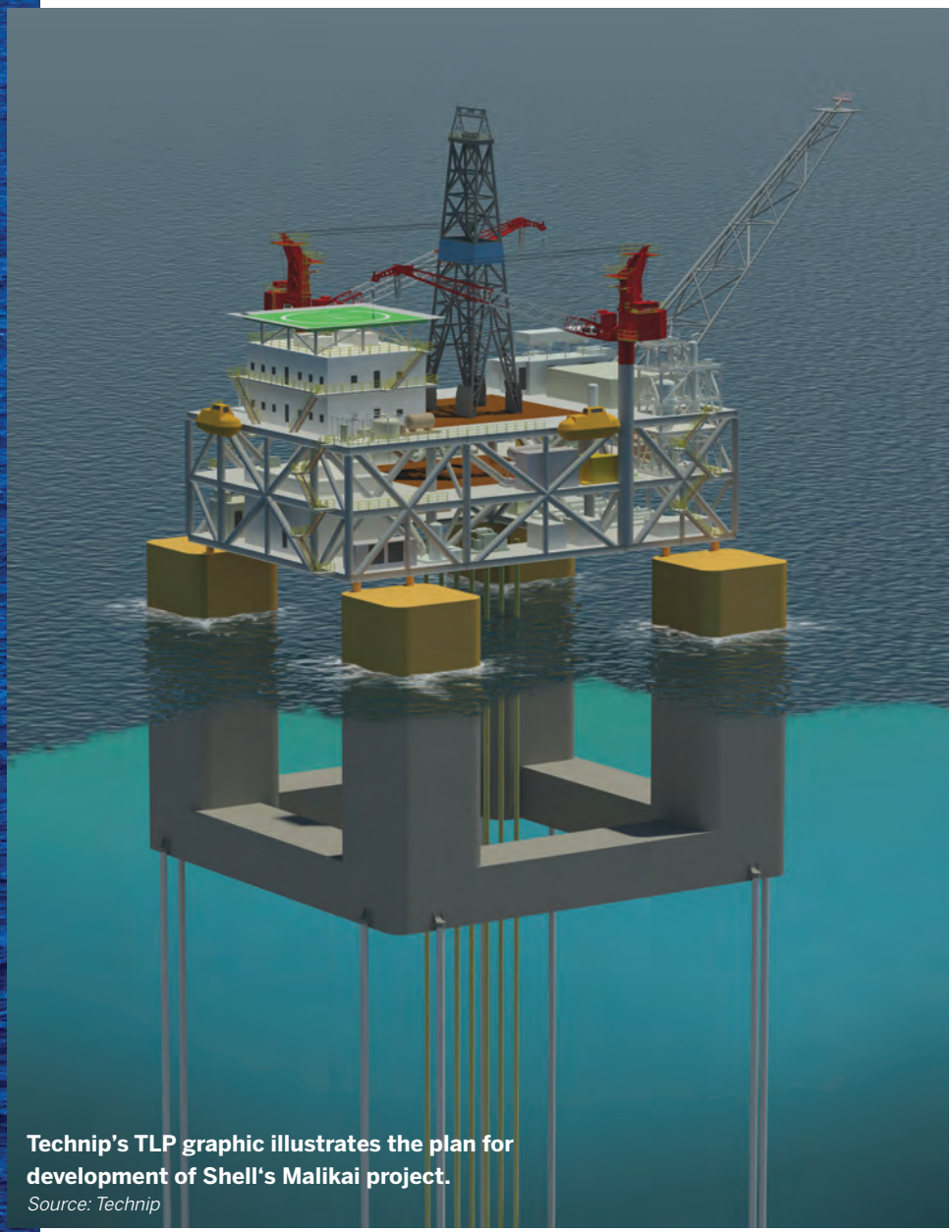
water platform, which in turn will be connected by pipeline to an onshore gas plant.

The Liuhua 34-2 field will be developed in parallel with the Liwan 3-1 field. Gas production from the Liuhua 29-1 field will share common gas processing and transportation infrastructure with Liwan 3-1 and Liuhua 34-2 and is expected to be onstream in 2014.

Off western Australia, Shell and Chevron (operator) continue to focus on the Gorgon project. The development is one of the largest natural gas projects in the world and includes five fields: Gorgon, Chrysaor, Dionysus, West Tryal Rocks, and Spar.

The Gorgon field has eight wells. First gas is expected in 2014, and is intended to supply Osaka Gas, Tokyo Gas, GS Caltex, Chubu Electric, and Nippon Oil Corp. The project is 55% complete and is expected to produce 15.6MM tonnes/year to feed liquefied natural gas into the markets by 2015. The project also includes the world's largest carbon capture and storage project.



Technip's TLP graphic illustrates the plan for development of Shell's Malikai project.
Source: Technip

Europe

Off the Shetland Islands lies the Rosebank oil and gas field in Blocks 213/26 and 213/27 of production license 1026. Chevron is the operator of the field with 40% interest; partners include Statoil (30%), OMV (20%), and Dong Exploration & Production (10%).

Rosebank is considered one of the biggest prospects in the UK Continental Shelf and Chevron plans to invest about $7 billion in its development.

The project is currently in the front-end engineering and design (FEED) stage. A final investment decision for the project is expected in 2013, followed by a drilling program in 2015. First production is expected in 2017. Chevron North Sea Ltd. awarded WorleyParsons and its INTECSEA subsidiary a FEED contract for new facilities associated with Rosebank field. In April, Hyundai Heavy Industries won a $1.9 billion order for a 99,750-tonne turret moored FPSO for Rosebank. Delivery is expected November 2016.

Exploration efforts off Norway continue to please operators. Statoil is preparing to install a platform at the Aasta Hansteen gas field, formerly Luva, in Blocks 6706/12, 6707/10, about 186mi. (300km) offshore in 4,265ft (1,300m) water-depth. The platform will be the first of its kind on the NCS with a production capacity of about 800MMcf/d.

Earlier this year, Italian energy company Eni secured a license to explore new acreage in the Barents Sea. The license covers about 160sq mi, east of Eni's Goliat field. Also, Statoil and its partners Eni Norge and Petoro drilled a discovery well on the Havis prospect in the Barents Sea, estimated to hold at least 200MMboe.

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Middle East

In the Middle East, Noble Energy couldn't be more pleased with its developments off Israel. In March, the company reported results from its second Leviathan appraisal well in the Rachel license. At its discovery, the Leviathan gas field was the most prominent field ever found in the (evidently under-explored) Levantine Basin. Production is expected to begin in 2017.

The Leviathan No. 4 appraisal well, drilled to a total depth of 16,992ft, encountered 454 net ft of gas pay in multiple intervals—the thickest net pay of any well drilled to date at Leviathan. This led to an increase in the estimated recoverable gross mean resources of the field to about 18Tcf. Assessment of pre-FEED is in progress, with initial production likely to begin in 2016.

In April, Noble announced that its Tamar natural gas field off Israel was successfully brought online with all five subsea wells producing at stable rates, totaling 300MMcf/d. When combined with existing Mari-B volumes, the total current sales are nearly 500MMcf/d and are expected to average 700MMcf/d through 2013. Initial sales began on March 31 as natural gas flowed from the field to the Tamar platform, and then onward to the Ashdod Onshore Terminal. The development is designed to deliver natural gas rates up to 1Bcf/d. The Tamar development includes five subsea wells capable of flowing 250MMcf/d each. Natural gas will flow from the field through the longest subsea tieback in the world, more than 90mi. long, to a platform near the existing Mari-B structure. The Tamar platform is tied into the existing pipeline that delivers natural gas to the Ashdod onshore receiving terminal.

Offshore Egypt, BP wants to close the gap of the domestic gas demand by covering 100% of Egypt's needs with its West Nile Delta development. West Nile Delta includes the North Alexandria, where BP holds 60% and is operator. RWE Dea owns the remaining 40%. In the West Mediterranean Deepwater license, BP is the operator with 80% working interest and RWE Dea has 20%. The West Nile Delta project has been planned to begin commercial operations by 2015.

KBR has been selected by BP to undertake the second stage of concept selection and definition for the onshore terminal and export pipelines for the resource. The scope of work

includes developing a technical definition package for an onshore terminal that will process 1,000MMcf/d of natural gas and condensate. The award follows the execution of the project's first stage by KBR, and builds upon the feasibility work completed by KBR's consulting subsidiary, Granherne.

North America

Deepwater drilling and production activities in the Gulf of Mexico began to increase at the end of the drilling moratorium instituted in 2011. Several projects are under development. Chevron is working on its Jack/St. Malo, Big Foot, and Tubular Bells projects. Jack/St. Malo (Walker Ridge Blocks 758 and 759) is about 55% complete and Big Foot (Walker Ridge Block 29) is about 65% complete. First production for all three projects is expected in 2014.

Hess, the operator of Tubular Bells in Mississippi Canyon Block 725, holds a 57.14% interest in the field. Chevron holds 42.86%. Hess and Chevron will spend $2.3 billion on the project, which will include three subsea production wells and two water injection wells, drilled from two subsea drill centers that will be tied back to the Gulfstar FPS, owned by Williams Partners. According to Williams, the FPS will be the first spar-based floating production system with major components to be built entirely on the Gulf Coast.

Williams Partners will provide production handling, export pipelines, gathering pipelines, and gas-processing services for the development. Initial production from the discovery is expected in 2014. Current estimates indicate peak production at nearly 45,000b/d, as the field could have about 120MMboe of reserves.

Anadarko Petroleum is working two major developments in the Gulf. Its Lucius project development is 230mi. offshore in Keathley Canyon Blocks 874, 875, 918 and 919, in 7,200ft of water. The project will be developed using a truss spar with the capacity to produce 80,000b/d and 450MMcf/d from six subsea wells.

Anadarko is also developing the Heidelberg field in Green Canyon Blocks 816, 859, 860 and 903. It tapped Technip to build and deliver a truss spar hull for Heidelberg. The spar will have a capacity of 80,000b/d and 81MMcf/d.

In March, Anadarko signed an agreement with an undisclosed party to enter into a carried-interest arrangement for a portion of Anadarko's ownership in the Heidelberg project. Anadarko will be carried for $860 million, representing its expected capital requirements until mid-2016 when the company expects the project to come onstream. In exchange, Anadarko will convey a 12.75% working interest in the Heidelberg development. Anadarko will continue as operator with a 31.5%

Global Deepwater Review

working interest.

In the Atwater Foldbelt, BHP Billiton's Mad Dog Phase-2 project is underway. Operated by BP in southern Green Canyon, the project will include a second spar and subsea production and injection wells. First production is scheduled for 2018.

ExxonMobil is progressing with its 2008 Julia discovery in Walker Ridge. Julia is the first well drilled under the 2005 agreement between StatoilHydro and ExxonMobil to explore the deepwater Gulf of Mexico, and is believed to be the largest find in the Gulf of Mexico since BP proved up the Thunder Horse field in 1999.

LLOG Exploration has awarded contracts for its Delta House project in Mississippi Canyon Block 254. Hyundai Heavy Industries will build a semisubmersible hull in Ulsan, South Korea, to house a floating production system (FPS).

The OPTI-hull design by Exmar is the second commissioned by LLOG. The first is serving LLOG's Who Dat field. Topsides for the Delta House FPS will be fabricated at Kiewit Offshore Services yard in Ingleside, Texas.

South America

Offshore Brazil continues to be a prolific region for Petrobras. Industry experts believe the region holds an estimated 31 billion boe of reserves in deepwater, pre-salt fields. As a result, Petrobras plans to build 24 pre-salt production systems by 2020.

Petrobras began oil production from its Baleia Azul, Jubarte and Pirambu fields in the Campos basin using the *Cidade de Anchieta* FPSO. Peak production is expected to reach 100,000b/d by 2Q 2013. The Sapinhoá field will be produced by the *Cidade São Paulo* FPSO. Lula NE will be produced by the *Cidade Paraty* FPSO. The company will charter another FPSO for its Iraceme Norte field in 2016. There, eight production and eight injection wells will by tied back to the FPSO.

In its Carioca project, Petrobras completed drilling Caioca Norte in the pre-salt layer of Santos Basin. Results obtained confirm the presence of light oil that had already been confirmed by wells 1-BRSA-491-SPS, Carioca Nordeste, and Carioca Sela.

At the Iara project, Petrobras confirmed oil in well 3-RJS-706 in Block BMS-11 in March, the fourth well drilled in the play. Further drilling will define the parameters of the field.

Petrobras moved forward on the Lula development in March, announcing that negotiations are underway with consortium partners Queiroz Galvão Óleo e Gás S.A. and SBM Offshore. The contracts are for two FPSOs at Lula Alto and Lula Central, in the pre-salt cluster of the Santos Basin. Each facility will be tied to 18 wells (10 production, 8 injector). Each FPSO will have a processing capacity of 150,000bo/d and 6,000,000cu m/d of gas. The FPSOs are expected on site in 2015 for Lula Alto and in 2016 for Lula Central. Production is planned to begin in January 2016 at Lula Alto and in March 2016 at Lula Central.

For the Papa Terra project, construction of the Petrobras *P-63* FPSO is nearing completion at Cosco's shipyard in China. The project will include three power modules with two 18-cylinder, 50DF dual-fuel engines per module, to be powered by treated well gas, crude, or marine grade diesel. Final commissioning of the engines will take place in late 2013 once the vessel is on location.

Deepwater oil and gas developments continue to be an integral part of the world's energy mix. As legacy onshore reservoirs are depleted, E&Ps are turning to deeper and more complex subsea developments, with many engineering and technical challenges. Subsea reservoirs challenges include hard rock, thick salt, and tightly-packed sands.

Such developments now account for more than 6% of global oil production. According to a recent statement by BP plc, that estimate is expected to rise to 9% by 2030. All indications are that E&P companies, service and supply providers are up to the task. Look for an update of this report in 2014. OE

The *Cidade de São Paulo* FPSO entered commercial production in January at Petrobras' Sapinhoá field.


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Full stream ahead

Dolphin Geophysical has set its sights on doubling its fleet and its market share. Meg Chesshyre hears from CEO Atle Jacobsen and his team.

Dolphin Geophysical's remarkable success, since it was established in late 2010, has been outlined by CEO Atle Jacobsen. He says that Dolphin had already become a sizeable player with a 5% market share, which it hoped to grow to 9% over the next couple of years. Revenues were US$221.3 million last year, up from $97.6 million in 2011, and were expected to be more than $300 million this year.

To help achieve this, Dolphin intends to double its fleet by 2015. It currently has two, high-end 3D seismic acquisition vessels on charter, *Polar Duke* and *Polar Duchess*, in addition to a medium-sized vessel, *Artemis Arctic*, and a 2D vessel, *Artemis Atlantic*. This year, Dolphin is taking on two, new, high-end 3D seismic vessels: the *Sanco Swift*, and the *Geo Atlantic*, from GC Rieber Shipping.

Sanco Swift, a 3250dwt newbuild, can accommodate 14 to 16 streamers and boasts a bollard pull capacity of about 200 tons, allowing it to tow large configurations. *Sanco Swift* will work half of the North Sea season this year with TGS-Nopec. It has a fixed term contract of five years, with two, three-year options to extend.

GC Rieber's *Geo Atlantic*, built in 2002, will be upgraded to tow 14 streamers at a yard in Singapore prior to delivery, which is expected to be in January 2014. Dolphin is chartering the vessel on a fixed contract of three and a half years, with additional options for two, two-year extensions. A second Sanco newbuild, *Sanco Sword*, is due for delivery in April 2014. It has a five-year contract with three, two-year options.

In addition, Dolphin has reached a further charter agreement with GC Rieber for a top-end, 22-streamer, 3D seismic newbuild vessel, working name *Super Duke*, with the highest ice-class. This will be constructed at Kleven Maritime in Norway, with delivery expected in March 2015. Its contract will be for five years plus two, three-year options. To support Dolphin's chartered vessel capacity growth, an additional equity of $41 million was raised in February.

Dolphin reports that recent contract awards include a three-year call-off agreement with Shell in Europe, a 3D survey for Genel in Morocco, a 3D assignment in the North Sea with Centrica, a further 3D project in Tanzania for Statoil, and a 3D assignment for Cairn Energy India off South Africa. In addition, OMV Petrom Romania has agreed a framework agreement, and Dolphin has two and half months' 2D work for the Norwegian Petroleum Directorate this year following a successful season last year.

Phil Suter, Dolphin's marketing and sales VP, comments: "These are exciting contracts, with great companies, in a range of geographical areas that offer some very promising exploration opportunities. We are expecting a busy period ahead in established European regions, such as the North Sea, and new territories along the African continent and beyond." Suter highlights an 8000sq km survey that Dolphin

Fourth-quarter utilization

During 4Q 2012, Dolphin's main focus was to follow through a strong backlog with 100% coverage for the quarter. The company obtained the traditionally high North Sea summer rates for the quarter in other geographical regions like Africa and South America with Shell, Statoil, and ONGC.

Afer mobilizing from Lebanon, *Polar Duke* worked on a high-profile, 12-streamer survey for Statoil off Tanzania. The *Polar Duchess* (pictured below) relocated to South Africa after a short yard stay in Stavanger, preparing for a record, wide-tow configuration for Shell in South Africa, which has now been completed. The *Artemis Arctic* finished acquisition for ONGC in Colombia last November and mobilized to northwest Africa for a project off Morocco.

The *Artemis Atlantic* completed the full North Sea season contract with the Norwegian Petroleum Directorate in mid-October. It then had a short project preparation yard-stay, before transiting to South Africa for a contract with Anadarko. The *Polar Explorer* was used to acquire a new phase of seismic for Dolphin's joint NWAAM multi-client survey off Mauritania. Dolphin decided not to exercise the option to extend the charter for the 2D vessel by a further year and it was redelivered to the ship owner last December.

completed for Shell earlier this year off the west coast of South Africa, using the *Polar Duchess* in a restricted weather window of only four months. The *Duchess* towed a record-breaking, very wide spread – eight streamers, 8km long, separated by 200m, constituting a moving width of 1.4km of equipment and covering a surface area of 11.2 sq km.

The survey was completed a week ahead of schedule, and during the survey Dolphin had 87% 'golden days' – defined by Shell as any day that has no HSE or technical interruptions.

Dolphin has a strong multi-client focus. It invested close to $60 million in multi-client projects in 2012 and is planning to invest $50-70 million this year. The initial focus is on the Barents Sea, the central North Sea, West Africa, and Brazil.

Johansen is optimistic about the market, and predicts continuing growth of typically 8-10% on the rate side. In 2011, the rates were $200,000-220,000/day for the big boats, 2012 produced rates of $250,000-280,000/day and this year capacity is being booked more than $300,000. Dolphin already has $150 million backlog going forward.

SHarp broadband

Dolphin Geophysical is to extend its 3D multi-client survey in the UK sector of the North Sea this year. The survey, which started in 3Q 2012, is the company's first commercial project employing its SHarp broadband seismic method. Chief geophysicist, Dr Gareth Williams, says: "Broadband seismic gives oil companies a much better understanding of the subsurface, which significantly reduces drilling risk.

That reduction of risk makes smaller fields in mature areas more economic, which is particularly relevant in the UK sector of the North Sea."

The deep, flat cable used by SHarp makes it easier to perform amplitude analysis (AVO), pre-stack inversion, and reservoir characterization, all powerful methods for detecting hydrocarbons. AVO and inversion are well-known techniques, but by increasing the seismic bandwidth, SHarp is said to provide both a higher definition image and, crucially, a more accurate description of the rocks and fluids prior to drilling.

Williams describes the processing package as the only seismic processing package written and developed for the 21st century.

"By combining acquisition and processing, SHarp is at the high-end of the seismic technology market. Some increase in bandwidth can be achieved using just processing, but to obtain the full benefit, the acquisition method must be updated as well. But it is the added capability of AVO and inversion, that really sets SHarp apart," says Williams.

Dolphin says SHarp's enhanced low and extended high frequencies (2Hz to 100Hz) provide greater penetration and higher resolution. The extra octave at low frequency enables imaging of subsalt, sub-basalt and deep targets, for which standard seismic methods are insufficient. It is also compatible with 4D.

With no special equipment required, all of Dolphin's vessels are capable of using SHarp. Processing begins onboard the vessels and is completed at its UK processing center in Tunbridge Wells. OE

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New drilling fluid offers environmental advantages

Environmental regulation has made drilling fluid selection increasingly difficult. Dr. James Gaertner describes a new water-based mud that balances performance and compliance.

There are two things the oil and gas industry can be certain of moving forward: the demand for petroleum is going to continue to increase into the foreseeable future and with that the demand for environmental compliance will grow. Recent events such as the Deepwater Horizon oil spill and the public debate on hydraulic fracturing, or "fracing", have led to increasing environmental awareness. Pressure on regulatory agencies from concerned stakeholders has led to recent local restrictions in exploration and production activities in New York, Pennsylvania, and Colorado, and to support more widespread and longer lasting measures from the EPA.

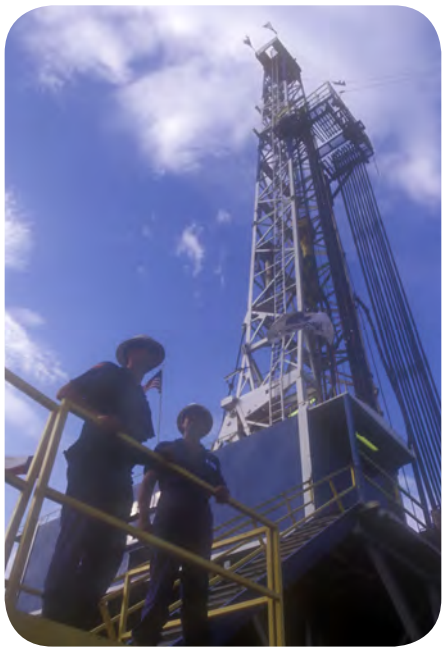
Despite these restrictions, the demand for oil and gas continues to increase at unprecedented rates, which has largely been met by new technologies that allow economic development of petroleum resources previously thought unattainable. Specifically, the use of hydraulic fracturing in conjunction with high-angle and extended-reach horizontal drilling has allowed development of unconventional shale resources. Today, more than 75% of formations being developed worldwide are in this group, despite the technically demanding well designs required. The combination of ever-increasing environmental regulation and sophistication of well design has made the selection of drilling fluids increasingly difficult. Operators face the complicated task of balancing environmental concerns and regulation compliance with the over-reaching goals of maximizing well production, protecting pay zones, and minimizing potential damage to today's sophisticated and costly rigs. Although conventional water-based muds (WBMs) are inherently environmentally friendly and have been used to drill thousands of wells, they many times fail to meet the high demands required to drill extended horizontal wells in reactive shale formations. On the other hand, oil-based muds (OBMs) are generally considered the benchmark for performance, but are plagued by serious health, safety, and environmental drawbacks, leading to use restrictions on- and offshore.

The use of a MHA drilling fluid system was developed to bridge the gap between HPWBMs and SBMs.

To address the need for a drilling fluid with high performance and environmental compliance several advancements have been made in formulations. Drilling fluids composed of low-toxicity, synthetic-base oils (SBMs), such as esters, linear paraffins, linear alpha olefins and internal olefins, have been developed to help to address the environmental concerns of diesel-based OBMs while maintaining performance. These SBMs however, still fail to meet the restrictions of whole-mud land farming, or discharge into the sea, and therefore require costly disposal. There are still concerns about the

toxicity of cuttings created while using SBMs, which have limited disposal options. The development of high performance water-based muds (HPWBMs) has gained recent widespread use as another strategy to balance performance and compliance. HPWBMs differ from conventional WBMs in their use of polymers, rather than bentonite clay to provide viscosity and API filtrate control. The use of polymers increases the fluid's resistance to contamination and allows a higher concentration, and wider range, of lubricants and shale inhibitors. Although HPWBMs adequately address the issue of environmental compliance, there is no clear consensus on whether or not they match the performance standards of OBMs.

The use of a Multi-Hydroxyl Alcohol (MHA) drilling fluid system was developed by ViChem Specialty Products specifically to bridge the gap between HPWBMs and SBMs. The MHA system is a hybrid between water-based and petroleum-based systems using a novel formulation. The system uses the unique properties of the MHA base fluid that acts as an environmentally-friendly alternative to the diesel- or synthetic-base fluids used in emulsion-based muds. The MHA base is composed of organic molecules that provide stability and performance characteristics comparable to petroleum-base fluids. However, unlike petroleum products, the MHA molecules contain multiple hydroxyl groups, allowing them to disperse in water without emulsification, and they are completely nontoxic to the environment. The system is designed for horizontal drilling in reactive shales and has been successful in both the Marcellus and Eagleford formations. This combination of performance and compliance would be especially valuable offshore where regulations on the handling and disposal of drilling fluid are more stringent. The use of the MHA system is currently being evaluated for offshore drilling and it has been extensively tested in onshore brine-based systems, Table 1.



Operators' must balance environmental concerns and regulation compliance making drilling fluid selection difficult.

The use of saltwater in the formulation of drilling fluid creates several obstacles to use, which can include clay flocculation and potential compatibility issues with viscosifiers, fluid loss additives, and lubricants. The MHA system is formulated without bentonite and great care is taken to keep native clays to a minimum. Native clays are inhibited from hydration through the use of solids control and shale inhibitors. All of this can help prevent the problems associated with unstable rheologies. The system is formulated to create stable properties and uses salt-tolerant polymers to provide viscosity and API filtrate control.

The use of lubricants in drilling fluids with high salinities can also create some unique issues in a drilling system. Incompatibilities of lubricants with divalent ions, such as calcium or magnesium, can produce a grease-like precipitate. "Greasing out" can reduce performance and potentially damage the formation. Some lubricants act like an emulsifier when coming into contact with even small amounts of oil in the system. This can cause inefficient operation of solids control equipment and damage the formation.

The L-20 lubricant has been extensively tested in high chloride drilling fluids and exhibits none of the problems associated with salt water systems. The company also has a popular coiled-tubing lubricant for use with brine completion fluids without any known incident of greasing-out or incompatibilities. Laboratory tests have confirmed field observations of its lubricity, Figure 1.

Another potential use of compatible lubricants is in underbalanced brine drilling operations that are often performed in dolomite or limestone formations such as those found in the Bakken Shale or Austin Chalk. Both the MHA base fluid and L-20 have proven their ability to maintain lubricating properties and compatibility with high chloride systems.

The complete MHA system includes formulations suitable for drilling salt strata that are prone to dissolution as well as formulations for use as sized-salt, drill-in fluids that offer the highest

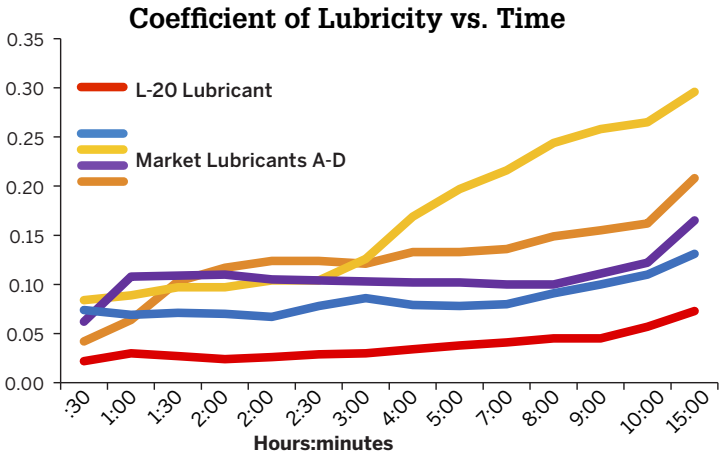
Drilling Fluid Properties	Salt-Water System			Sized-Salt System		
	Salt-Water Base Mud	Typical Lubricant	MHA System	Sized-Salt Base Mud	Typical Lubricant	MHA System
PV/YP	18/10	19/13	18/11	16/19	18/21	17/20
API Filtrate	6.1	6.6	5.1	4.2	4.4	3.8
% Shale Inhibition	83.4%	86.6%	96.7%	88.1%	87.8%	98.7%
Coef. Lubricity	0.421	0.341	0.201	0.397	0.278	0.144
% Reduction	—	19.0%	52.3%	—	29.9%	63.7%
Film Strength	10,700	14,500	32,400	11,600	16,200	34,600
% Increase	—	136%	303%	—	140%	298%

Table 1. Drilling fluid properties of saltwater and sized-salt muds before and after adding typical lubricant compared to the MHA fluid system.

possible protection for the payzone. Drilling with saltwater muds can be useful when the economics involved in using seawater or completion brines offer a significant advantage over freshwater systems, such as in offshore operations. Saltwater muds are also useful in preventing problems associated with drilling salt formations, including wellbore erosion by dissolution and salt creep that can cause excessive torque and packoffs.

Although it is often not seriously considered during the selection of drilling fluids, laboratory studies and field observations have shown the potential for drilling fluids to cause damage to the payzone by reducing permeability. Although many wells drilled today are fraced after drilling is complete, it is good practice to use every precaution to maintain an unobstructed flow from the reservoir to the wellbore. Sized-salt systems can provide superior filtration and loss control, as well as provide a high quality filter cake that is readily removed with fresh water or unsaturated brine washes.

By combining the performance characteristics of the MHA system with sized-salts, operators have a sophisticated, alternative to WBM or OBM system with the highest return on their investment, while exceeding environmental compliance restrictions of today, and tomorrow. OE



Lubricity of 2% KCl brine solutions of market lubricants and L-20, measured with the OFITE Lubricity and EP meter.

Dr. James *Gaertner* *is Director of R&D for Vi-Chem Specialty Products in Conroe,TX. He has authored technical papers on topics from drilling fluid performance to microbial contamination of drilling fluids. Gaertner worked as an environmental consultant on industrial air quality before joining ViChem and earned a PhD. in Aquatic Resources from Texas State University.*

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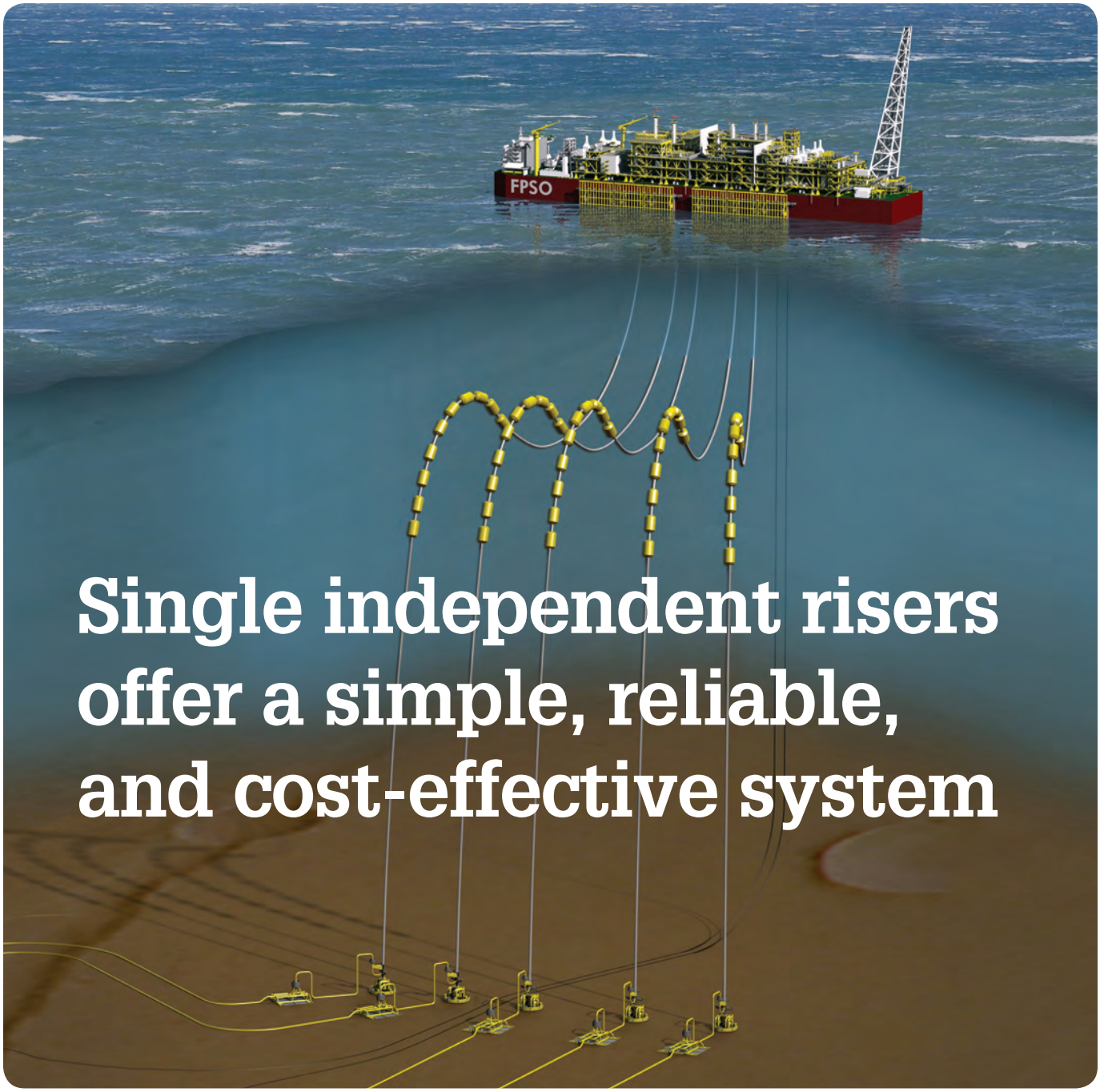


Single independent risers offer a simple, reliable, and cost-effective system

By François Lirola and François-Régis Pionetti, Saipem

With the booming deep and ultra-deepwater field developments, the need for innovative riser technology to cover this market has increased very quickly. Saipem has worked to develop new concepts specifically adapted to operators' needs.

The Single Hybrid Riser (SHR) is a field-proven riser concept for deepwater fields and consists of a vertical, rigid steel riser that is tensioned at the top through a buoyancy tank via a tethered connection, and anchored at the riser base with a pile foundation, Figure 1. However, technical challenges appear as the water depth increases, and conventional SHR solutions are not suitable because of the size of the required buoyancy tank.

Saipem developed a new type of deep and ultra-deepwater riser concept called Single Independent Riser (SIR) that addresses drawbacks of the SHR concept. This SIR concept is adaptable to any floater, even in harsh environments.

The Single Independent Riser allows a steep wave configuration where the buoyancy is distributed or continuous.

Along with these solutions, Saipem has also developed an innovative buoyancy and insulating material called "Glass Bubble Gum" (GBG). It offers good insulating properties as well as low density and

can be easily manufactured locally in large quantities.

The SIR is a hybrid riser with an almost-vertical tensioned rigid steel line and a steep wave flexible jumper termination. The SIR is a kind of steep wave configuration where all the buoyancy is either distributed or continuous, thus removing the need for a buoyancy tank.

In addition, the SIR concept makes use of field-proven technology, leading to a simple, highly reliable, and cost-effective system. There is no water depth limitation to the SIR application. Each section is self-compensating, meaning that increasing the water depth only requires increasing the number of sections.

The dynamic response of the SIR is very low, as the flexible section of the riser decouples vessel motions from the SIR. Compared with an SHR, the SIR is very compliant and easily accommodates imposed displacements. This is due to the fact that the tension within an SIR decreases upward from the bottom, while tension increases upward in an SHR.

When comparing the stress response amplitude operators (RAO) of the SIR to the ones of an SHR at their most critical location, it appears that stresses within the SIR are significantly lower than the ones in an SHR.

The SIR was initially designed using distributed buoyancy modules. However, using the modules has two drawbacks: they are difficult to produce locally, and raw materials are quite expensive. Therefore, Saipem focused on developing a material to address these two issues.

The company is developing an insulation and buoyancy material that could be easily produced in large quantities and fitted on complex structures, such as bundles. This material is composed of a filler and glass bubbles trapped into a polymer matrix.

The filler has very low thermal conductivity, while the glass bubbles decrease the density of the mix, making it a very light and a good insulator.

The ratio of the components can be adjusted so that the density is as low as possible while the viscosity remains low.

The material is created in two steps: First, mix a monomer, solvent, and glass bubbles; Second, add a polymerization agent to trigger the formation of the matrix, trapping both glass bubbles and solvent.

GBG main characteristics

A wide qualification campaign is currently underway. This test campaign comprises mechanical tests (density; modulus of elasticity; shear modulus; Poisson coefficient; allowable stress); thermal tests (thermal conductivity; heat capacity; expansion coefficient; potential life); and aging tests.

So far mechanical, thermal and potential life tests have been completed. Aging tests are currently on-going and are expected to be completed this year. The measured properties of the GBG are presented in the table below.

Property	Value
Buoyant	Density < to 600 kg/cu m
Pressure resistance	Up to 3000m
Local content friendly	Process adapted to site conditions
Life aging	20 years, with float-ability loss < 5%
Corrosion resistance	No deterioration
Easy to process in industrial quantities	Hundreds of cu m; not exothermic
Compliant with installation method	Easy process, not on the critical path
Temperature resistance	4°C, up to 80°C, or higher (110°C)
Good insulation properties	λ≈0.13 W/(m.K) < 0.16 W/(m.K) (Syntactic PP) / 0.215 W/(m.K) Solid PP
Mechanical properties	
Density	600 kg/cu m
Modulus of elasticity	4.220 MPa
Shear modulus	0.035 MPa
Poisson coefficient	0.5
Allowable stress	0.410 MPa (axial) /0.0211 MPa (Shear)
Thermal properties	
Thermal conductivity	0.121 W/(K.m)
Heat capacity	1655 J/(K.kg)
Expansion coefficient	58 10^{-6} K^{-1}
Pot life	
Duration	6 to 12 hours

Onsite

Local content is a growing requirement for operators, especially in Brazil and West Africa. The fabrication process for the SIR using GBG allows it to be assembled onshore in a local yard.

The steps to fabricate the SIR include: welding the joints together; setting multiple joints in-line with previously fabricated sections and

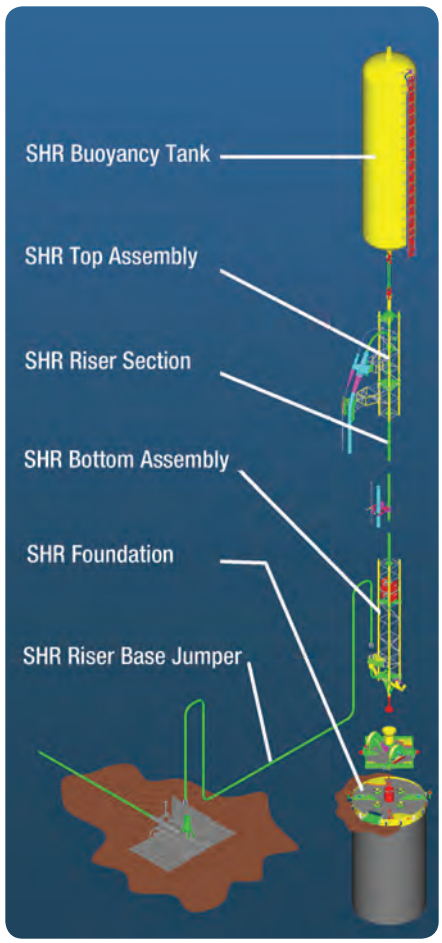


Figure 1. Single hybrid riser sections.

A: Bundle empty

B: Bundle half full

welding together; setting spacers in place and skin with it injection ends; pull forward pipe; inject GBG into the annulus between the pipe and skin.

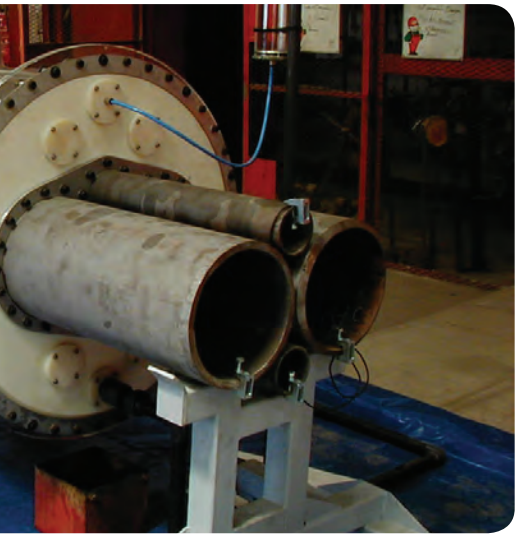
The injection zone features a slight slope to ensure that GBG properly spreads around the pipe.

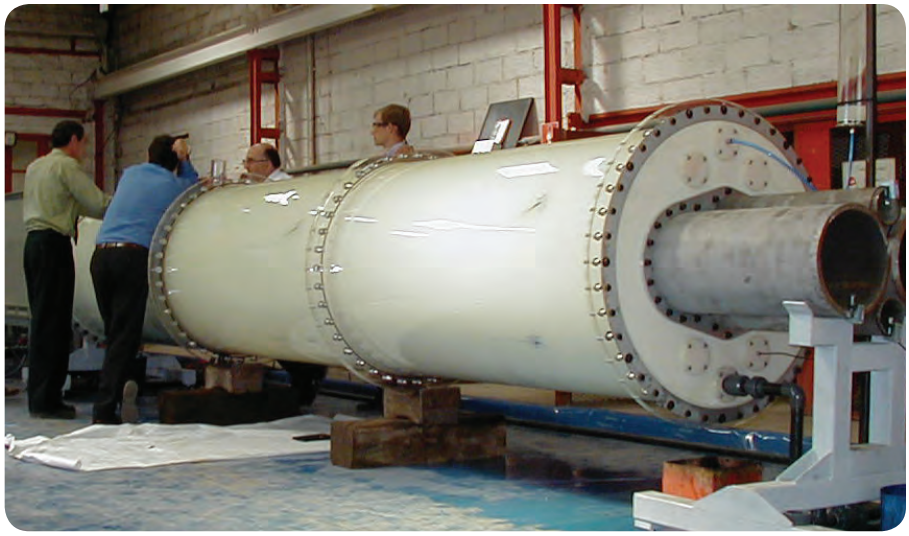
Note that using GBG with conventional fabrication methods (J-laying for instance) is still possible.

The SIR can be installed using a standard towing technique. The tow can be performed with or without the flexible jumper in place.

Analyses on the up-ending procedures have also been performed. A clump weight is attached to the bottom of the SIR to compensate for its buoyancy. Winch cables are used to control the up ending. An illustration of the various steps of the up-ending is given below.

If the FPSO is not yet in place, it is possible to use a stand-by buoy for





C: Bundle full

either temporary storage of jumpers. In case the jumper is installed after the up-ending, a specifically developed and qualified connector will be used.

The SIR proposes an evolution of SHR and pushes forward the water depth limit. This is made possible by simplifying the structures (no top nor bottom assembly) and proposing a solution that is almost insensitive to water depth. The analyses that were performed on actual case studies have so far proved the SIR to be a solution well-adapted to the industry needs.

The GBG is an enabling technology allowing for cheap buoyancy and insulation in large quantities and complex structures such as bundles. The simplicity of the industrial process associated to this material makes it particularly fit for local production.

The combination of the two technologies allows for maximizing the local content. OE

HHI changes approach to systems and software on semi-sub newbuilding

Hyundai Heavy Industries and Fred. Olsen Energy are implementing DNV's ISDS class notation for integrated software dependent systems on the semisub newbuilding *Bollsta Dolphin*. Key stakeholders discuss expectations and challenges.

Seong Cho, project manager at Hyundai Heavy Industries, admits reticence about taking on DNV's ISDS standard for complex systems in the building of Fred. Olsen Energy's new semi-submersible, *Bollsta Dolphin*. "At the beginning, some of us were not very positive about this program because we had lots of new activities to perform and many documents needed to be prepared," he says. "But as our understanding grows and the more activities are progressed, the more we feel positive about ISDS."

The ISDS notation establishes a methodology that aims to minimize software integration errors and delays in projects that involve integrating software dependent systems. The notation includes the development of quality assurance processes that will last throughout the semisub's operational lifetime.

Hyundai Heavy Industries (HHI) is Korea's largest yard and DNV is providing the full ISDS package including training for yard personnel with the expectation that it will be adopted for future projects.

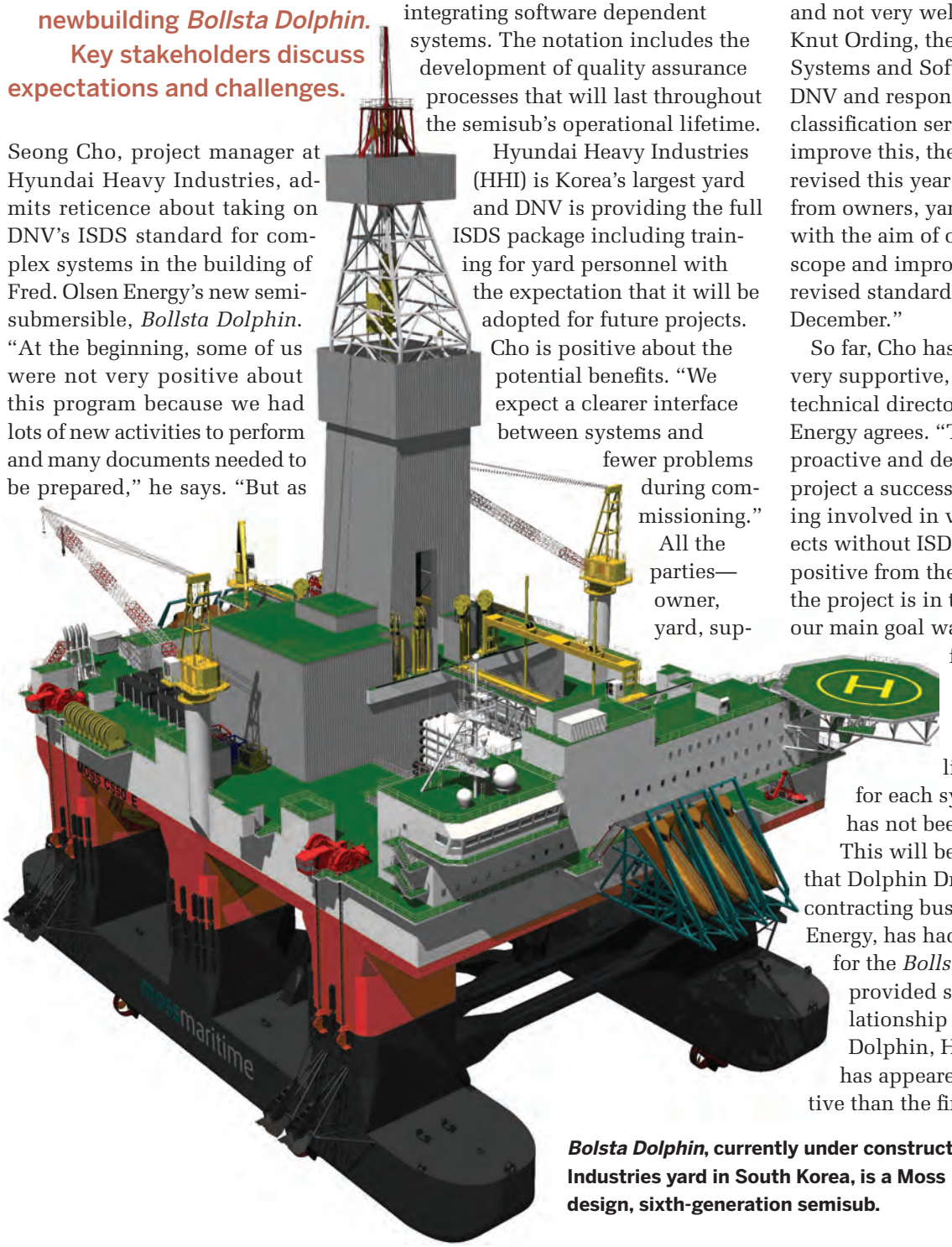
Cho is positive about the potential benefits. "We expect a clearer interface between systems and fewer problems during commissioning."

All the parties—owner, yard, suppliers and DNV—will have to work very closely as a team for successful implementation, he says. He believes change will be progressive.

"We are aware that the current edition of the Offshore Standard for ISDS has been a bit academic and not very well structured," says Knut Ording, the Head of Section for Systems and Software Reliability in DNV and responsible for DNV's ISDS classification services. "In order to improve this, the OS-D203 have been revised this year based on inputs from owners, yards and suppliers, with the aim of offering a clearer scope and improved ease of use. The revised standard was launched this December."

So far, Cho has found DNV to be very supportive, and Einar Tyssen, technical director for Fred. Olsen Energy agrees. "They appear very proactive and dedicated to make the project a success," says Tyssen. "Being involved in various other projects without ISDS, I have been very positive from the offset. Even though the project is in the early phases our main goal was to define a scope for the project so that the constraints could be fulfilled and we could establish better planning for each system, which to now has not been the case."

This will be the second project that Dolphin Drilling, the drilling contracting business of Fred. Olsen Energy, has had with HHI. "ISDS for the *Bollsta Dolphin* has provided so far, a very good relationship between all parties, Dolphin, HHI and DNV. HHI has appeared to be more proactive than the first project (*Bolette*



***Bolsta Dolphin*, currently under construction at Hyundai Heavy Industries yard in South Korea, is a Moss Maritime CS 60 E design, sixth-generation semisub.**

Dolphin) and appear to be committed in learning and developing ISDS for the systems that they are providing and integrating for the *Bollsta Dolphin*."

By combining the quality assurance efforts towards all key vendors and by doing extensive hardware in the loop testing upfront of factory acceptance tests, Tyssen aims to reduce the need for rectifications during commissioning and testing significantly. "We expect the critical systems to be operational systems from day 1 after delivery and to have a reduced risk for hidden failures and thereby a reduced risk for failures on safety critical systems while in operation," he says.

Tyssen wants to treat changes in the software system in the same structured manner as they handle changes on other critical components on the rig. "For me, ISDS is about planning things right and facilitating structured collaboration between all the key vendors including the yard to ensure that when all the systems are installed its just plug and play. Our experience from the pilot we ran on *Borgland Dolphin* is that we significantly reduced the commissioning time after installation on board."

DNV applies methodologies that have proven effective in the aerospace, telecommunications, defence and automotive industries. Their experience with ISDS from previous projects with Seadrill, Odfjell, Total, and Statoil indicates that applying the ISDS class notation can easily save US$6-20 million, by addressing potential problems early in a project and thereby avoiding the delays caused by the need to re-work software.

As DNV's experience grows, so do examples of ISDS success, says David Card, senior principal specialist, Ships and Offshore Electrical at DNV. "Most suppliers have no structured way of making sure all software functionality has been verified," says Card. This is corrected with the creation of verification strategies and traceability from requirements to verification procedures.

"In an earlier project we found that the yard had assumed the supplier was writing the functional design specifications for the mud system. The supplier assumed the yard was writing it. ISDS assessments identified that it was not being handled." In another case, interface design activities required by ISDS detected that the interfaces for the rig data recorder were not being handled during design. Additionally, it was determined that some suppliers were proposing software solutions based on Windows XP, no longer supported by Microsoft.

Fred. Olsen Energy has an option for more rigs from HHI and DNV hopes that the *Bollsta Dolphin* project will see a strategic shift by both companies towards ISDS. OE

Decommissioning—a view from the Southern North Sea conference

By Elaine Maslin

Innovating and being willing to do things differently could help save in excess of £100million of the cost of decommissioning its southern North Sea assets, says Anglo-French independent Perenco.

But there is still plenty of scope for improvement, says Keith Tucker, decommissioning manager for the firm. In these early years the industry is probably over-engineering decommissioning, he says.

"It looks at this stage as if the sector is over engineering decommissioning," said Tucker. "Operations people working in decommissioning use the same processes of project appraisal. But decommissioning structures is largely salvage. "

Perenco's portfolio of assets—it has more platforms than anyone else in the UK North Sea—will all need to be decommissioned and, like many others in the basin, it is beginning the process, with many fields continuing for at least another 15-20 years.

However, the scale of the task means that Perenco has been keen to try out alternatives to make the process, a sensitive, costly exercise with no returns, as lean as possible.

Its first project was the 10-month-long decommissioning of the minimal production Welland platform, in winter 2011 (*OE* April 2011). The facility's 1000-ton topsides were taken by transport barge to Vlissingen (Flushing), Zeeland province, where they were refurbished before being reinstalled off Cameroon with a self-installing jacket. The legs were dismantled and recycled.

A key saving on the project was the use of a sheerleg lift barge (*Scaldis* Salvage & Marine Contractors' *Rambiz*). This lift barge is usually used during wind farm installations off Northern Europe - for the heavy lifts of both the topsides and jacket, instead of a more expensive, larger, heavy-lift vessel. Despite early concerns by the Health & Safety Executive (UK regulator), the firm proved its case and transported the jacket on the crane hooks instead of transferring to a transport barge, which reduced the spread required.

Perenco also pre-cut the legs for the topside lift using 15,000 psi waterjet, creating a beveled finished cut, so the separated pieces were still "cupped" in place, and could be held in position with a clamp.

This meant Perenco could "walk away" from the facility and give the crane barge contractor a wide timeframe for completing the project, avoiding potential costly weather delays and enabling Scaldis to fit it into their schedule.

Removing platforms in the UK North Sea is a sensitive, costly process that can be made cost effective by developing alternative methods.

Cutting the piles was carried out internally with sections cut and pinned to be lifted out with the same tool used for the cutting. Before the lift, the cut piles were held in place with suspended sleeves, so that it was still safe to have men onboard or walk away and leave the structure in a safe state if the weather turned.

Another area to save costs is to reduce the need for environmental plugs in wells being abandoned by displacing the residual oil (left-over drilling mud) from the c annulus. Setting each cement plug costs about £30,000. In some cases, that is being spent to seal in only a few dozen barrels of oil-based mud.

On the three trial surface wells, Perenco managed to flush out the residual oil from the annuli which meant they did not have to put in a surface environmental plug before

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cutting the surface tubulars.

"We are cleaning, rather than perforating," said Tucker, a process costing just £2,000 instead of £24,000. This removes the pollutant from the environment rather than sealing it into the abandoned well.

Perenco also dealt with liquids from the well by re-injecting them, where possible, back into the subsurface reservoir, or pumping into a producing pipeline to another platform for disposal within a contained system.

Combined, these initiatives across Perenco's 46-platform portfolio could save over £100million, and that's the start, says Tucker. They're still learning and there are plenty of areas he can see room for improvement, from refining the process for cleaning out the C annulus to completely new processes.

"We cannot help but think there is a better way of doing things," says Tucker. "There is still more we will be able to innovate."

Tucker wants to see alternatives to high-pressure waterjet cutting - an expensive process.

"We know there is ongoing research into laser cutting and a process called EDM [electro discharge machining] or there could be chemical cutting. Or cold fracture potential - we don't know if there is technology at the moment but we know most pipe will start to fracture at -30 degrees Celsius.

"Perhaps there is potential to use a liquid nitrogen wrap to super-cool a section of pipe and then induce a brittle fracture by some sort of automated local impact device. Pipelines are generally on seabed and any cutting technology which reduces the need for extensive dredging would be very interesting. We want to see methods developed that can reduce the spread cost and the environmental impact."

Tubular removal also needs to be made easier, he said.

The Welland platform's 1000-ton topsides were removed from the North Sea, refurbished, and reinstalled off Cameroon, Africa.

The tubulars can be pulled out with a jacking system that also pins, cuts and lifts out the concentric bundles of tubulars in sections. This requires a capability to lift 100 tons for the first lift, even on a small platform. Another option is to use a lift barge and lift out whole, 50-100 ft sections in a single lift.

"However, the individual components of the tubular bundles weigh less than 20 tons and any method of cutting and lifting small weights at a time using a smaller spread, would be very desirable," said Tucker.

"It becomes difficult to deploy heavy-duty jacking spreads for the smaller platforms – so spread size reductions will open up further opportunities."

For abandoning subsea wells, he would like to see a process that could perform the cut subsea, through all the well sections, at the same time as sealing in the annulus, which could save millions of pounds.

Tucker would also like to see an alternative to air diving from a drilling rig. Divers are needed as part of the subsea tieback well abandonment process, but have very limited work windows – only 20 minutes per tide (every six hours) at the dive site – and they require a platform or rig to work from.

A two-hour job can take a week or more if weather comes in and meanwhile, the hire charges from the drilling rig continue to accumulate.

Saturation or TUP (transfer under pressure) diving would give more bottom time but so far no one has developed a mobile unit spread small enough to sit on a small/medium-sized drilling rig.

There are likely to be more areas for improvement in decommissioning methods in the North Sea in coming years and decades, not least in the harsher northern North Sea where structures are larger and costs even greater.

The industry, including Perenco, an early starter in the North Sea decommissioning world, is keen to share what it has learned so far. **OE**

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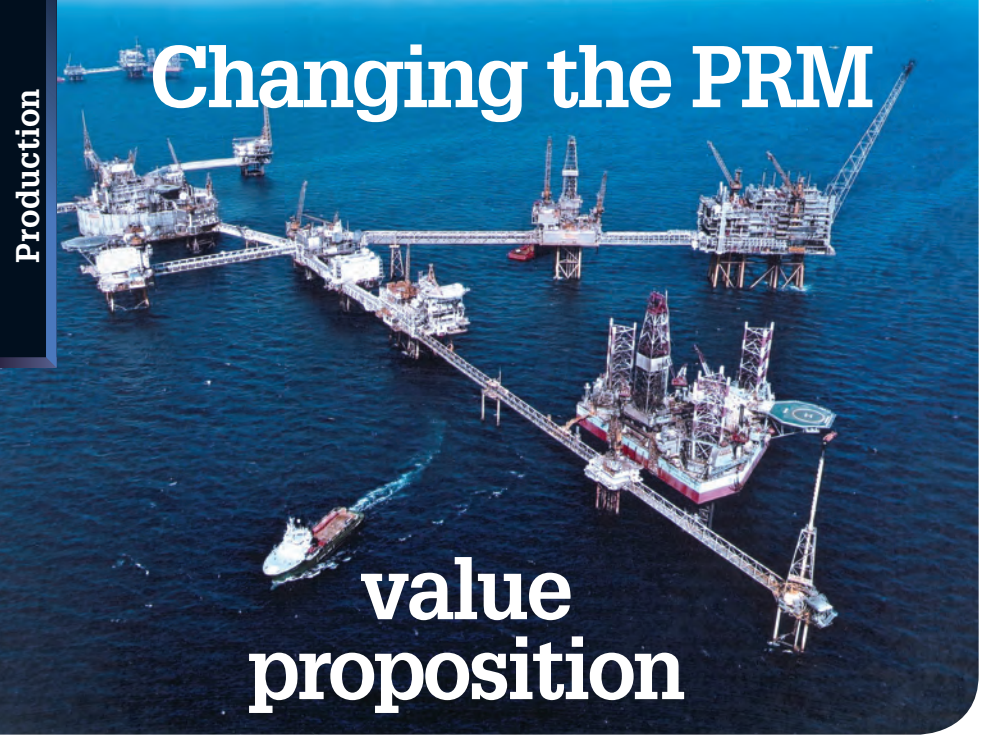
Changing the PRM value proposition



Andrew McBarnet suggests that seismic permanent reservoir monitoring may soon be seeing a new wave of interest if not an increase in projects.

It seems like forever that people in the E&P business have been talking about a digital oilfield in which seismic permanent reservoir monitoring (PRM) would play an integral part. Ever since 3D time-lapse seismic, or 4D seismic, was shown to work, in the 1980s, the potential value of having seismic recording instruments placed on the seabed for the lifetime of a field seemed so logical as to be irresistible for optimal reservoir management. Once a system is installed, regular, more or less exactly repeatable, seismic surveys can be shot at the minimal cost of a vessel with an airgun and some instrumentation. The result should offer valuable images of the changes in a reservoir's character as a result of hydrocarbon extraction, and provide data to determine the best oil and gas depletion strategy.

As we know, things haven't turned out quite as expected. It is now 10 years since BP began operations with the first life- of-field seismic (LoFS) project on the Valhall field, off Norway. UK-based WGP Group has been carrying out two monitoring surveys each year, using a portable modular source system (PMSS) that it designed. Not so long ago, the company reported the 15th reshoot over Valhall. Over the years, there have been numerous testimonials from BP to the technical success and economic value of LoFS in helping to boost production from a field expected to continue until 2050. The apparent value of LoFS encouraged BP to undertake further PRM-type installations on the Clair field in the UK offshore sector and on the Azeri-Chirag-Gunashli (ACG) complex in the Caspian Sea.

Not surprisingly, the BP experience fueled an expectation in the E&P seismic community of new business. But PRM has attracted so few takers in the last decade that it could just as well stand for Phantom Reservoir Market. Excluding the BP fields, the tally for PRM projects, either announced or in service, amounts to Ekofisk in Norway (ConcoPhillips); Jubarte in Brazil (Petrobras); BC-10 in Brazil (Shell), Snorre, and Grane (Statoil). Not exactly a boom.

Oil-company pushback regarding the adoption of seismic PRM has either been on technical grounds, the value proposition or, whether such a system is appropriate or necessary. Whichever it is, the onus has fallen on the service sector to come up with a winning solution. As with much technology advance in the seismic business, oil companies have been able to sit back and wait to see what is on offer.

Ironically, the major marine seismic contractors have not fallen over themselves to win this particular technology race because it is not a great value proposition for them. Supplying equipment and installing a PRM system is a one-off project, while the margins to be made in equipment maintenance, reshoots, and even the regular data processing are not that enticing. There needs to be a stream of coming projects for the business to make commercial sense. It is perhaps symptomatic that Schlumberger, which was involved in the very first pioneering PRM system, on the Foinaven field west of Shetland in the late 1990s, has not been involved in advancing this technology. The company apparently does not regard it as a sustainable business. This has not stopped major geophysical companies such as Petroleum GeoServices (PGS), CGG, and TGS from investing in seismic PRM technology solutions.

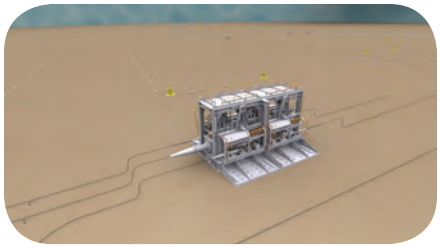
Marine seismic contractors do understand the value of 4D seismic to offshore oilfield operators. Up to now, they have successfully persuaded the industry that towed-streamer, repeat 3D, high-resolution seismic surveys over a reservoir target can provide a satisfactory monitoring solution at a fraction of the cost and risk of a PRM survey installation, or even an ocean-bottom seismic survey using retrievable cables or nodes. The towed-streamer results cannot compete with the improved imaging from multi-component seismic recording on the seafloor. Only a few companies, with the financial capability and technical competence to make full use of that data, will order ocean bottom 4D, but they are very much in the minority.

But any type of 4D seismic can scarcely be called mainstream. For example, this year offshore UK and

Norway, where the technology has seen most deployment, there will probably be a dozen 4D seismic surveys, mainly undertaken by the better-resourced oil companies. Worldwide, the technology is only gradually being adopted, and for many companies the value is too intangible to justify the risk and expense for stakeholders. They may also not have the technical resources to adequately deal with the data provided. It's also true that the case for 4D seismic does not always exist for simple geological reasons, or scale, i.e., there are not enough reserves to work with.

Since the Valhall LoFS installation, the service sector has basically had to engage in a battle of persuasion with the oil companies over seismic PRM on two fronts, technical and cost. It has already been a long campaign with no obvious outcome.

A number of companies believed that they could improve on the buried seabed cable program adopted for Valhall, using the pioneering equipment supplied by OYO Geospace (renamed Geospace Technologies last November) that's based on conventional, ocean bottom cable. Their goal was to answer the perceived industry concern over the longevity of the systems designed to last 25 years. Three solutions, OptoWave (now part of the Fugro-CGG Seabed Solutions joint venture), OptoSeis (now part of PGS), and Stingray (now part of TGS) offered a fiber-optic based alternative. This



A node with optical wet-mates enables the connection to the array loops. Riser cables from the FPSO and other lead-in cables help position the array where sensors are desired.

is said to be more reliable and long lasting, principally because no in-sea electronics were involved and fiber-optic cable has a long-term track record in the transocean communications business.

The response to the fiber-optic option has been mixed as far as take-up is concerned. On the Petrobras Jubarte field off Brazil, PGS has recently completed the deployment of what is said to be world's first full-solution, deep water, seismic PRM installation in water depths between 1200m and 1350m.

The project makes use of OptoSeis, a fully fiber-optic sensor array installed on the seabed with opto-electronics on the topside of the FPSO P-57. The sensor array cables are laid out in two loops on the seabed with array cables placed 300m apart. There are sensor stations every 50m along the cables.

A node with optical wet-mates enables the connection to the array loops. Riser cables from the FPSO and other lead-in cables help position the array where sensors are desired.

PGS will acquire seismic data once a year using a source vessel and passive seismic data twice a year. It will process the seismic data at its center in Rio de Janeiro. Early results are said to be promising.

Before the Fugro-CGG Seabed Solutions joint venture was initialled in February, CGG had conducted four monitor surveys on the Ekofisk field in 70m water depth. Its OptoWave fiber-optic system was installed for ConocoPhillips, covering an area of 60sq km with 200km of cable trenched at one-meter depth, containing 4000 four-component receivers. That service has now devolved to the joint venture.

Whatever the merits of the fiber-optic solution, Geospace Technologies has stayed in the game with its conventional ocean-bottom cable approach. Last year, it won a $14.9 million contract to provide over 100km of deepwater seabed seismic reservoir monitoring equipment for the BC-10 field off the coast of Brazil, operated by Shell. The system will be laid on the sea floor in 1700m water depth. The company followed this up later in the year through Statoil contracts worth $160 million for 660km of seabed seismic reservoir monitoring systems at the Snorre and Grane fields on the Norwegian continental shelf. Separately last month, CGG announced it had received the contract for long-term seismic imaging services for the project.

The choices of seismic PRM sys-

tems by different oil companies suggests that no technology has a clear lead. Indeed there is some feeling that Geospace Technologies is proving durable because, for the moment, it is the tried and tested supplier with a track record on all BP's LoFS projects.

However, big questions still hang over current seismic-based PRM systems. None of the systems so far really address the issue raised most by oil companies, which is the value proposition. The high upfront capital cost is the main sticking point for several reasons. First, this plays havoc with the amortization of the field development costs. Second, there is risk. Companies can listen to suppliers' assurances and look at projections based on modeling the future. However, most have clearly concluded that it is inherently unlikely that any equipment as sophisticated as the seismic recording cable involved will operate trouble-free for 25 or so years. In effect, only the well-resourced major can afford to take the risk. Third, it is often pointed out that oilfield development is conducted by asset teams focused on short term results, which they can report. Investing in long-term PRM does not fit into that category.

What we may be seeing now, is a move to answering the oil companies' value proposition with more flexible solutions that present less risk and require lower capex. The impetus is a growing interest in ocean bottom seismic technology and economics and the emergence of new organizations. Among other things, this reflects an anticipated demand from oil companies for improved methods to image complex geological settings, deep water, and frontier environments, which is where much oil will be found in the future.

It is early yet, but the Fugro-led Seabed Solutions JV, which has emerged from the CGG purchase of Fugro's geoscience division and was finalized earlier this year, brings together seabed seismic-node expertise from both companies, plus CGG's ocean bottom cable and PRM experience. The formation of the JV alone suggests an expectation of growing opportunities.

A Norwegian company, Magseis, in which Anders Farestveit, legendary founder of Geco and Wavefield-Inseis, is the working chairman, has just won its first ocean-bottom cable contract for 200sq km of seismic for Statoil. Mike Scott, one of the founders of PGS and RXT, is also expected to join the fray with his new company, Seafloor Geophysical Solutions. The company promises ocean-bottom seismic to address enhanced oil recovery (EOR) and challenging deep-water exploration targets.

One of the most likely scenarios that could improve the economics and operation of seismic PRM is node development. ION Geophysical, which has in the past focused on its VectorSeis Ocean seabed cable solution, is known to be considering node operations; whether permanent or retrievable is unclear. Similarly, Geospace Technologies has introduced an ocean-bottom recorder for shallow and deepwater applications.

Fairfield Nodal may be the furthest along in using nodes for PRM. The company has already been operating the Z700 and Z3000 node systems, for shallow and deep water, respectively, around the world, so it should be familiar with seabed seismic challenges. It is working on a system that can place and leave nodes on the seabed for extended periods of time, and therefore enable a number of monitor surveys to be shot with the nodes in the same location. The key is to preserve battery life by being able to turn the nodes on and off. The company also envisions an underwater optical communications system. Using ROVs, it is easy to see how nodes could be replaced or serviced while staying in position.

There is also a move toward offering more extensive monitoring. One example of this is Bergen-based Octio, in which Statoil became the major shareholder earlier this year. Octio's ReM product line proposes an open architecture. The "Ethernet on the Seabed" infrastructure combines broadband reservoir monitoring for increased oil recovery with environmental monitoring and risk reduction during drilling and injection of fluid, gas, or waste.

With such a range of ocean-bottom seismic technology, active or in development, oil companies may soon be more open to the seismic PRM value proposition, but it's not a given that this will translate into a rush of new orders.

PGS PRM project is in water depths between 1200m and 1350m, with sensor array cables laid out in two loops on the sea-bed of the Jubarte field. Array cables are placed 300m apart and have sensor stations every 50m along the cables. OE

WGP use its PMSS equipment on BP's Valhall field off Norway

Close up of guns used on BP's life-of-field seismic project

images: WGP Group

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Coiled tubing use extends offshore productivity

New uses for present technology with new equipment to further effectiveness

By Victor Schmidt

The Coiled Tubing and Well Intervention Conference, sponsored by ICoTA, the Intervention and Coiled Tubing Association, was held in late March in The Woodlands Conference Center north of Houston. Speakers presented a range of operational experience, practices, and well intervention improvements using coiled tubing and other techniques. Sessions included electric line, slickline, and wireline operations, fracturing and stimulation using coiled tubing (CT), as well as offshore and subsea well intervention. Among the highlights:

Velocity strings

In the North Sea, older fields are being brought back into production by installing coiled tubing as velocity strings to unload excessive fluid from gas wells. Speakers from Netherlands-operator NAM (Nederlandse Aardolie Maatschappij) presented SPE 163905, "Extending the operation life of mature North Sea assets by big-scale offshore installation of large-diameter chrome coiled-tubing velocity strings."

NAM installed 2 3/8in. and 2 7/8in. 16-Chrome coiled tubing in 20 wells, using a dedicated, self-propelled jackup during a two-year, field-life extension project. The crew installed the pipe in wells on small production platforms and unmanned installations after a careful evaluation process to identify wells that would best benefit from deliquification. Gas production after the workovers increased by 1.7–5.3MMcf/d per well, returning the wells to profitable operation and extending their economic life.

Clean cutting

Welltec won ICoTA's seventh annual Intervention Technology Award for a new tool, the Well Cutter, and was presented with the winner's trophy, the Quaich cup, which it later displayed in its booth. The electric-line conveyed tool is a mechanical cutter that uses grit-embedded pads to cut tubulars. The pads are expanded outward at the bottom of the tool to contact the inner pipe wall, and then are rotated to sever the pipe, Fig. 1.

The tool's operation was explained in technical paper SPE 163890, "Electric-line pipe-cutting operation optimizes completion removal, offshore Russia." During the operation, the tool successfully cut a 4½-in., 12.6lb/ft tubing below 2,133m, in a 57° deviated well off the east coast of Russia. Cutting time was about 80 minutes.

Metal filings produced by the pads were easily flushed out of the wellbore, unlike shards from explosive cutting, or metal chips and curls from a milling tool. Because the cut was clean, no additional trip to collect junk or dress the top of the remaining pipe was required. The cut left a smooth, beveled interior surface to the pipe, which was easily fished, and the remaining pipe pulled.

The operator Sakhalin Energy, realized significant cost savings because no explosives were used to cut the pipe. They did not have to pay for explosives permits, follow special procedures, provide additional security or special storage, limit radio or vessel traffic, or spend extra rig time on secondary runs to dress a flared, ragged pipe end. The tool can be used on drill pipe, liner, tubing, packers, or casing.

Vibration-enhanced drilling

Another new tool at the event was presented by TeleDrill Inc. in SPE 163883, "Low frequency water hammer for extended-reach applications." The CT-MWD (coiled tubing-measurement while drilling) tool sits behind the bit and uses an actuator system to create low-frequency vibrations in the drilling mud stream that serve two purposes. First, the vibration excites the coiled tubing (CT) to keep it moving through tight sections or when lying against the bottom of the hole while drilling lateral sections. Second, the induced fluid vibrations can be used to transmit data uphole from other sensors in the bottom hole assembly.

Figure 1. ICoTA awarded its annual Intervention Technology Award to Welltec for its Well Cutter tool.

Traditional mechanical water hammer systems operate at frequencies of 12-40 Hz, are generally preset for a given drilling mud circulation rate, and are not adjustable. The programmable pulse technology in the new tool allows the pulse amplitude to be varied without tripping out of the hole.

The tool modulates circulation pressure in the 1.5-2Hz frequency range to vary load on the bit, creating axial oscillation in the tubing. This "ballooning effect" reduces friction along the pipe, prevents helical buckling, improves weight transfer for milling and drilling operations, and increases CT reach. TeleDrill continues to develop the tool and has schedule additional field tests for later this year. OE

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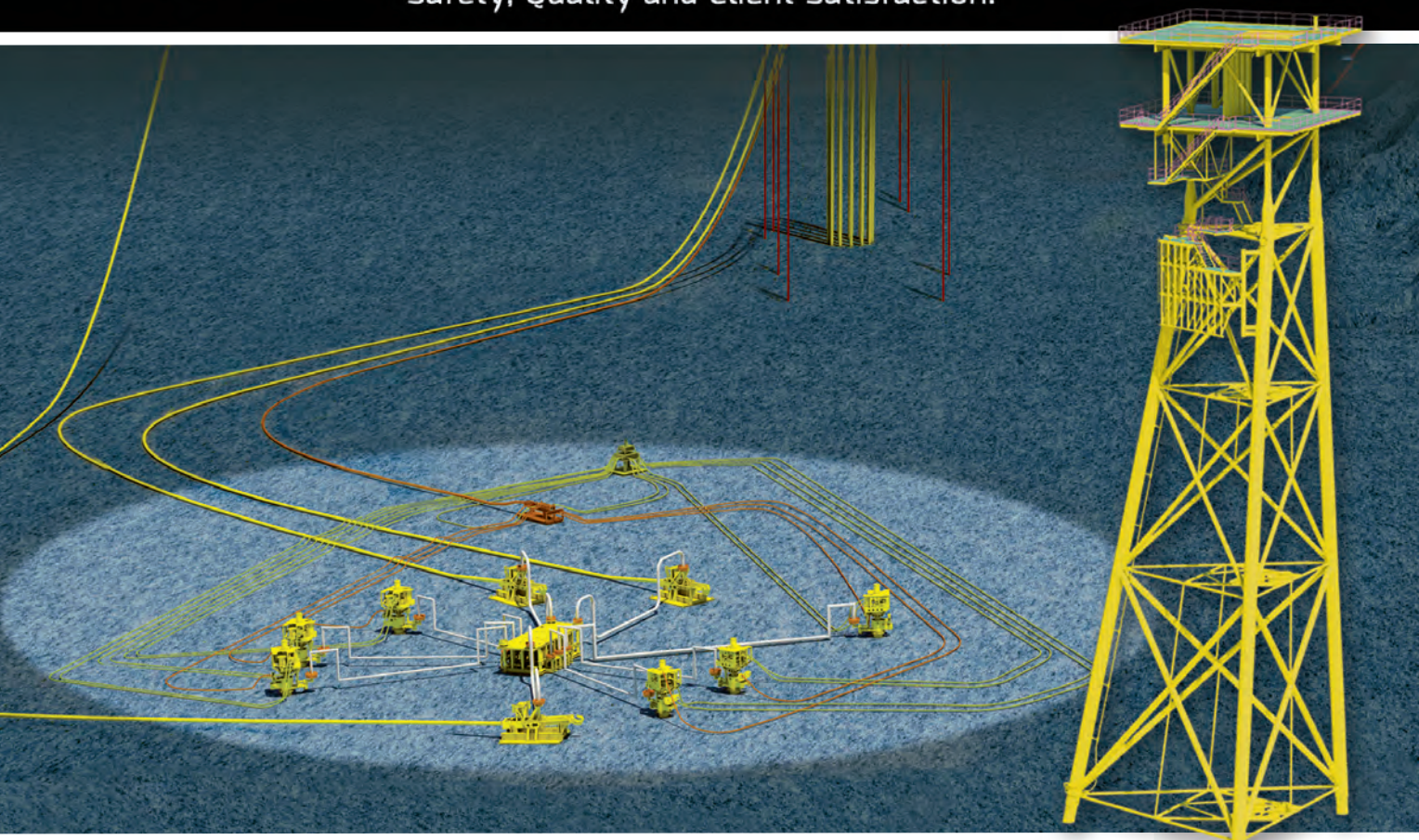

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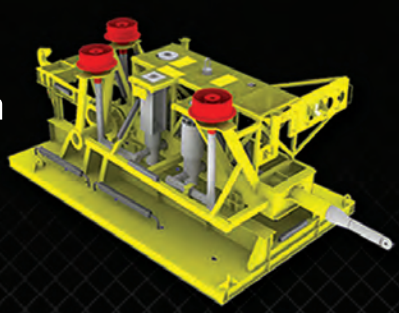

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Lifting operations underway at the FPSO *P-63*. (Image: Wärtsilä)

Finland **suppliers** offer manufacturing expertise for deepwater needs

The offshore market is becoming of increasing importance to Finnish suppliers, partly because of the current downturn in traditional shipbuilding orders. Finnish companies have a wealth of offshore-related niche expertise from ice management to automatic welding for shipyards. Meg Chesshyre went to Helsinki to find out more.

Global power and automation specialist ABB Marine received a US$160 million order this spring from the Jurong shipyard in Singapore for the design, supply, installation, testing and commissioning of the main electrical systems for seven next generation drillships being built to operate in the ultradeep pre-salt region off Brazil. Equipment deliveries to the shipyard are scheduled for 2013 with the first drillship due for delivery in 2Q 2015.

The group has a couple of recent technological developments of specific interest for offshore applications. It continues to develop its family of azipod thrusters, built at factories in Finland and China. There are now around 230 azipod systems in operation worldwide with 24/7 maintenance and modernization back-up. Azipod XO is the newest member of the family in the 4.5 to 25 MW power range. A compact Azipod C series is available for the power range up to 4.5 MW. The emphasis is on continuing to improve operation and maintenance costs.

ABB's new onboard DC grid is now commercially available and the group has won a pilot order from Norwegian owner Myklebusthaug. The grid is being installed a newbuild platform supply vessel, *Dina Star*, under construction at the Kleven shipyard in Ulsteinvik. *Dina Star* is a 93m-long, 4800 GT type MT 6015 multipurpose oil field supply and construction vessel designed by Norwegian company Marin Teknikk. It has five variable-speed diesel generators, four rated at 2300 kW and one at 930 kW, two 2200 kW main propulsion units and three additional thrusters for DP operations.

The new DC system merges the various DC links around the vessel and distributes power through a single 1000V DC circuit, thereby eliminating the need for main AC switchboards, distributed rectifiers, and converter transformers with consequent weight savings. All electric

power-generated is fed either directly or via a rectifier into a common DC bus that distributes the electrical energy to the onboard consumers.

Each main consumer is then fed by a major inverter unit. Additional converters for energy storage in batteries or super capacitors for leveling out power variations can be added to the grid. The system has been remodeled so that most of the well-proven products used in today's electric ship such as AC generators, inverter modules and AC motors can still be used.

The DC grid concept allows for increased efficiency because the system is no longer locked to a specific frequency (usually 60 Hz on ships), even though any 60 Hz power source may still be used. The new freedom of controlling each power consumer independently opens up numerous ways of optimizing fuel consumption. The end result is that a typical offshore support vessel can achieve fuel savings of up to 20%. The system is a nominee for the technology spotlight award at OTC this year.

Aker Arctic

Aker Arctic Technology (AARC) was established in 2005, as a spin off from Aker Yards, but has more than 40 years of ice-modeling experience behind it. Past references include 60% of all the world's icebreakers. The shareholders are STX Finland, ABB and Aker Solutions. A new state of the art ice model test facility in the Vuosaari business park in the new port area of Helsinki was opened in 2006. The new test facility, believed to be the only such privately own facility in existence, has been fitted with a glass bottom to improve the possibilities for visual observation. It required an investment of €10.3 million.

AARC managing director, Mikko Niini, says that more and more of the company's activities are now being devoted directly to offshore developments. "Oil majors are our main clients nowadays. We have framework agreements in place with most of the oil companies. We do a lot of feasibility studies for them." A current project involves working with CB&I Lummus carrying out studies for Novatek and Total, for transportation options from the Russian Yamal pennisula. The operators are now evaluating tenders for the 12 LNG tankers which will be needed for the project.

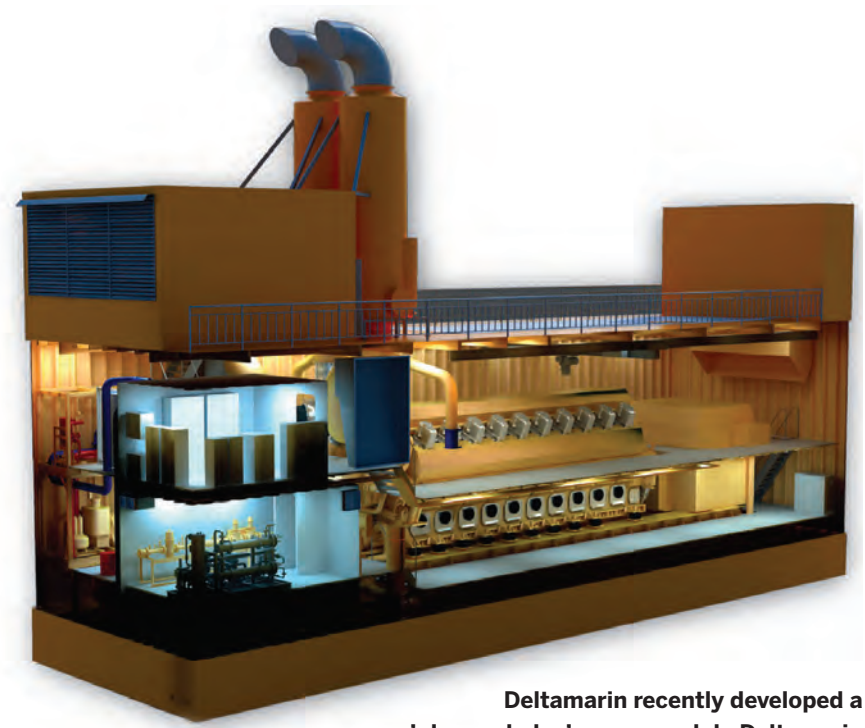
AARC is looking into new modeling tools for ice management and has developed a real-time ice simulator in partnership with Finnish software and system development companies Imagesoft and Simulco. A first agreement for the use of the simulator as a training tool has been signed with the Finnish Maritime Academy Aboa Mare in Turku.

It is also looking into designs for the development of ice-management vessels. It has had requests for designs, but no vessels have yet been ordered. Efficient ice management could lead to a change in design criteria. With ice management vessels on hand to break ice into smaller pieces, it would no longer be necessary to take into account the 1000-year load, so structures could be smaller. Shell's drilling campaign in Alaska last year involved ice management principles, using the existing ice-breakers *Fennica* and *Nordica*.

For the past year Aker Arctic has been designing the new polar icebreaker for the Canadian Coast Guard as part of a team led by STX Canada Marine. The second phase of the design is now being completed and the final design stage is expected to be ready in November this year. The new Canadian polar icebreaker *CCGS John G Diefenbaker* is intended to replace the *CCGS Louis St Laurent* by 2017.

AARC carried out a concept design contract for an ice breaker for China Polar Research Institute of China last year. The basic design starts this summer, to be ready by the end of 2013. The ship will be built at a Chinese shipyard in Shanghai. It will have accommodation for 90, a length overall of about 120m, a breadth of 22.3m and a draught of 8.5m. It will be able to break through 1.5m of level ice at 2 to 3 knots, including multi-year ice.

Another current project is the Aurora Slim, designed for Ericon (European Research Icebreaker consortium) an EU-funded project set up to design a new multi-disciplinatry polar research icebreaker with core drilling capability. The



Deltamarin recently developed a 'plug and play' power module Deltamarin

Ericon members represent national maritime research institutions from Germany, France, Italy, Denmark, Finland, Romania, Bulgaria, Norway, Russia, Netherlands and Belgium. Aurora Slim is a cost-effective technical solution and proposal developed designed and tested by Aker Arctic Technology. The concept uses ABB Marine's Azipod propulsion. The construction schedule has not yet been decided

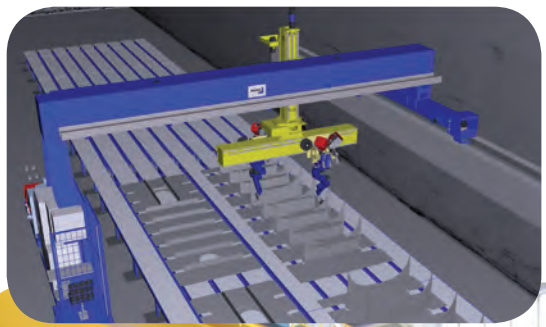
On a commercial front, drilling contractors are beginning to look at drillships with ice capability. AARC is carrying out study work on behalf of clients, but the contracts are confidential.

Deltamarin

Finnish-based naval architect and engineering firm Deltamarin has an impressive track record in FPSO and ship design. It hopes to announce another FPSO FEED contract award shortly. It carried out four FPSO FEEDs in the North Sea last year. Three of these were for refurbishment of existing FPSOs for *Teekay Petrojarl*. The fourth was a conversion FEED for an existing tanker to operate in the UK sector. This contract is in the tendering stage.

"Generally in the North Sea the most challenging issues that we face and what we try to resolve are struture related issues – the fatigue of the conversion vessel, combining hydrodynamic expertise and structural analysis to provide a very comprehensive motion analysis," says Sales Director Oskari Jaakkola. Interface management is very critical, working very closely with topsides engineering companies such as WorleyParsons or Amec.

Other recent projects included the *Dockwise Vanguard*. Delivered earlier this year, it is designed to transport cargos without length restrictions. An additional feature is that it can also be used for drydocking FPSOs offshore without needing to disconnect from the turret or riser system. Another very interesting vessel has been designed for Allsea's



Pemamek has recently been selected by rig builder Keppel FELS to implement the latest in modern welding automation system for the Singapore yard's production facilities.

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Pieter Schelte, the world's biggest ship – 382m long and is currently under construction at Daewoo Shipbuilding & Marine Engineering (DSME) in Korea **(See page 108 for separate story)**.

Revenue from offshore related work increased to about a third of Deltamarine's total revenue last year, with average total annual revenue running at about €25-30 million. Jaakkola sees the North Sea as the company's main market, but it is also eyeing Brazil, because of the extreme depths, and West Africa because of the massive size of the units.

Deltamarin recently developed a "plug and play" power module, which it is marketing through partner Caterpillar's dealer network. It is being tendered on various projects, and Deltamarin hopes to secure it s first contract very soon.

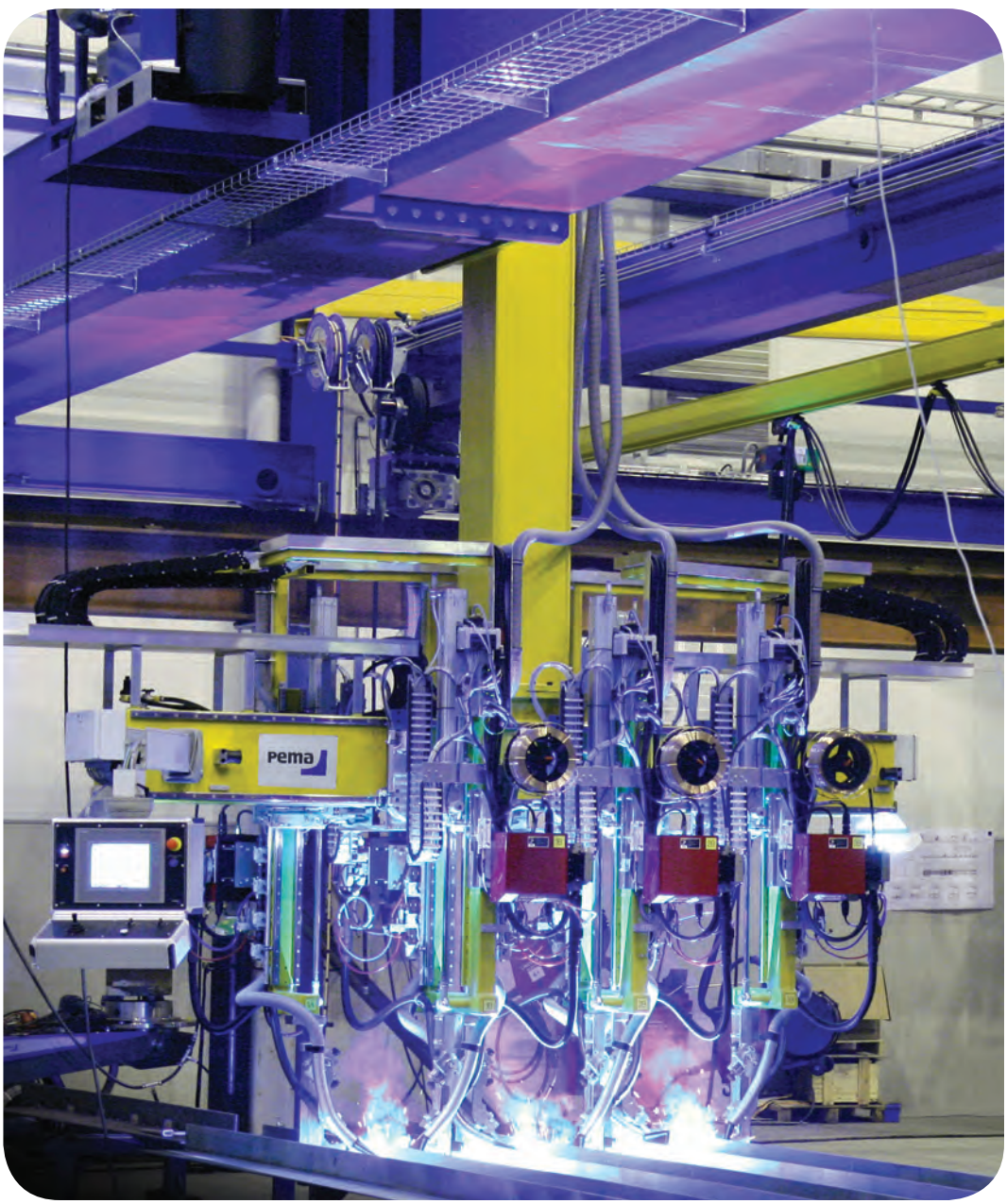
The module is based on Caterpillar's CAT CM-series engines. It is designed to meet the criteria for even the harshest environments, such as the North Sea, and for single lift installation onto an FPSO deck. It combines the reliability of CAT products with a state of the art packaging solution from Deltamarin. The modular design allows for the generator, or other equipment, to be removed (and installed) through a hole in the roof. The power rating ranges from 3800 to 17820 kWe and the weight from 240-600 tons. It can run on MDO, HFO, crude oil or fuel gas.

Pemamek

Finnish-based Pemamek has a 40-year track record of delivering advanced automation solutions to shipyards. Jukka Rantala, director, sales and marketing with the company, acknowledges that "at the moment, offshore is the driving force in shipbuilding. Traditional shipbuilding is pretty dead still in many places."

Pemamek has recently been selected by rig builder Keppel FELS to implement the latest in modern welding automation system for the Singapore yard's production facilities. The contract is worth over €10 million. Keppel FELS has successfully delivered almost half of the world's newbuild jackup rigs and a third of the semisubmersibles in the past decade.

Delivery to Singapore will consist of an extensive flat panel line with several highly advanced systems and a supporting micro panel line. They can be further upgraded with roboticsto improve the productivity of the yard. Installation will be performed while production continues. The Pema welding stations and portals will use the latest welding



Pemamek has recently been selected by rig builder Keppel FELS to implement the latest in modern welding automation system for the Singapore yard's production facilities.

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technology from Pemamek's global partner Lincoln Electric.

Pemamek will also provide Keppel with local service support and maintenance to ensure smooth production and minimizedowntime. Pemamek says that advanced technology of its welding and cutting automation will reduce production costs and increase the speed of the panel line process.

This contract is the second between Keppel and Pemamek in a year: Keppel Offshore & Marine's new yard in Baku, Azerbaijan, acquired a panel line system in early 2012. Keppel's Baku Shipyards focus on building tankers, offshore service vessels (OSV), and ship repair.

Technip in Norway and Finland is another customer, as is the Chouest Group in the US. For Technip, Pemamek has delivered columns and booms to the Orkanger base in Norway. These are used in supporting the submerged arc welding equipment for double jointing the pipes into 24m lengths. For the Chouest Group, Pematek has supplied production automation systems used in the production of offshore vessels for Edison Chouest Offshore.

Pemamek has developed the Pema 200 VisionWeld system, an easy-to-use welding automation system. This enables anyone to program the machine to weld with one short day's training. The VisionWeld system differs from conventional offline welding systems because of its built-in CAD system and by the instant welding when the first task has been given to the system. Use of VisionWeld system requires no input from the customer's CAD system.

Everything is based on a patented positioning system that uses images recorded by a robot.. The robot takes several images of the work piece or of the working area, and the operator is instantly ready to draw first welds for the robot using a mouse. VisionWeld is able to program from one to eight robots in the same gantry so that a single operator controls multiple arc systems, providing a low cost means of raising throughput.

STX Finland

Following STX Europe's sale of STX OSV to the Italian shipbuilding group Fincantieri at the beginning of this year, STX Finland is beginning to take an interest in the offshore construction vessel market in its own right, according to Eero Mäkinen senior vice president, marketing, STX Finland.

STX Finland, a subsidiary of STX Europe, has a 50:50 joint ownership in the Arctech Helsinki shipyard with Russian ship building giant United Shipbuilding Corporation (OSK). This has been in operation a

Arctech Helsinki has just completed two icebreaking offshore supply vessels for Sovcomflot (SCF Group).

INVEST ABERDEEN

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Aberdeen, in the North East of Scotland, has drive and ambition with an enviable position as the Energy Capital of Europe. As a UK economic driver, Aberdeen's economy is bucking the trend in comparison to other parts of the country, often described as a microclimate; the city is very much open for both business and investment.

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- **The European Offshore Wind Centre** – a ground breaking facility off the coast of Aberdeen
- **Aberdeen Hydrogen Bus Project** – a fleet of 10 hydrogen fuel cell buses, the largest fleet of hydrogen buses in Europe
- **Aberdeen Harbour Board Master Plan** – a £65million development strategy which will deliver significant port improvements.

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ABERDEEN INVESTLIVEVISIT

couple of years. STX Finland owns two other shipyards in Finland - Turku and Rauma, but these specialize more in cruise ships and ferries. STX Finland also has a 71% interest in Aker Arctic Technology.

Arctech Helsinki has just completed two icebreaking offshore supply vessels for Sovcomflot (SCF Group). The vessels will supply ExxonMobil's Arkutun Dagi oil and gas field in the Sakhalin area in Far East Russia. The *Vitus Bering* (yard No. 506) was delivered ahead of schedule in December. Its sister vessel *Alexei Chrikov* (yard No. 507) was due for delivery last month.

Both vessels for Sovcomflot will be similar measuring 99m in length and 21.7m in breadth. Their four engines have the total power of 18,000 kW and the propulsion power of 13,000 kW. They are both equipped with two 6.5 MW Azipod VI (ice version) units supplied by ABB. These vessels have been designed for extreme environmental conditions. They will be operating in thick drifting ice in temperatures as cold as minus 35° C.

The vessels' main role is to supply the gas production platform and to protect it from the ice. The icebreaking capability of the vessels is extremely high. They are able to operate independently in 1.7m-thick ice. They are multipurpose vessels, capable of carrying various types of cargo and equipped for oil spill collection, fire fighting, and rescue operations. The rescue capacity is for 195 persons.

Arctech Helsinki is also participating in the construction of an icebreaking multipurpose emergency and rescue vessel (yard No. 508) for the Russian Ministry of Transport. The contract is a joint one with United Shipbuilding Corp. subsidiary Shipyard Yantar JSC. The vessel will be delivered to the customer in December 2013. The hull of the vessel is being built by Shipyard Yantar. The outfitting and finalizing of the vessel will be done by Arctech in Helsinki.

The design of the vessel is based on the ARC 100 concept, which has been developed by Aker Arctic Technology for the Arctech Helsinki shipyard. The vessel features a patented oblique design with asymmetric hull and three azimuthing propulsors, which allow the vessel to operate efficiently ahead, astern and obliquely (sideways). The vessel can proceed on a continuous mode in 1m-thick level ice both ahead and astern and in oblique mode it will be able to generate 50m-wide channel in 0.6m level ice.

The vessel will be used in icebreaking operations, sea towing of vessels, floating facilities, and also features a very advanced oil recovery system suitable for operation even in heavy waves. The vessel measures 76.4m in length and 20.5m in breadth. The three main diesel generator sets have a total power of 9 MW. Total propulsion power is about 7 MW.

Icebreaking supply vessels *NB506* and *NB507* will be used year-round on the the Sakhalin-1 Arkutun-Dagi oil and gas field. *(Image: Arctech Helsinki)*

TTS Group

The TTS Group is headquartered in Bergen, Norway, but has subsidiaries in Sweden, Finland, Germany, Italy, Czech Republic, Greece, US, China, Korea, Vietnam and Singapore. TTS Group CEO Johannes D Neteland has a target to make the group a €1 billion company by 2016 through organic growth within offshore and port, strategic acquisitions in the marine sector, and increased service volume all over. He sees supplying equipment to the offshore rig market as an obvious choice for growth.

Neteland describes TTS' market potential within offshore heavy lifts as sizeable, and characterizes a crane contract with Sigma Drilling last December as a landmark deal. TTS Offshore Handling Equipment will supply the total crane package for a Sigma drillship, including a state of the art subsea crane with active heave compensation. TTS invested US$5 million in Sigma Drilling at the time of the order.

The value of the Sigma contract is around NKr130 million (US$23 million), but according to Neteland, the underlying value to TTS is even greater: "This could well prove to be our golden ticket to an offshore rig market where the word promising might be an understatement." He estimates that some 30 new drillships are built a year. "If TTS can win crane contracts for only a few of these projects annually, things can really get moving." At the time of writing, TTS is involved in eight tenders for crane packages for offshore rigs.

The second main ingredient found in the 2016 master plan is increased service volume, the profit margins within service and after-market sales being relatively higher than for new equipment. The TTS board of directors has recently approved

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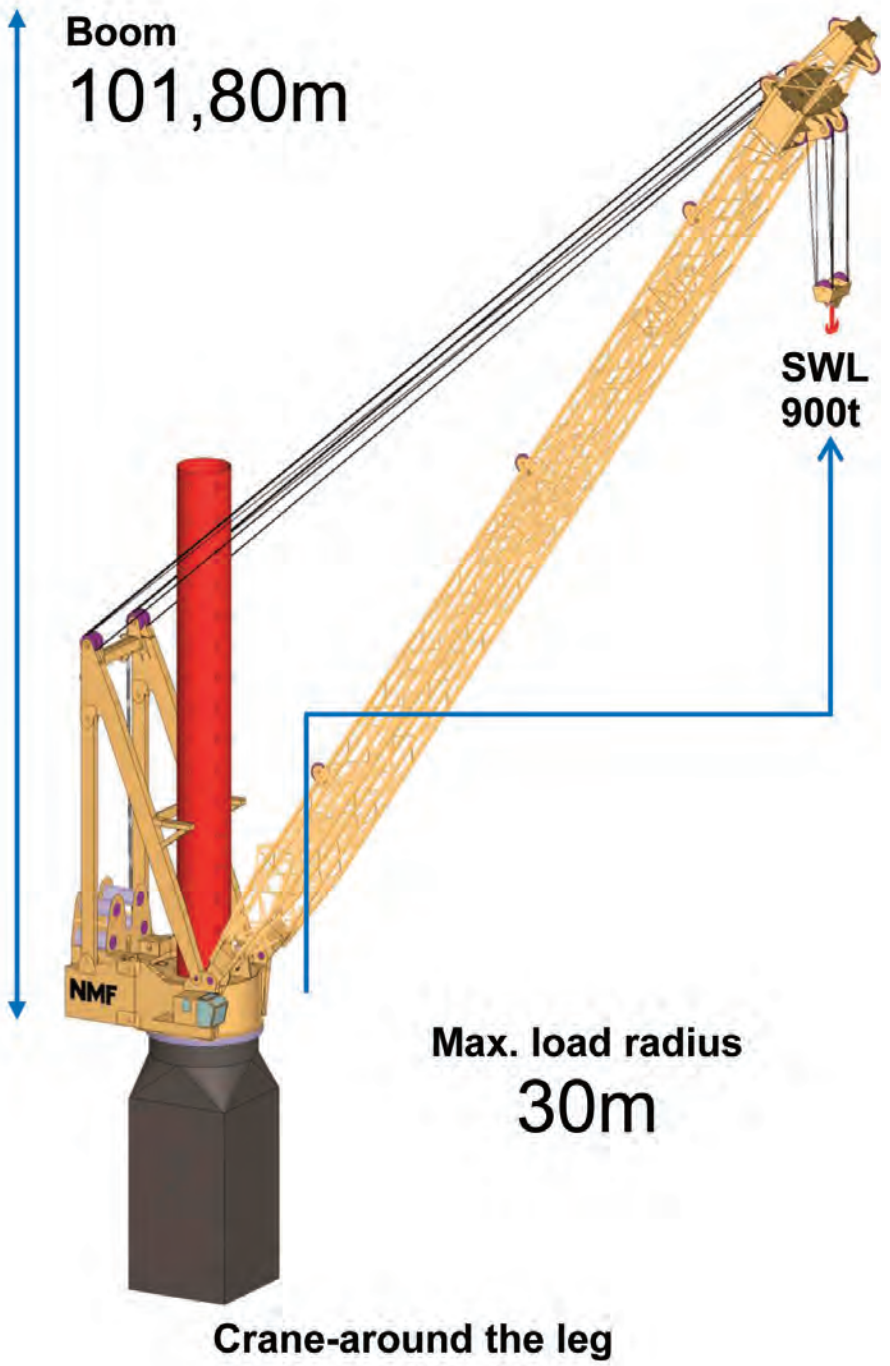
The Sigma contract is with STX Offshore & Shipbuilding Co, in Korea and comprises the delivery of four large offshore cranes and equipment for riser handling, including a special crane for pipe handling to be installed on a drillship ordered by Sigma Drilling The contract with STX also comprises an option for delivery of four identical equipment installations. The delivery will take place in 3Q and 4Q 2014. In addition to the Sigma Drilling award, recent offshore awards for TTS have been the supply of a 135tonne subsea crane to Ulstein's *Seven Viking* and five consecutive orders for large offshore cranes for Kleven offshore vessels.

Following the completion of the acquisition of Neuenfelder Maschinenfabrik (NMF) in August 2012, TTS integrated all German crane operations into the TTS NMF company and facilities beginning in early March. The integrated team now covers the full range of cargo and offshore cranes from operations in Hamburg. TTS NMF has also delivered a 900 tonne, lattice boom windmill installation crane which will be installed on board of M/V *Aeolus* operated by Dutch owner Van Oord and built by Sietas Shipyard.



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Wärtsilä

The offshore sector is a significant proportion of power solutions company Wärtsilä's business, says Magnus Miemois, vice president, solutions, in the ship power division. This is particular sobecause the merchant market is down. The sector comprises offshore drilling, FPSOs, and OSVs. Wärtsilä is a significant ship designer in the OSV sector. "We easily stand for 25%, sometimes 30% of the vessel value."

A recent ship design contract is for a new diving support vessel (DSV) to be built for Subsea 7. The brand new VS 4725 DSV design has been created by Wärtsilä Ship Design specifically for this vessel, which is being built at the Hyundai Heavy Industries (HHI) shipyard in Korea and is scheduled for delivery in 2015.

Another ship design contract has just been awarded by Armada Offshore MPSV, a wholly-owned subsidiary of Malaysia's Bumi Armada Berhad, for a series of four multi-purpose platform support vessels (MPSV). The vessels will be built by a subsidiary of Malaysian shipbuilder Nam Cheong, in one of its subcontracted yards, Fujian Mawei Shipbuilding, in China. The order follows the successful

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execution of a similar MPSV order in 2011 for Bumi Armada Berhad

An interesting contract for Wärtsilä has been the supply of three main power modules to the Brazilian industrial group QUIP for the new P-63 FPSO vessel, which will be the first FPSO to use gas engines to produce more than 100 MWe of power. Designed and produced by Wärtsilä, each power module includes two 18-cylinder 50DF tri-fuel engines in V-configuration, as well as alternators and all required auxiliary equipment.

The contract includes commissioning, start-up and operational supervision. The vessel, which has now arrived in Brazil, will operate on the Papa Terra oilfield, located some 110 kms off Rio de Janeiro in the southern Campos Basin. The field development concept involves the P-61 tension-leg wellhead platform coupled to the P-63 FPSO. The Papa Terra joint venture partners are Petrobras (operator) and Chevron.

Another recent offshore order is for the supply a series of pumps to be installed on a new floating storage unit, being built by Samsung Heavy Industries in South Korea for Statoil. When completed, the unit will be located on the Heidrun oil and gas field in the Norwegian Sea. Delivery of the Wärtsilä equipment is scheduled for February 2014.

On the technology side, the Wärtsilä GasReformer is one of the nominees for the spotlight on new technology prize and this month's Offshore Technology Conference in Houston. The equipment uses steam reforming technology to convert associated gas to a quality that can be used as fuel in Wärtsilä's range of gas-fueled engines. The reformer enables self-sustaining power generation for the offshore operation, provides cost savings and has the benefit of environmental sustainability.

With the development of tighter emission controls worldwide, there is growing interest in the LNG-powered OSVs. Wärtsilä is at the forefront here. The first gas-fueled platform supply vessel, Eidesvik Offshore's *Viking Energy*, has just turned 10 years old. It was designed by Wärtsilä Ship Design, and built by Kleven and is on long-term charter to Statoil. It is fitted with four six-cylinder Wärtsilä 32DF dual fuel, diesel and gas, engines, but runs on gas almost all the time resulting in 85% lower NOx emissions than when using diesel.

Wärtsilä's latest order from Harvey Gulf International Marine is the fifth it has received from the vessel operator. The contract is to supply a complete liquefied natural gas (LNG) package, including the propulsion, auxiliaries and controls, for a new offshore support vessel designed by STX Marine. The vessel will operate in the Gulf of Mexico. In October 2011, Wärtsilä technology was selected for two new Harvey Gulf offshore support vessels making them the first ever US-flagged platform supply vessels (PSVs) to be powered by LNG. The order to supply gas propulsion packages for a further two Harvey Gulf ships was received shortly thereafter.

Wärtsilä is in the process of setting up a new fully-owned manufacturing facility in Brazil to meet the increasing market demand, particularly in the offshore market. **See page 125 for more on this new facility.** OE

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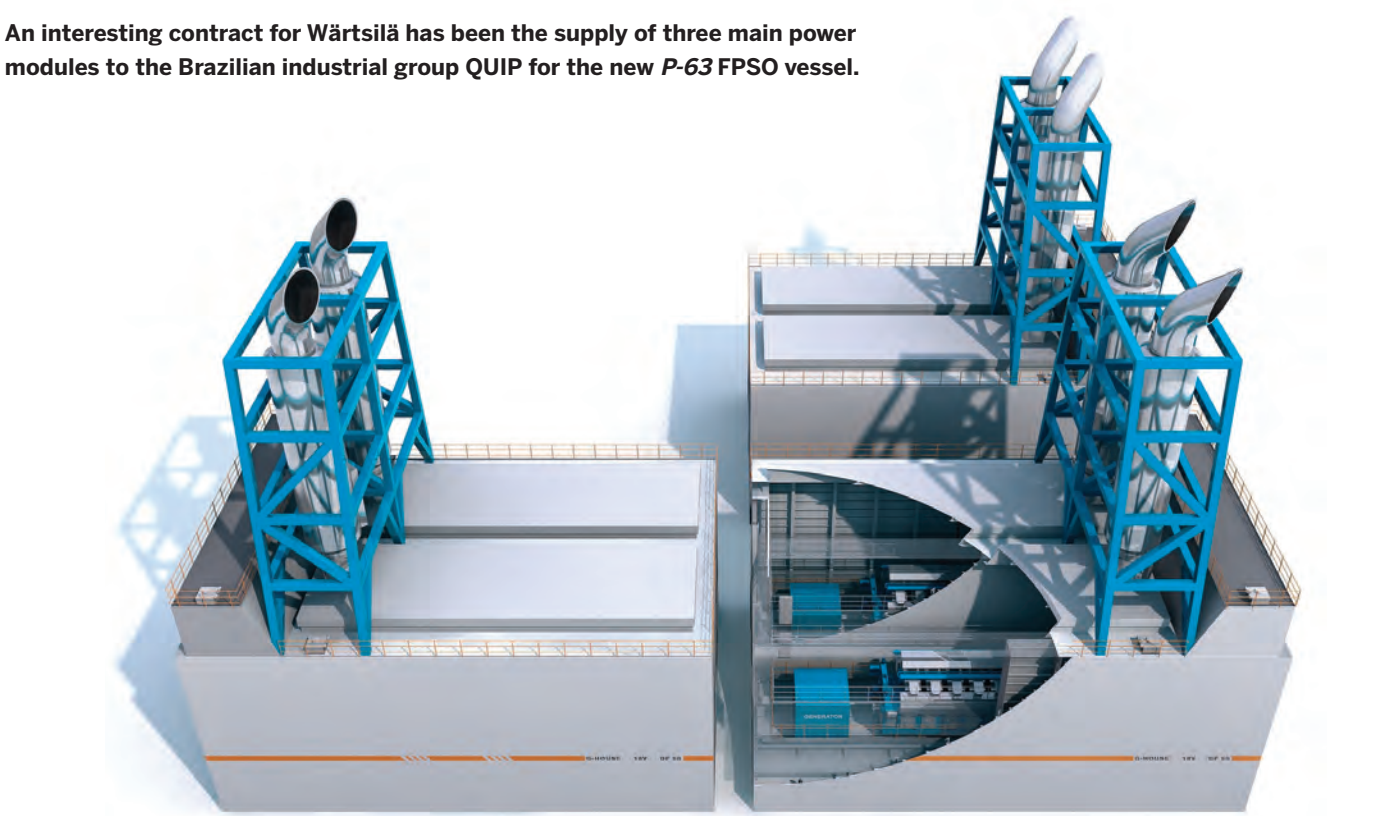

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Industry takes steps to monitor, control subsea processing

Milton Korn of ABS explains how industry is monitoring well conditions and fluids for efficient and safe production.

The task of monitoring and controlling operations is difficult onshore, and when subsea drilling and production are taking place in ultra-deep water, the complexity and magnitude of this task is compounded several-fold. Monitoring and control concerns are moving to the forefront now that previously unreachable reserves are being recovered and particularly when the percentage of recovery is increasing toward 50%.

Expanding needs

With the discovery of deepwater reservoirs, operators are expending great effort planning the development of their fields to do more with less, to maximize the amount of oil recovered from each field as well as the rate of recovery from individual reservoirs. Fields can include multiple reservoirs that can be spaced over an area as large as 100sq km or more with multiple production wells and additional wells for stimulation and re-injection.

Production wells are connected to a subsea collection network that spans the field. Operation of valves and pumps, etc., controls the movement and manipulation of well fluids as they are processed as necessary to facilitate transport to the surface or tieback to shore. Each of these wells while in production requires monitoring for effective control. Some wells include electric submersible pumps to help lift well fluids to the sea floor level, and stimulation and re-injection wells have their own subsea piping network.

The extensive geographic coverage of modern ultra-deepwater fields and the large number of systems and equipment being deployed to the sea floor is increasing the volume of monitoring and control information that must be exchanged. Monitored information can include temperatures, pressures, flow rates, well fluid viscosity, etc. both down hole as well as at various points in the subsea collection network, risers, tie backs and processing equipment. Control information and signals might extend to the position of valves to shut in a particular well, valve position control to direct flow, valve position modulation to control flow rates, the starting/stopping and speed control of pumps and compressors, pipeline heating, and the control of subsea processing and separation equipment.

The proliferation of subsea monitoring and control information manifests itself in several ways. The repetitive sample rate of select individual channels is increasing along with the overall bandwidth requirement as the number of individual channels of information dramatically grows. The ability to reliably exchange information and transmit and receive control commands without corruption over the great distances envisioned in fields with tiebacks extending hundreds of kilometers is of paramount importance; safety and shutdown systems including BOPs and HIPPS (high-integrity pressure protection systems) are critical.

Wired vs. Wireless

Choosing between wired and wireless subsea communication is a matter of great importance, but the decision is not straightforward.

Long-distance "ocean bottom cable systems" are wired solutions that can be pneumatic or hydraulic. The challenge with these technologies is that they can be limited by the great distances and depths. Other wired solutions include copper and fiber-optic systems, which use proven technologies that are firmly established in the scientific community and are likely better choices.

The great bandwidth, immunity to interference and noise, and the ability to carry information over long distances with minimal attenuation make fiber optics a preferred choice for communications. One of the challenges to the full deployment of fiber-optic communication in the production environment is the development of wet-mate, fiber-optic connectors for use at depth that can be readily manipulated by an ROV. Allied technology is regularly covered at the bi-annual IEEE Symposium on the Scientific Use of Submarine Cables and Related Technologies. Manufacturers that have established solutions for scientific applications are transferring the technologies to the offshore production environment.

Long-distance copper-based electrical communication is possible; however, it is susceptible to more interference and noise and exhibits greater signal attenuation than is encountered with fiber-optic communication. Copper-based electrical systems possibly could require additional repeaters (amplifiers) along the length of the communications line than would be needed in a fiber-optic system and consequently would be more power intensive. In many cases, the communication line can be included as part of a subsea power cable from shore, integrated into a flow tieback or umbilical.

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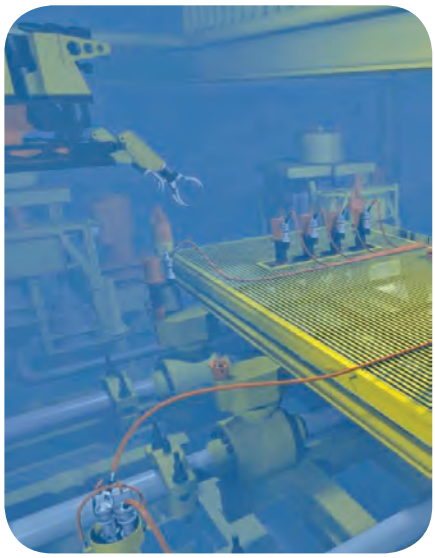
The International Cable Protection Committee (www.iscpc.org/) provides many resources on long-line submarine cables. The wet-mate connectors used for copper communications are not envisioned to be covered by the draft standard for wet-mate power connectors being developed by the Subsea Electrical Power Standardization (SEPS) Joint Industry Project (JIP). At present, the operating voltage is envisioned to range from 3.6kV to 36 kV.

Wireless communication is an option for certain applications that may apply diverse technologies: acoustic, radio frequency, and free space optical. The Subsea Wireless Group JIP is building on the efforts of many early pioneers and contributors to transform the concept of subsea wireless into reality. Various wireless technologies exhibit different capabilities with regard to effective range, data rate, immunity from noise and electro-magnetic interference (EMI), and power requirements.



Some wells include electric submersible pumps to help lift well fluids to the sea floor level.

Acoustic communication is well established within the subsea control field and often is considered as a backup technology for communication and control of BOPs and other similar devices. It also can be used for low-data-rate telemetry. The effective range of acoustic communication and control system could be on the order of 10km; however, as mentioned, the data rate is very low. With "spread spectrum" encoding techniques, acoustic signals are quite immune to interference and with low energy at any one particular frequency are not likely to be harmful to marine mammals and other marine life. Radio frequency communication is effective at much shorter ranges and within the effective communication range offers much higher data rates than acoustic communication schemes. Free-space optics offer the highest bandwidth and are immune to EMI, but are susceptible to interference from turbidity and require more accurate alignment of the sender and receiver.

The use of "hybrid" systems for communications, monitoring, and control allows for placement of technologies in their "sweet spot," allowing hardware and communication strategies to be optimized for maximum communication life, and reliable and repeatable communication system performance. Some wireless techniques envision piggybacking communication and control signals between devices to achieve the data rates and ranges required to effectively communicate with a central "hub" that would collect/distribute information to and from an FPSO and the shore. Wired techniques would be used for long-haul communications to an FPSO or to shore.

Looking ahead

A major challenge for wireless communications is providing for and managing the energy and power required. In some instances, it may be possible to connect a device directly to a wired subsea communication and control power network – networks such as this are likely to operate at voltages below that of the electrical networks used for subsea electrification.

A more attractive option is for wireless energy and power transfer between the subsea communication and control power network, using inductive coupling. For short-term deployment, it could be possible to use a battery attached to the device. For longer-term deployments, energy and power consumption need to be managed carefully.

The industry is working to move subsea communication forward with considerable R&D investment. These systems, when mature, will help move oil and gas development into even more remote and harsh environments.

R&D targets subsea

The push for subsea development options has led to R&D efforts across the industry aimed at finding technical solutions for the challenges of subsea applications.

Engineers at ABS are among those looking for innovative solutions. In-house investigations are examining the characteristics of electrical insulation systems for electric submersible pumps and other subsea pumping and compression applications where the insulation system is in communion with high-temperature, high-pressure corrosive well fluids. Other subjects of interest include thermal management of permanent magnet machines, and simulation and analysis techniques for subsea power transmission, distribution, utilization, and control networks.

ABS has organized recent discussions on the topic of subsea electrification (subsea_electrification@eagle.org) and is interested in expanding R&D efforts through industry partnerships that address additional areas of subsea research.

Milton Korn *serves as managing senior principal engineer, leading the Electrical & Controls Group within the Corporate Offshore Technology Division of ABS in Houston. He holds a current chief engineers license with STCW endorsement, and is a registered professional engineer in New York and New Jersey.*

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UTC presenters tackle hydrate flow challenges

Welltec's team lowering the toolstring the electric wireline removal of hydrates on a North Sea well.

Dealing with hydrate formation in pipelines is becoming a hot topic. The issue will be the focus of multiple papers at this year's Underwater Technology Conference.

By Elaine Maslin

Statoil intends to have a "full subsea factory" by 2020 and one of its key projects to achieve this is the Åsgard subsea compression project.

In development since 2008, it will be the first of its kind in the world when it starts up in 2015, adding an extra 280 mmboe from the Mikkel and Midgard reservoirs through the use of two 10MW gas compressors together with a scrubber, pump and cooler.

However, the 75m x 45m x 20m compression unit will have to deal with an issue common to new and redevelopment projects alike – hydrates.

It is an area drawing a lot of interest, including at this year's Underwater Technology Conference (UTC) in Bergen, June 19-20.

Solutions are being sought and offered from design through to monitoring and metering, management and removal.

Henrik Alfredsson, CFD lead engineer at Aker Solutions, says flow assurance in general and hydrate prevention specifically have been key to the Åsgard subsea compression project.

"Hydrate clogging is and has always been a challenge in the oil & gas industry," he says. "The challenge now, as we move in to subsea processing and more specifically subsea compression, is that the process as such is more complicated than for a normal SPS (subsea pro-

cess system).

"The inclusion of subsea cooling, as a vital part of the process, infers stream temperatures decreasing towards or even below hydrate formation temperatures. Inhibiting fluid, or anti-freeze if you will, is therefore required in order to prevent a hydrate plug from forming.

"On Åsgard, we have gone to great lengths to keep us safe from hydrates. For the Inlet Cooler, it has been quite a focus and through thorough engineering and testing we feel confident that we have succeeded. Subsea cooling and passive subsea cooling is definitely a field for the future," Alfredsson says.

On Åsgard, the Inlet Cooler is designed to perform two functions – cooling the hot gas coming back from the compressor in an anti-surge event, and also to cool the wellstream in normal production and increase the efficiency of the compressor station as a whole. By cooling the wellstream, the compressor operates at a higher efficiency and, in addition, more water and hydrocarbons are condensed and can be pumped in the form of liquid rather than compressed as gas.

"The potential problem arises when you cool your gas stream below the hydrate formation temperature," Alfredsson says. "Not having hydrate inhibitor available would mean that the pipe would eventually clog. And you have to bear in mind that there are a multitude of pipes in this cooler. The challenge lies within distributing the hydrate inhibitor, in this case monoethylene glycol (MEG), in to each and every pipe. Through evaluations, simulations and testing we have however made certain that inhibiting fluid is properly distributed to all the pipes. We can hence operate safely without unplanned shut downs due to hydrate clogging."

Existing flow assurance challenges and addressing hydrate formation on Norway's Ormen Lange development will be discussed by Pabs Angelo, senior flow assurance engineer, Norske Shell.

Ormen Lange's flow assurance system was upgraded in 2011 to include a new pipeline monitoring system and leakage and blockage module based on a new transient multiphase flow simulator, FlowManager Dynamic.

It has been able to give accurate predictions of pressure, temperature, and flow rates of gas, condensate and water/MEG in the wells, templates, flowlines and slug catchers.

It has also helped reduce the "significant challenge" of hydrate and ice-formation by calculating the pressure, temperature, water content and MEG concentration through the

This year's UTC theme is "Global subsea challenges, managing the old and the new." The event will include the launch of a study commissioned from analysts Rystad Energy on the numbers of qualified people in the industry globally. The study shows where there could be gaps and helps the industry find possible solutions, including the most important training/education facilities. The event will be held June 19-20. For more information go to: www.utc.no

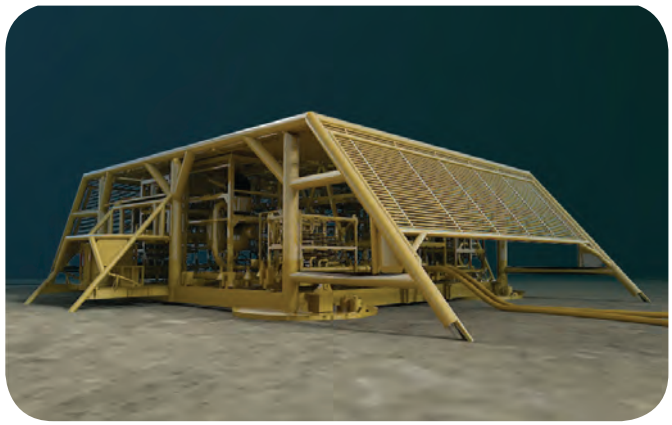
Welltec's WellCleaner tools

entire subsea system, giving the margin to the hydrate formation curve for actual operation conditions.

Cameron will present the development and qualification of its new high flow chemical injection metering valve for gas projects.

David Simpson, subsea product manager for Cameron, will outline how deepwater chemical injection of large volumes of MEG or methanol for hydrate inhibition will be a significant challenge for some of the large bore gas wells currently under development or being planned.

Cameron's new valve aims to achieve accurate delivery of hydrate suppression chemicals through a patented non-intrusive ultrasonic flow measurement closed-loop control device currently being deployed on a number of gas projects in the North Sea, South China Sea and Western Australia.



An artists' impression of the Asgard compression module.

It provides infinite flow rate regulation up to 26,500 l/h+, with high native flow rate measurement accuracy in an extremely low pressure drop device, Cameron says.

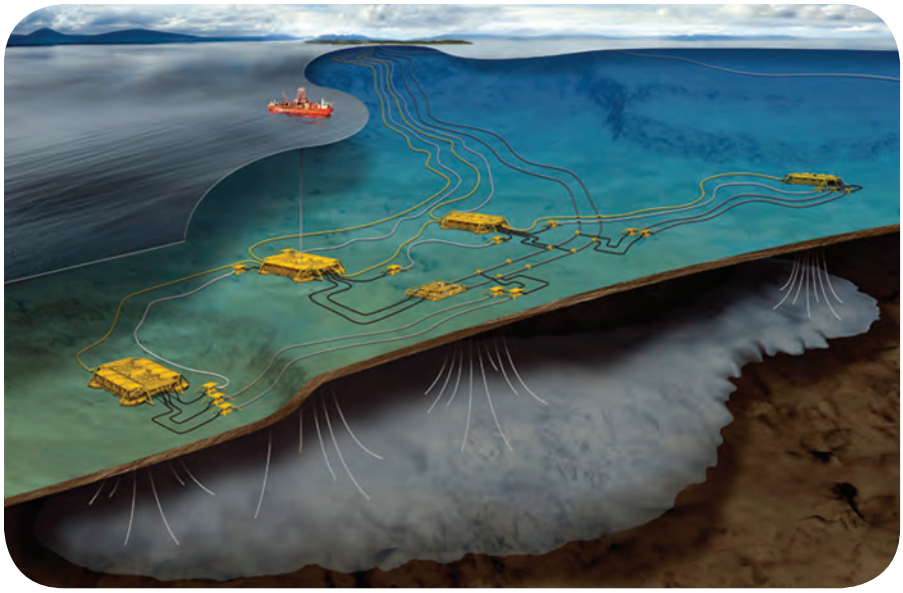
Despite all the efforts, hydrates can still form. Being able to remove them from subsea wells is a problem that will be addressed by Welltec at UTC.

The firm is to present on what is being billed as the world's first hydrate removal on an electric line from a riserless light well intervention (RLWI) vessel by Welltec.

Ole Eddie Karlsen, VP Subsea, at Welltec, says the firm was brought in after a build-up in the wellhead cavity was observed indicating a possible blockage by a hydrate plug.

Methanol had been pumped through the injection master valve, which had cleared the hydrate between the flow valve and the wing valve, but the amount below the subsea tree was unknown.

"Instead of going in with an expensive rig, we went in with a vessel and electric wireline," Karlsen says. "Usually you use risers and pump MEG in. We went in with our (3.8) reverse circulating bit tool, closed the well, and filled the lubricator on the subsea stack with MEG, then ran in and started milling, displacing the



Ormen Lange field, located 120 km northwest of Kristiansund, Norway, holds the world's largest gas wells, with a line size of 9 5/8 inches.

MEG."

The hydrate tagged at 553m where the electric line cleaner was activated, and it removed the hydrate down to a depth of 608 m in 20 hours of actual milling time. This allowed the operator to reestablish functionality to the downhole safety valve.

He estimates the method could save a third or half the cost of using a rig to intervene in the well.

A project to develop new technology for detecting hydrate restrictions subsea will be presented by Lee Robins, head of subsea, Tracerco Norge AS, and Keijo Kinnai, Senior specialist flow assurance, Statoil.

The two firms have been co-operating over several years on the project, development work on which started a decade ago using existing Tracerco technology developed for topside usage.

Its "œtomography" scanning equipment was successfully applied to locate restrictions on a couple of Statoil-operated platforms.

"Some initial tests were performed at the operator's K-Lab underwater testing facility at Kårstø, Norway, using the flow assurance test flowline, which provided excellent results and paved the way for a new development," Robins says.

"Due to increased needs at Statoil to have a fully operational tool available for locating hydrate restrictions the cooperation was accelerated to a new level with highly ambitious objectives.

"A development project for a new tool producing extremely high-resolution pipeline tomography scans, using a large number of gamma detectors, was therefore launched in 2012. This project has now produced a tool that will be ready for large scale testing in 2013 and subsequent quick commercial applications."

The presentation at UTC will cover the background of the development work and give a description of Tracerco's technology for solving flow assurance challenges.

Preventing, mitigating, detecting and removing hydrates is just one of the themes to be addressed at UTC.

The event's overall theme is Global Subsea Challenges, managing the old and the new. "It is a challenge for operators and suppliers in our industry to connect new and innovative solutions to ageing infrastructure and installations," said conference chairman Trond Olsen.

"The challenge is most likely to grow as even more subsea tiebacks are installed, equipment gets refurbished, control systems is modified and updated, and a new generation of people coming in to the industry shall relate to and understand technology developed before they were born." OE

Van Oord commissions *Stingray*, new shallow-water pipelay vessel

International contractor Van Oord is in the final stages of commissioning its first shallow-water pipelay vessel, Stingray, at the COSCO shipyard in Nantong, China. Meg Chesshyre spoke with Maurice de Kok, Van Oord ea manager for offshore pipeline installation, to find out what the new vessel will bring to the company.

"Our strategy is to both reinforce our existing position as an EPC contractor and expand our activities in the shallow water oil and gas market" says de Kok. "Van Oord has been active in this market for several decades, but with more focus on seabed intervention works such as trenching and backfilling for pipeline shore approaches. Complementary to this, we have built up a worldwide track record in the installation of pipelines using barge-mounted, high-capacity winches to pull prefabricated sections from the shore; this known as the "on-bottom pull" method. The problem is that there isn't always a suitable area available at the shoreline to prefabricate the pipeline sections, or, where there is, you are often not allowed to weld because of safety and environmental restrictions. *Stingray* will give us new in-house capability to lay subsea pipelines."

Stingray is equipped with state-of-the-art machinery to install pipelines from 6-in. to 60-in. diameter, and its primary focus will be the undertaking of S-lay pipe-lay works. Ideally, these will be in combination with shore approaches and other shallow water activities that Van Oord can undertake with its fleet.

"*Stingray* allows us to offer a package that we believe to be unprecedented in the offshore construction industry" says de Kok. "We aim to provide our clients with total in-house capability in shallow water oil and gas developments, with Van Oord offering integrated marine solutions from the shoreline to water depths of around 100m." Complementary activities will include the construction of landfalls, rock installation, trenching and backfilling and the installation of single-point mooring systems and gravity-based structures. The absence of contractor interfaces that have been common in these types of project will save time and money and, most importantly, reduce risk.

In addition to pipe laying in shallow water, the integral 500 tonne capacity crane and large area of free deck space make the vessel suitable for a wide range of related offshore activities such as buoy and manifold installations, hook-ups, commissioning, piling and midline tie-ins.

"*Sting*ray will also offer added value for our activities in the SPM installation market, where EPC contracts for the entire offshore facility are commonplace. If we are involved at an early stage of such projects, we can optimize the engineering to provide more practical and economic solutions."

The barge was built at Jingjiang Nanyang Shipyard (owned by POET Singapore) in China and acquired by Van Oord when nearly complete in July 2011. Official handover took place in mid-February 2012. Since

Van Oord's offshore oil and gas industry track record

Norway: Ormen Lange subsea rock installation

Russian Federation: Baydaratskaya Bay crossing

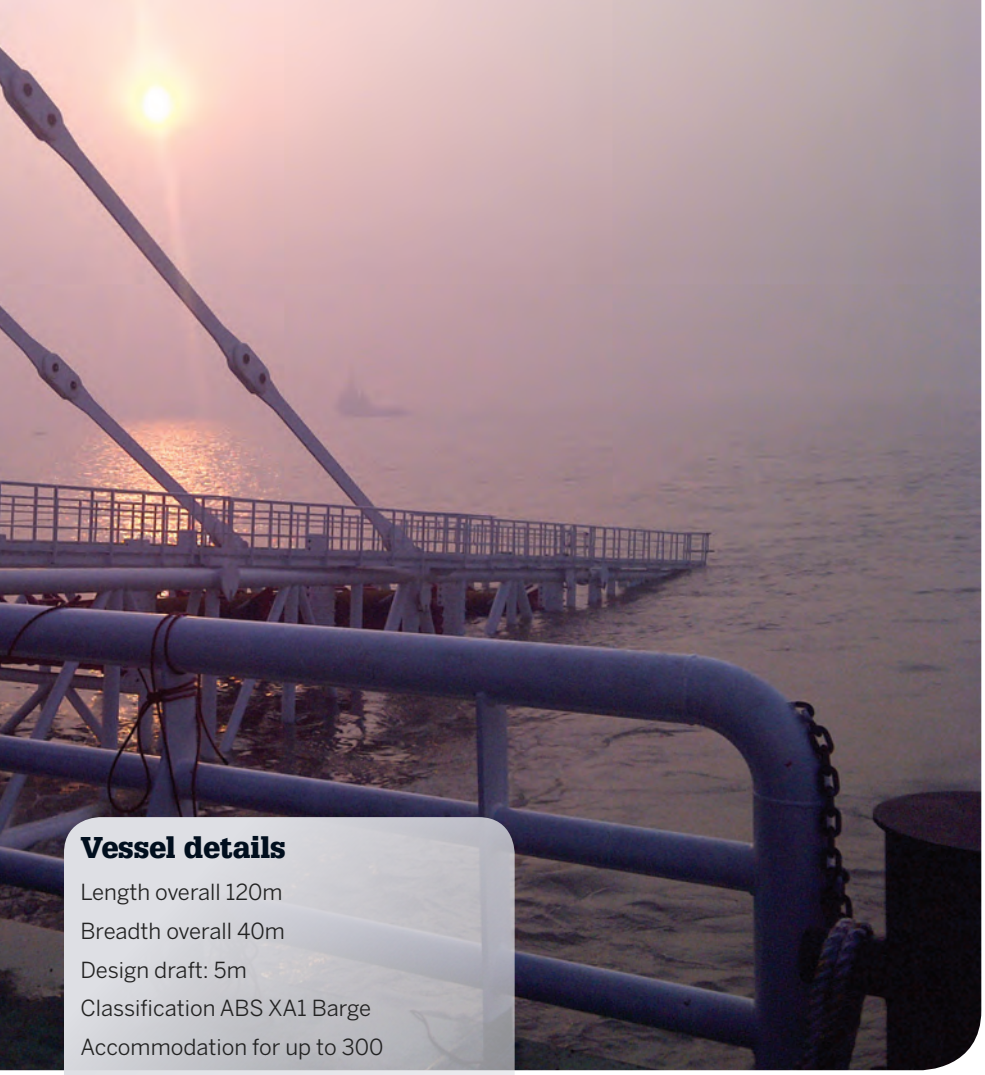
Russian Federation: Sakhalin Island – Arkutun Dagi GBS

United Arab Emirates: FAPCO Single Point Mooring Fujairah

United Arab Emirates: EPC Offshore facilities ADCOP

Canada: Excavated Drilling Centres for Hibernia

Australia: Gorgon Northern Scarp deep sea dredging



Vessel details

Length overall 120m

Breadth overall 40m

Design draft: 5m

Classification ABS XA1 Barge

Accommodation for up to 300

Total installed power 6 x 1,230 kW

Mooring system 10 x 12tonne Flipper Delta

Crawler crane 250 tonne Kobelco 2500CE, 42m boom

Free deck area 2000sq m

Allowable deck load 12.5tonne/sq m

Tensioners 2 x 70te capacity

Welding stations 3 nos. fully automatic welding stations

NDT / Repair Station 1 no.

Field Joint stations 3 nos.

Stinger Fixed, fully adjustable, 55m length in two sections, ABS certified

A&R winch 150te capacity, upgradeable to 200tonne

Main crane 500t revolving crane, make Liebherr

Main hook capacity: 500t@18m radius

Crane pedestal suitable for upgrade to 2000tonne

Working depth 5 - 100m (depending on pipeline parameter)

Stinger Fixed, 55m total length in two sections, ABS certified

Helideck CAP 437, suitable for S-92 Sikorsky helicopter

then, Van Oord has focused on upgrading the barge to enhance its capabilities, including the design, construction and installation of the stinger, installation of firing line facilities, and upgrading the accommodation.

Further enhancement of the barge will be considered as need demands. "If required, we can increase the crane size, as the pedestal has been designed to support one of 2000 tonnes capacity" explains de Kok. "However, with the current 500-tonne crane, we have sufficient capacity for the most offshore operations."

There is accommodation for up to 300, but, depending on the complexity of the project, Van Oord intends to operate the vessel with 120-150 people on board. *Stingray* is 40m wide, has ample deck space, and is capable of storing a lot of equipment and line pipe. This means fewer transfers and lifting operations offshore, minimizing the associated safety risk.

The vessel is currently in sea trials, including the test lay and retrieval of a 500m section of subsea pipeline. Upon completion, *Stingray* will be mobilized to its first assignment in Ulsan, South Korea to work with main contractor Daewoo on a project for its client, S-Oil. Van Oord's scope includes installing a 3.2 km-long, 42-in. diameter subsea pipeline and associated SPM system. In line with their strategy of offering integrated solutions, Van Oord will also be responsible for the associated dredging; this including the excavation and subsequent backfilling of a trench for the subsea pipeline that will be installed by *Stingray*.

De Kok is confident that the new vessel will be much in demand by operators active in shallow water oil and gas developments. At the moment Van Oord is focusing on deploying the vessel in Southeast Asia, but he says prospects are good worldwide.

Asked if there were plans for further shallow pipelay vessels, de Kok replied: "We are looking into the market and are making preliminary plans to expand further, but let's first make this one a success... We are looking forward to providing enhanced marine solutions with this new addition to the fleet."

Netherlands-based Van Oord is an international contractor specializing in dredging, marine engineering and offshore projects (oil, gas and wind), for which it has a 100-year-long track record. Turnover in 2011 was €1,715 million. It has 5,000 employees, more than 40 branch offices and 100 main vessels.

Van Oord Offshore is a separate business unit within Van Oord and provides total capability in EPC packages focused on the preparation, installation and protection of offshore oil and gas infrastructure. Its range of offshore capabilities includes subsea rock installation, pipeline shore approaches, shallow water pipeline installation, offshore trenching and backfilling and SPM system and GBS installations. **OE**

Subsea grouting solves many seabed problems

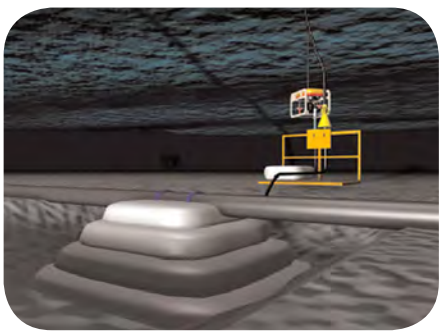
Subsea damage and support problems can often be solved using injection grouting. James Bell of FoundOcean tells us how its accomplished.

Extending the life of an asset means that the structure can still generate revenue, whereas removing it can be a highly complex operation, often more so than the original installation. There are many options to rehabilitate structures. The state of the asset will have a bearing on the likely success and available restoration options: for example, upgrade works due to regulation changes are likely to be relatively straightforward, whereas vessel damage repairs will be more technically challenging.

Grout is the essential element securing jackets, monopiles, gravity-base structures, and tripods to the seabed via:

- Foundation grouting
- Pipeline and J-tube grouted fabric formwork supports
- Member infilling to strengthen flooded or degraded jacket members
- Grouting repair clamps around damaged pipelines and jacket members
- Other highly customized projects.

Fabric bags are filled with grout as seabed supports.



Where the sea floor undulates, Grout bags can be installed to form support across freespans.

Fabric formworks

Fabric formworks are used to prevent or cure pipeline freespans. They can also be used to raise a pipeline or structure by jacking it up. The flexible, high-strength synthetic woven fabric bags are cost effective to make and are easy to deploy by ROV or diver.

Freespan rectification

It is recommended practice for pipeline engineers to adhere to specific design codes like DNV-RP-F105, or similar codes, for freespans. Surveying the seabed topography and local currents can help engineers to plan whether freespans or scour may occur during the installation of a new pipeline. This can influence the design and path of the asset and enable operational teams to plan scour rectification measures into the installation schedule, or incorporate closer inspection regimes during the asset's operational lifetime.

Grout bags can be installed in both preventative and curative instances. Where the sea floor is particularly undulating, new pipeline installations will require some form of support to ensure freespans fall within the regulatory parameters, preventing unacceptable freespans from occurring.

Current velocity increases locally around a mass that lies on or protrudes from the seabed. This causes localized seabed erosion adjacent to the structure and is known as scour. Curative formworks can be installed when seabed scour has eroded previously supportive sediment, and in some instances, can actually help reinstate the seabed.

FoundOcean recently completed a project in the Bay of Bengal to install formwork supports for a new 32in. export pipeline and 14in. intra-field pipeline. Engineers used computer modelling software to identify tens of potential freespans that would need addressing along the pipelines' paths. But, it was not possible to confirm whether the spans were acceptable until the pipeline had been laid.

Fifty-one custom grout bags were designed and manufactured to suit the terrain and height of the freespans. The large-base grout bags had anti-scour protection skirt sleeves built into them, which slows down the local current and causes suspended particulate matter to settle. Over time, the skirts become engorged with sediment, reinstating the seabed.

The grout bags required filling in two or more stages due to their volume. This was achieved by injecting grout into the lower section of the bag and allowing it to cure to provide a stable support for the grout injected in the upper sections later. The formworks were installed in water depths up to 186m over a 90-day campaign.

Deepwater pipeline separation

There are other subsea applications for fabric formworks, such as jacking or separating crossing pipelines. This year, the company was contracted to work in the Gulf of Mexico to separate two subsea pipelines that crossed at a depth of 1,370m (4,500ft). The solution chosen protects the lower pipeline and provides support to the upper pipeline.

The two pipelines will be separated by jacking the upper pipeline

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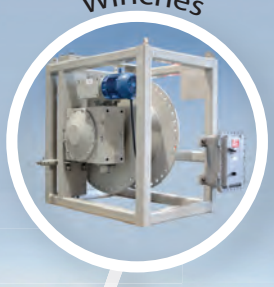

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to 18in. above the top of the lower pipeline. An ROV will then take a 1.2m-high crossover formwork off the deployment sled and maneuver it into position.

Ordinary Portland cement (OPC) grout is mixed on deck. It is pumped to the grout bag via a deepwater grout umbilical, connected to the formwork deployment sled. After sufficient grout has entered the formwork to stabilize the bag, checks are made to ensure that the bag orientation and position is still correct and that it is filling evenly.

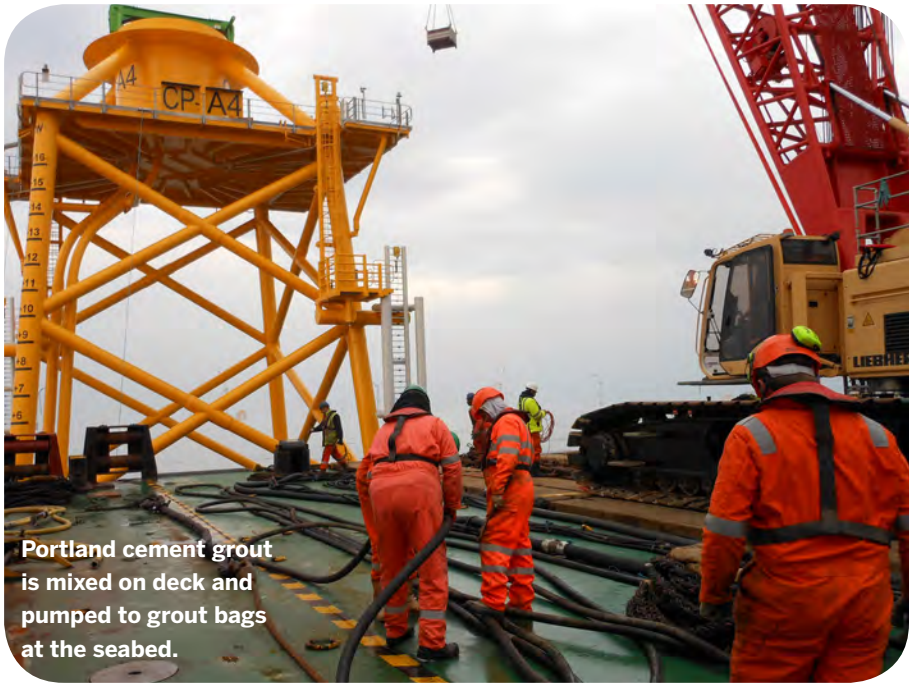
The crossover grout bag is designed to be filled in three stages due to its size and volume. The lower compartment is filled and allowed to cure sufficiently to support additional grout in the upper compartments.

Grouted clamps

Another form of remedial work is the grouted clamp. These have been used successfully to restore pipelines, strengthen jacket members, and repair caissons. A clamp is composed of two or more steel segments, which are placed around an object. The segments are bolted together along their edges prior to the injection of grout into the annulus between the clamp and the asset.

The grouted repair clamp allows for greater design and fabrication tolerances, as the grout fills the annulus and evenly distributes the load of the object the clamp is being placed around.

Clamp segments are bolted around an object, and then the annulus is injected with grout to create a permanent seal.



Portland cement grout is mixed on deck and pumped to grout bags at the seabed.

In 2007, the 233 mile, 36in. CATS pipeline supplied 12% of the UK's gas. However, the pipeline had to be shut down due to damage from a vessel's dragged anchor. A fast response and first time fix was vital to get supplies back up and running. A repair sleeve was bolted into position and the grout hose was connected to the inlet. Grout was pumped into the annulus. Accurate and complete filling was controlled using carefully positioned overflow ports and valves. The repair was completed ahead of schedule and at short notice, with the client acknowledging the company's efficiency.

This same technique was used more recently in deeper water. Saipem America awarded a contract to repair a damaged pipeline in the Gulf of Mexico. A cable-laying vessel's anchor had dragged along the seabed and over the 750m-deep pipeline in bad weather. This resulted in the pipeline being operated at a reduced pressure until remedial work was complete.

To enable access, the seabed was dredged around the damaged pipeline section. An ROV transported the two steel half-shells of the clamp to the seabed and maneuvered them into position around the pipeline, and tightened the bolts. Crews delivered grout using a deepwater grouting umbilical system.

Due to the extra load on the pipeline, a fabric formwork was installed under the clamp to provide additional support and prevent buckling. In total, 28 tonnes of cement was used: four tonnes for the clamp and 24 tonnes for the fabric formwork.

Inspection, repair, and maintenance projects demand an experienced supply chain whose skills can be deployed at a moment's notice. Tried and tested offshore procedures, coupled with planned-for contingencies, and astute offshore personnel, ensure savings in both project costs and time. OE

James Bell *has been managing director of FoundOcean since 2005. He has been involved with numerous challenging projects including the BP CATS pipeline repair, ConocoPhillips Ekofisk strengthening, Exxon Diana Truss Spar riser system. Bell earned a Civil Engineering degree from London's City University.*

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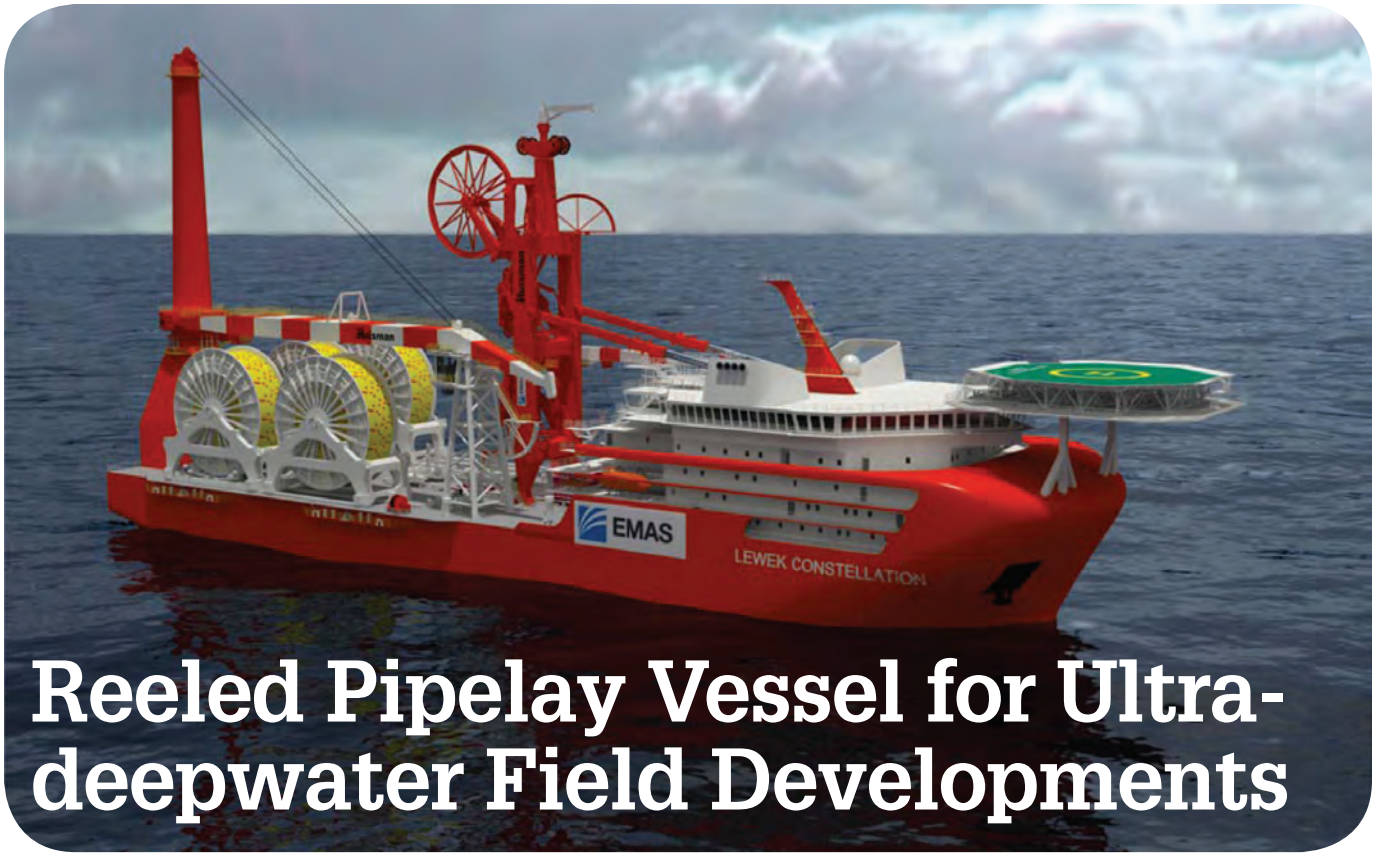

Reeled Pipelay Vessel for Ultra-deepwater Field Developments

By **John Meenaghan** and **Erik Christiani**-
EMAS AMC, Houston

Reeled pipelay has normally been used in fully developed and matured offshore oil and gas field areas with close proximity to onshore support, onshore logistics, and with short offshore transit distance to onshore spoolbases for loading the pipeline stalks onto the reel. This activity normally requires comprehensive planning both onshore and offshore, and is often on the pipelay'critical path.

New discoveries in remote locations, such as the Brazilian pre-salt and post-salt developments, often have long transit times from established spoolbases and port facilities, rendering certain reeled lay scenarios uneconomical. To reach the post-salt and pre-salt reservoirs in Brazil and West Africa and the Miocene and Lower Tertiary subsalt zones in the Gulf of Mexico, it is necessary for operators to drill wells in deep and ultra-deep water in increasingly remote regions.

This presents a challenge for operators as subsea construction services are not always readily available in remote locations and thus have to be mobilized from established regions. This also creates a logistical challenge, as most of these areas do not have spoolbase and shorebase support facilities within a reasonable transit distance.

Specifications

The *Lewek Constellation* is an innovative, state-of-the-art, DP 3, ice-class pipelay vessel that not only has the ability to install multiple risers, flowlines, flexibles, umbilicals, and platforms in a field, but also can do so in remote locations. The vessel has a multi-lay system and heavy-lift capabilities. By using a portable reel system, the vessel is able to stay in the field or in close vicinity, thus taking reeling operations off the critical path and maximizing the vessel's operational time.

The vessel's multi-lay system (MLS) is comprised of an 800Te tiltable tower, a 60Te pipeline end termination (PLET) handling system for large PLETs, and a 1200Te A&R system. The tower has dual 400Te tensioners, a straighter for handling pipe-in-pipe flowline systems with outer pipe up to 16in. outer diameter (OD), a 900Te hang-off module, and a movable/adjustable work platform along the tower. The tower can be adjusted from 60° to 90° to accommodate pipe laying from shallow water to ultra-deepwater. The A&R system has two 600Te traction winches and a 125Te secondary winch.

Lewek Constellation **multipurpose lay vessel and subsea construction vessel with four fully loaded vertical reels on board.**

In rigid reel lay, the vessel can apply up to 800Te of dynamic top tension on flowlines and rigid risers up to 16in. nominal OD. In flexible mode, the vessel and lay system can accommodate sizes up to 24in. nominal OD, while applying 400Te and 430Te of top tension, respectively.

Spooling barge

The pipelay vessel will use a spooling barge with a ballasting system to manage the heel and trim of the reels. The barge will be outfitted with a spooling system that includes a fleeting roller track assembly, a fleeting tensioner, a reel cradle

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assembly and winches. The barge will be moored at the quayside where the pipe stalk will be pulled over the stern using the winch, through the fleeting tensioner and across the rolling support assemblies, as pipe is spooled onto the reels. Once spooling is completed for a reel, the spooling spread will be fleeted into position for spooling of the next reel. Upon completion of all spooling operations, the reel barge will be towed to the Lewek Constellation to complete the offshore reel transfer.

The reels will be brought offshore to the pipelay vessel at a favorable location. The vessel will then use its heavy-lift system to offload empty reels and load full reels. This reduces the project time by taking reeling off the critical path and by removing the transit time back to the spoolbase to pick up additional product, Figure 1.

Heavy-lift system

The 3,000Te crane at the stern of the vessel can be used for heavy lifts of large manifolds, platforms, and topsides. To transfer the reels from the barge, the vessel will use the 3,000Te crane. The reels will have a weight of about 850Te empty and about 2100Te fully loaded.

Once a reel is transferred onto the pipelay vessel, the reels are moved into position using the reel skidding systems (RSS). The RSS moves the reels both transverse and longitudinally along an "H" shaped track on the main deck. This allows loaded reels to be moved into position for reeling operations and empty reels to be moved to a storage position for offloading.

The reel drive system (RDS) is situated forward of the main crane and is used to drive the reels during pipelay. The RDS will also maintain the back-tension during pipelay.

Hang-off module

The hang-off module (HOM) provides up to 900Te of tension on the pipe during pipeline tie-in, termination, and abandonment operations. The HOM is located inside of the moonpool and has forward and aft fleeting capabilities that allow for stowage during transit. A workstation can be moved into place when the pipe is in the HOM. The work station is used for welding and coating activities; it can be moved out of the firing line during pipe transfers or installation of large structures.

PLET handling system

The PLET handling system (PHS) is used to move either first- or second-end PLETs up to 60Te into position and alignment for welding operations. The PLET will be upended using the 80Te deck crane and placed onto the PHS. Grippers are then engaged to prevent the PLET from rotating while on the PHS. The PLET handling system is then skidded into position on the firing line. Once the PLET is in position, hydraulic arms rotate the PLET to match the inclination angle of the lay tower.

The vessel has two 1250Te carousels in its hold, Fig. 2. When in flexible mode, product is guided over chutes through the tensioner. The carousels can handle flexible pipe and umbilical ranging from 4-24in. OD.

In addition to the heavy-lift crane, the vessel has an 80Te telescopic crane and an auxiliary hoist capable of handling 10Te at any reach. The 80Te crane is used for auxiliary deck operations, PLET handling and mobilization/demobilization of the vessel.

The vertical reels used on the

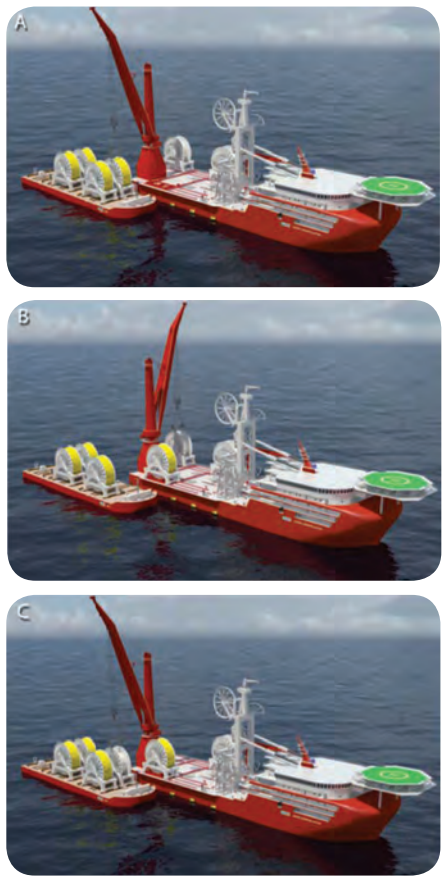

Figure 1. a) Lifting full reel off barge; b) Placing full reel onto RDS, offloading empty reel; c) Offloading empty reel to barge.

Figure 2. Vessel cut away showing below deck carousels and *Lewek Constellation* in flexible lay mode.

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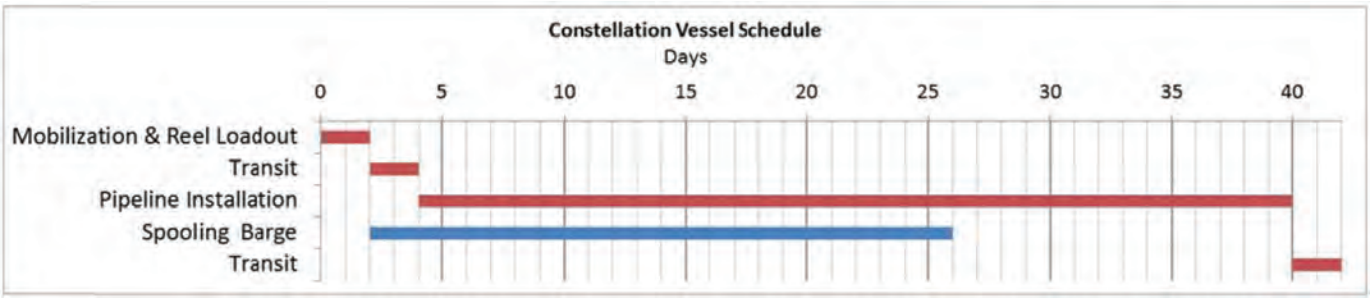

Figure 3. The *Lewek Constellation* shortens the pipelay schedule by 12 days, using a spooling barge to transport reels.

vessel are a standard design with a capacity of 1200Te per reel. Standard reels ease the handling and moving of reels to and from the vessel. Optimizing reel packing is important for the efficiency of a given pipelay campaign.

The vessel has a high top tension capability to lay pipe in deep and ultra-deep water. The sizes of pipe are bound by the minimum reelable wall thickness, the minimum wall thickness to resist collapse, according to DNV-OS-F101, and the maximum static top tension of 640 Te.

Pipelay comparison

Traditional reel lay piplay vessels have spooling operations occurring on the critical path, because they have to transit to a spoolbase to reel pipe. By using portable reels, it is possible to take spooling operations off critical path. A typical schedule has been developed to compare the duration of a deepwater pipelay project performed by a traditional reel lay vessel and a project completed by the new vessel, Figure 3.

Having a continuous pipelay campaign allows pipelay to be done more quickly. This can be ideal for remote locations close to the Arctic, by minimizing weather downtime. Project duration is shortened by about 12 days compared with the traditional reel lay pipe vessel schedule.

Project execution

With the heavy-lift crane and multilay system, the Lewek Constellation is a "one stop shop." For a typical offshore development, the vessel is capable of lifting and installing topsides, as well as the entire subsea field. The vessel can install a rigid or flexible riser, weld the flowline to the riser, lay the flowline, and terminate the line with a PLET.

The vessel also has the deck space to perform post metrology welding and field joint coatings of pre-fabricated of rigid jumpers. The jumpers can then be installed directly from the deck of the vessel using the vessel crane. The multilay system gives the vessel the ability to install umbilicals and flexible flowlines. Two work-class ROVs can assist with pre-commissioning activities.

The vessel's ability to reconfigure from pipelay, to flexible and umbilical lay, allows for the installation of field developments with multiple flowline and umbilical products. Furthermore, the vessel can reconfigure to heavy-lift mode to install large manifolds, subsea pump stations and fixed platforms.

By using the vessel to install an entire field development, the need for additional vessels is minimized, thereby reducing the chance of a schedule slip and increased cost from multiple mobilizations and transits to remote locations. OE

New vessel wins contracts

EMAS AMC won two significant contracts for its new pipelay vessel, *Lewek Connector*. Statoil awarded an installation contract for the transport and installation of subsea templates for the Aasta Hansteen field development. The field is 300km west of Bodø in the Norwegian Sea in 1300m water depth. Work scope includes the transport and installation of two four-slot templates and one single-shot template. All templates will be transported from Aker Solutions' facilities in Sandnessjøen, Norway. The vessel will handle transport and installation work, and will partner with local suppliers for work prep and vessel supplies. Engineering and planning will be managed by EMAS AMC in Oslo and the work will be done in 2015.

The company was also awarded an engineering, procurement, construction, and installation (EPIC) contract, valued at about US $165 million, from Det Norske Oljeselskap ASA. The contract is for rigid pipelay and related subsea work in the Ivar Aasen field in the Norwegian North Sea.

The field contains about 150MMboe and is about 180km off Stavanger, Norway. Work scope includes project management, detailed engineering and procurement, construction, and installation of three 10km rigid pipelines via reels, including spools, pipeline end terminations, and seabed intervention. The contract also has an option for EMAS AMC to procure and install a subsea power cable connecting the neighboring Edvard Grieg platform to the Ivar Aasen platform.

Project management and engineering work will begin immediately and will be managed from the company's offices in Oslo. Offshore activities are scheduled to begin in 2015 with completion in 2016.

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Mega projects on the horizon for the *Pieter Schelte*

The *Pieter Schelte* newly joined twin-hull in Daewoo's H-quay.

After 20 years as an idea, the *Pieter Schelte* heavy-lift and pipelay vessel is getting close to winning its first work, with the North Sea its most likely first customer. Elaine Maslin shares a look.

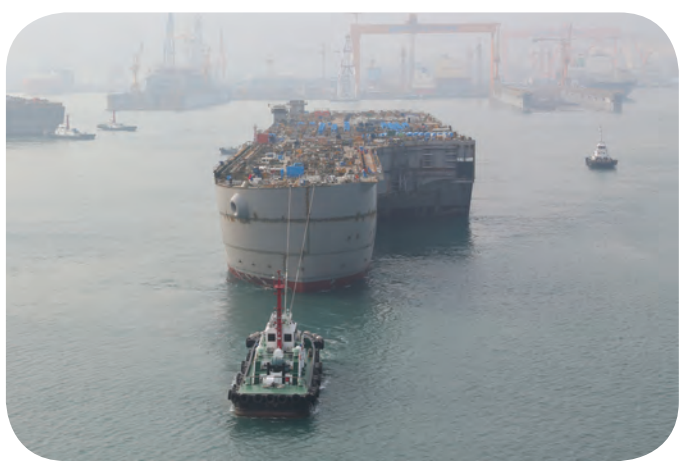
Big just got bigger, and what was once a dream is getting closer by the day to becoming reality.

It is Allseas' mega-vessel, the *Pieter Schelte*, which over the past year has been taking shape in Daewoo's South Korean docks – as have talks with operators, including Shell, over its potential first application.

The twin-hull, €2.2billion vessel is a behemoth at 382m long and 124m wide. It was designed to make a significant impact on the heavy lift capability currently available in the global offshore market, both for platform installation and decommissioning; and pipelay with its 2000 tonne (2205 short tons) tension capacity S-Lay pipelay package.

Its lift capability is given as an eye-watering 48,000 tonnes (53,000 short tons) for topsides and 25,000 tonnes (27,500 short tons) for jackets.

However, following the construction and then provisional joining of the two hulls at the end of last year, the firm decided to increase the width of the vessel's unique slot between the two hulls, to be used for installing or removing topsides, by 7m-59m (193ft). The portside hull will enter the floating dock this month to allow for the erection of the widening blocks. In mid-July, the two



The two hulls were floated from their docks and positioned together at sea before being floated back in to dock.

hulls will be re-joined afloat.

While slightly delaying its final completion, the move will improve *Pieter Schelte*'s capacity, still well before Shell's North Sea Brent decommissioning project.

Edward Heerema, Allseas' president and the creator of the *Pieter Schelte* concept (named after his late father, a pioneer of offshore heavy lifting) explains: "We determined the width of the slot a long, long time ago, 20 years ago, and in those days we established that the widest docks available were 120m wide. We did analysis of the platforms that had to be taken away and we did not get very accurate information from the oil companies in those days, so we underestimated the width that was needed. Because of the limitations of the building docks in those days we decided that the vessel could not be wider than 117m with a slot width of 52m.

"But during studies over the past two years for clients we have received very accurate information and we saw that the slot width should be increased. We also realized that the dock width at Daewoo was actually 134m – a lot more than available a long time ago."

It is an evolving project. Edward Heerema's concept for the *Pieter Schelte* was first launched in 1988, just three years after he started Allseas. Even until recently, the firm has still been finalizing designs – the tilting lift beams for jacket removal and installation, which lift, tilt and then lay down jackets, will not be installed until a year after the vessel is launched, due to Edward Heerema wanting to get them right.

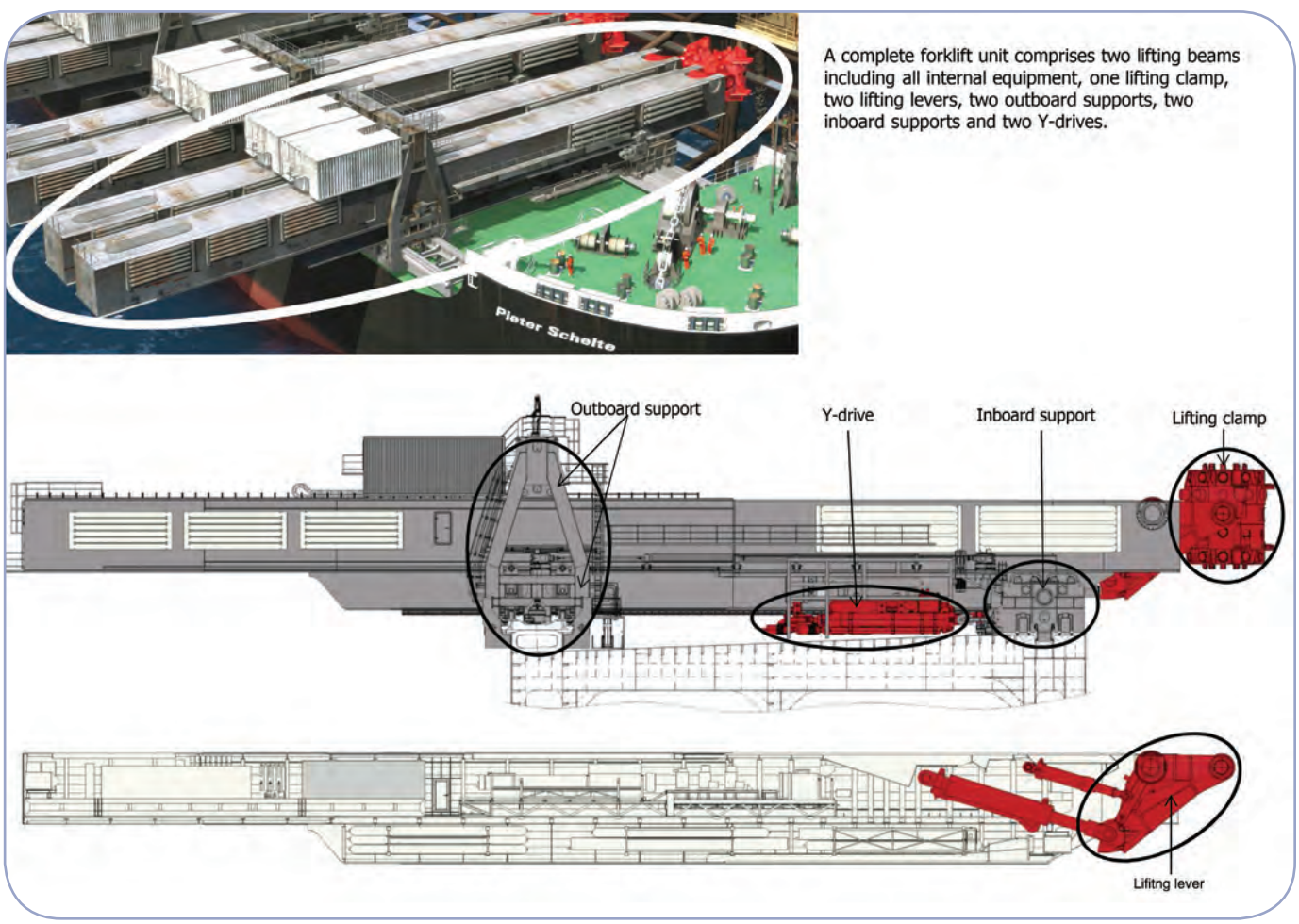
"This ship, novel in every respect, has required from us years and years of analysis work," he says. "But because it represents so great a cost, we have to do it right the first time. It is an engineer's paradise; the fun is to solve it."

The vessel's concept is the use of eight sets of horizontal lifting beams across its slot for removal or installation of topsides. They have a motion compensation system to operate in rough seas. The vessel will have two tilting lift beams on the stern, and laydown space for the installation or removal of jackets. It will be powered by eight main diesel generators, providing a total installed power of 95 MW (megawatts), powering 12 azimuth thrusters.

For pipelay, it will handle 12m pipe sections held under tension by four 500 tonne (550 short ton) tensioners with a 170 m (558ft) long stinger supporting the pipe as it leaves the vessel.

Between summer and December last year, the two hulls were composed separately from sections partly built in China, also by Daewoo, in two floating dry docks in South Korea before being towed out into open water, to be provisionally welded to-

A schematic of the Pieter Schelte's topsides lifting beam system.



MAN diesel engines and thrusters were shipped to the Daewoo shipyard in China for installation in the *Pieter Schelte's* hulls.

gether. The combined hull, complete with its current 52m slot, was then brought into a single larger floating dry dock.

The vessel's 12 thrusters – at 75 tonnes (83 short tons) a piece - have been delivered to the yard and construction of the lifting beams, including eight 200-tonne (220 short ton) clamps, which will straddle the slot, is underway.

"So much has happened between the summer and December," Heerema says, "providing fascinating pictures."

Work finding a first customer for the vessel has also been progressing.

"The timing of the construction of the *Pieter Schelte*, with its delivery late 2014, fits in beautifully with the timing of, for example, the Brent decommissioning program," Heerema says. "The first project might be the removal of the Shell Brent platforms."

The Brent Delta platform reached "cease of production" (COP) in December 2011. Brent Alpha and Bravo are currently scheduled to reach COP in late 2014, with the Brent Charlie COP date scheduled beyond 2015.

The work scope, should Allseas win it, would be for the removal of the four topsides and one jacket structure – the other three are concrete gravity-based structures which will be left in field under a derogation order.

"Shell has studied our ship for two and a half years," Heerema says. "They had us do very serious and thorough studies, so Shell has got to know our vessel and its capabilities in and out. They have had their best people evaluate what the ship could do.

"It would be a great entry for us and for the business. Having an award for platform removal changes our whole position. Over the many years we went through the phases that this vessel was just a story, a nice intention. Then came the phase of designing it in detail, building it, and now it is for real. We are very hopeful of the Brent project."

Heavy-lift work of this type would be the vessel's primary target market, being able to do what smaller heavy lift vessels currently do in a modular fashion, taking more time.

The North West Hutton topsides decommissioning project, for example, involved 58 separate moderate and heavy lifts, and about 100 days of heavy-lift vessel time. The semi-submersible vessels being used are certainly cheaper per day, Heerema saysw, as they have already paid off their capital costs.

Because the market for very large heavy lifts is limited, the vessel will also be looking for new platform installation work, to make sure it is sufficiently utilized. There is not sufficient heavy lift work to be occupied a significant part of the year, which is the reason for adding the pipelay capability.

"There are also new elements in the market, such as the installation of 10,000-15,000 tonne (11,000-16,500 short ton) transformer stations for wind energy," Heerema

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The *Pieter Schelte*'s thrusters and MAN Diesel engines in transport to the Daewoo shipyard last year.

The topsides lift system levers during fabrication.

says. "They are just odd projects, not frequent, but they give us added work."

Heerema says that because of the capabilities of the vessel, oil and gas operators would also be able to consider single lift installation of platforms, meaning far less hook-up work offshore.

"So far they have to design to the capacities of the largest semi-submersible heavy lift vessels, which is about 11,000 tonnes (12,200 short tons) at the required outreach of the cranes," he said. "Now they can consider whether they want to lift bigger units in one, which gives them savings on hook-up costs – they can put together more of the platform onshore before it goes offshore."

The vessel's capacity will also challenge the yards who could receive the immense structures it will handle. A 200m (656ft) long cargo barge is being built to help transfer structures when the vessel cannot line up directly on the quayside.

All big fabrication yards in the UK and Norway will be able to take the barge, Heerema says.

However, some yards will need to make upgrades to take the work.

"They need load spreaders and beams (for the weight of larger structures), they have to have big cranes to take the structures all apart and they need to mobilize sufficient manpower to do all that work," Heerema says.

"Most have sufficient area; their question is mainly quayside strength. Some need to drive piles in the quayside area.

"It does take some initiative on the side of fabrication yards, but the response has been positive. They will find answers. We think with them, we try to come up with solutions that are practical for them and for us to skid from the cargo barge onto the quayside in one movement."

Thanks to the extra work on *Pieter Schelte*, the dismantling yards now have until late 2014 or early 2015 to get ready.

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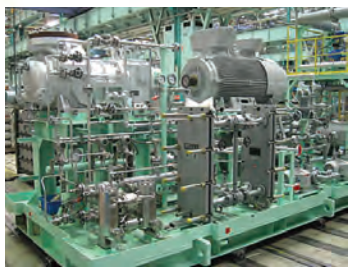

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Evolution of a Fleet

Bourbon took delivery of the third vessel in its planned 10-vessel inspection, maintenance, and repair (IMR) fleet. The vessel, *Bourbon Evolution 803*, will operate in multi-service vessel (MSV) mode for subsea system service, off Malaysia.

The Evolution 800 vessel series is designed to operate safely in 2500-3000m water depths and satisfies oil company requirements for operations, risk management, and cost optimization in deepwater theaters.

The design provides multiple configuration options. As a flotel, a vessel can accommodate over 200 people. In wireline mode, a vessel can conduct well intervention operations and well testing. Other functional modes enable fire fighting, rescue, and oil-spill control (storing and deploying floating barriers for hydrocarbon isolation).

Primary features of the design include:

- **Redundancy:** Vessels have seven diesel-electric generators, two machine rooms, two electric rooms, two VSAT communication systems, two cranes that can work simultaneously, and six propellers: three in the bow and three astern.
- **Maneuverability:** Vessels maneuver and maintain station using DP3.
- **Client space:** Each vessels' interior provides a dedicated client deck with communications for monitoring all operational information (surface/subsea maps, ROV video, etc.), Internet connectivity via satellite, and a wide view of operations.
- **Efficiency:** Vessels are equipped with diesel-electric propulsion systems (fuel consumption of 12cu m/d, said to be 25-50% less than the market average).

Cranes are one key feature of the new design; a 150tonne active heave-compensated (AHC) crane for installing subsea trees and a 40tonne AHC crane for general use. The cranes can deploy mudmats, flexible or rigid jumpers, and other well tie-in equipment. They can be used to service subsea operations and equipment including: diving operations (riser and spool work), dredging, placing ROV tool baskets, as well as replacing chokes and control pods (***OE*** January 2012).

West Africa

Bourbon has long-term deepwater commitments for its eight vessels operating off West Africa. Most of the vessels operate off Angola (Blocks 15, 17, 18, and 31), with some in support of Nigeria's Bonga and Akpo fields. Both of the *Bourbon Evolution 803*'s sister ships, *Ungundja*, and *Bourbon Evolution 802*, operate off West Africa.

The *Ungundja*, the inaugural Evolution-design vessel, entered the fleet in December 2011 and is working off Angola. It has installed numerous jumpers and subsea trees on the Dalia and Pazflor fields. Ten months later in September 2012, the *Bourbon Evolution 802* joined the fleet. It operates off Nigeria (***OE*** April 2012).

The company began its IMR-vessel building program in early 2008. The design is from Guido Perla & Associates (GPA), and the vessels are built at the Sinopacific shipyard in China. Deliveries will continue through 2014. **OE**

Evolution design specifications (selected).

Length:	95.6m
Breadth:	21m
Depth:	8m
Draft (min/max)**:**	5.4m/6m
Deadweight:	4858tonne
Gross tonnage:	6000 UMS
Moonpool:	8m x 8m (not opened – option)
Helideck: (Diameter/Tonnage)	20m/11tonne
Deck: &	940sq m @ 5tonne/sq m 10t/sq m (aft)
Mezzanine: m	230sq m @ 1.4tonne/sq + reinforced beams
Deck cargo: (transit-operations)	2000-1300tonne
Fuel oil: (capacity-transfer)	1096cu m – 150cu m/hr @ 7 bar
Drill or Water ballast: (capacity-transfer)	2508cu m – 150cu m/hr @ 7 bar
Fresh water: (capacity-transfer)	946cu m – 150cu m/hr @ 7 bar
Methanol: (capacity-transfer)	2 x 187cu m – 2 x 100cu m/hr @ 9 bar

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The modern liftboat could be a jackup

Liftboats started as a concept in South Louisiana with the first-known liftboats conceived in Braithwaite. The technology was developed locally and has continued to improve. A liftboat is a self-elevating, self-propelled vessel equipped with at least one crane and with open deck space that can be used for multiple purposes.

That there is only a local understanding of these vessels cannot be more evident than by the fact that only one major class society, American Bureau of Shipping, has rules specifically written for liftboats. The *ABS Guide for Building and Classing Liftboats* came out in the 1990s, and the most recent update was published in March 2013.

The SUDA 320-L3 liftboat

Until recently, there has not been a high-degree of global recognition for liftboats. Whatever recognition there has been outside the US for liftboats has been as small jackups. In Europe and Southeast Asia, where these vessels have found a home, the designs are influenced by jackups.

Larger liftboats may look like jackups, but they are not jackups and the design philosophy should reflect that. A jackup-influenced liftboat design leads to inefficiencies. For example, some 320ft leg liftboats have leg walls up to 2.5-in. thick. Liftboat designer A.K. Suda, Inc.'s model 320-L3 liftboat has 1.5-in. maximum leg-wall thickness and has a higher VDL and environmental criteria than the 2.5-in. leg-wall vessels.

The newly designed SUDA 450-L3T liftboat has 450-ft legs.

VDL means Variable Dead Load. It is the sum of weights of liquids (consumables, not ballast) and deck cargo. Environmental criteria consist of Wind, Wave Height and Period, and Current. All these produce a load on the structure. A higher Environmental Criteria set is a combination of these items that produces a higher load on the structure.

There is also the problem of the jacking system. A liftboat requires, in some ways, a more complex and robust jacking system. Suda found that it is no more expensive than one used in the traditional jackups.

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ABS' liftboat guide notwithstanding, there is still a significant degree of confusion and incongruity between ABS and USCG rules. This leads to an unnecessarily high margin of safety not evident in other craft because the US Coast Guard does not recognize the ABS Guide. Instead, the USCG utilizes a combination of ABS Mobile Offshore Drilling Unit (MODU) rules and its own Offshore Support Vessel (OSV) supplemental rules (most recently updated January 2013). This sometimes results in more stringent requirements than those for full-fledged MODUs.

Scheduled for delivery in 3Q 2013, SUDA 300-L3 features the shortest towers of any vessel in its class and can serve as an accommodation vessel. *(Image: A.K. Suda, Inc.)*

Liftboats are typically limited to locations within 12 hours travel to an area of safe refuge, unlike MODUs that should need, if anything, a higher margin of safety.

These limitations sometimes result in owners changing the flag of vessels operating outside US waters. This is not an easy decision. A liftboat that changes flag can never work in US waters again, barring some very remote possibilities.

New designs

Suda recently completed the design of a 320-ft-leg vessel (model SP 320-L3). There has been a liftboat with longer legs, but the usable leg on the SP 320-L3 model and cranage make it the "world's largest liftboat."

The company is currently designing a 450-ft-leg SEU (SUDA 450-L3T). Two of these vessels, the largest of their kind, are under construction by EMAS in Singapore. These vessels have a large deck area and can carry up to 250 passengers. They are suitable for operation in the North Sea and will carry Wind Farm Installation Maintenance and Repair Certification.

This liftboat (called so because it is self-propelled) is also a new generation jackup. It incorporates a new-generation jacking system design concept. The compact, high-capacity accommodation meets what

more owners want – a self-elevating unit that can do everything. It can work in the wind farm area with its liftboat-type jacking system. It can also be fitted with a drilling package to work in the oil and gas industry.

Also under construction are four 335-ft-leg liftboats (SUDA 335-L3), each with 160-passenger capacity and large deck area and variable deck load. Each vessel includes a custom jacking system based on the one developed for the SUDA 300-L3 currently under construction in Houma, Louisiana.

The SUDA 300-L3 is scheduled for delivery in 3Q 2013. This design features a hull depth of 13ft, no more than what is absolutely necessary to provide a strong, stable, and efficient working platform. The saving in hull weight benefits the leg and jacking system design, which in turn, improves variable load carrying capacity. The leg design has a lower weight per foot, based on comparable designs in the industry, while still meeting or exceeding all design factors of safety based on class and other standards. This vessel may have the largest deadweight tonnage/displacement ratio (a measure of merit in ROI) of its type. DWT is the *displacement* at any loaded condition minus the lightship weight.

The SUDA 300-L3, like the SUDA 335-L3, also features the shortest towers of any vessel in its class, worldwide. SUDA assisted the jacking system vendor in developing this efficient jacking system design for this unique application. This liftboat will carry a very high variable load and will also have the longest usable leg length for a vessel in its class.

Suda designs typically incorporate capabilities for multiple uses. Thus, the SUDA 300-L3 can work as an accommodation vessel, for oil production operations such as coiled tubing operations, cantilever, skid mounting, as well as for wind turbine installation, maintenance, and repair. The vessel can carry the components for an entire wind turbine in a single trip. It will be the "smallest" vessel to receive the ABS Wind IMR certification.

In the same lineage is the SUDA 260-L3, currently owned by Hercules and operating in the Middle East. This vessel has a deck load capacity over 915-ton, and a depth of only 11ft. A similar vessel in this series is operating in West Africa.

***Ajay K. Suda**, president of A. K. Suda, Inc., a firm of naval architects and marine engineers that provides design and engineering services to the maritime industry. Suda holds a B.Tech in Naval Architecture and Marine Engineering from the Indian Institute of Technology, and an M.S.E. in Naval Architecture and Marine Engineering from the University of Michigan.*

New process brings FLNG to small and mid-size fields

As FLNG starts to take off on a large scale, a consortium of companies is looking to make it a more cost effective and compact proposition.

A consortium of companies has designed a new floating LNG (FLNG) system specifically aimed at small to mid-size gas fields.

LiBro FLNG is a system that hopes to use an alternative cooling process making use of waste heat from gas turbine exhausts instead of using flammable substances. This in turn allows for more conventional and smaller vessels to be used for FLNG.

It also proposes use of existing tank systems, which could be retrofitted to vessels, further opening up use of standard vessels, increasing the number of yards able to complete such projects, and potentially making conversions of existing vessels a practical possibility.

The concept has been developed by ship classification society ClassNK, Tokyo-based floating production supplier/operator Modec and plant manufacturer Toyo Engineering – and it has already secured its first front end engineering design (FEED) contract with Malaysia's Petronas.

The consortium says that while many FLNG systems are primarily attempts to take onshore LNG technology and adapt it to offshore uses, the LiBro FLNG system has been developed specifically for use offshore.

The core technology behind the system is a combination of Modec's LiBro technology with Air Products' Triple N2 Expander Liquefaction technology.

While the safety of N2 refrigerants is widely accepted, the limited efficiency of such systems has prevented their widespread use in FLNG systems, says the group. The technology addresses these concerns by using Lithium Bromide absorption refrigeration technology that produces chilled water using waste heat from gas turbine exhaust. This process is already used in centralized mega air conditioning systems onshore and to date in excess of 10,000 such units have been delivered, with the largest in operation for over five years.

A standard 300m-long, 50m-wide, Capesize carrier could support LNG topside facilities to produce 2,000,000 MTPA.

The system integrates the LiBro unit with Air Products AP-N LNG Process so that the chilled water produced in the unit pre-cools the natural gas and N2 refrigerant, resulting in improved LNG train efficiency. Chilled water is also used for cooling the gas turbine combustion air, maximizing output of the gas turbine driver and improving the overall efficiency of the LNG train.

In addition, the cooling system uses non-flammable nitrogen instead of flammable hydrocarbons such as methane, ethane, or propane, used in most FLNG systems, to cool and liquefy the gas. The latter increase both environmental and safety concerns and mean accommodation space must be kept at a safe distance – increasing hull-size specifications.

The system is currently being used in the FEED of FLNG projects under development, says the group.

This includes a FEED contract of an FLNG unit from Malaysian National Oil Company Petroliam Nasional Berhad (Petronas). This will be Petronas' second FLNG unit and would be designed to produce 1.5 million tons per annum (MTPA) of LNG at offshore Sabah, Malaysia. The FEED and cost estimate are expected to be completed by the middle of 2013.

"As a design which has the potential to greatly increase the scope of offshore gas development, especially for small and mid-size fields, we were particularly excited about the LiBro system and began a joint research and development project with Modec/TEC for 10 months from September 2011 to June 2012," said Hayato Suga, general manager, ClassNK Natural Resources and Energy Department.

"During this time, we had weekly

Hayato Suga, General Manager ClassNK Natural Resources and Energy Department

meetings concerning the marine and topside design; we also witnessed the LiBro absorption chiller dynamic motion testing and were very impressed by the result.

"One of our main contributions to the project was risk and safety assessment of the LiBro FLNG design as a third party. As part of this process we carried out the hazard identification (HAZID) meetings to identify risks and potential areas for improvement. Through such whole process, we confirmed satisfactory integrity, feasibility and safety of the LiBro FLNG design and eventually issued Approval in Principle (AIP) to the design."

Another difference in the system is its storage tanks – it uses the Self-Supporting Prismatic-Shape IMO Type B SPB tank design developed by Japan's IHI (now JMU) in the 1980s. SPB tanks have been used previously in gas carriers, but are increasingly being chosen for use in FLNG designs due to their resistance to sloshing and the flat, open deck space that use of the tanks allows.

As an independent tank design, it can also be retro-fitted onto existing hulls, allowing the tank system to be built separately from the hull (conceivably even by different shipyards) and opening the way to converting existing merchant vessels to FLNG, potentially reducing capex. Modec says that the system will also allow for either side-by-side or tandem LNG offloading.

For the consortium, all these innovations mean the opportunity for much smaller vessels with less capex, potentially making smaller marginal fields economically viable where they would not make the mark otherwise.

As an example, the group say Shell's Prelude FLNG system is nearly 500m long. It says the LiBro FLNG design could be installed in its entirety on a standard Capesize bulk carrier hull. For a typical offshore gas field, a standard 300m-long and 50m-wide, Setouchi-max, Capesize carrier could accommodate topside facilities with an LNG production capacity of 2MTPA and LNG storage capacity of 160,000cu m.

The group does admit a disadvantage - typical production capacity is less than that on larger FLNG designs. A traditional large scale FLNG system typically has a process capacity of more than 3.5MTPA, compared with the 2MTPA offered by the LiBro FLNG. But it says because it is aiming at the smaller fields this makes reduced capacity a practical possibility. **OE**

Audrey Leon reports on the latest project and facilities updates in the region.

Brazil in progress

Brazil is a veritable diamond in the rough for foreign and local investors. Firms are investing in new centers of technology, fabrication, and worker training to increase the country's skills and alleviate infrastructure difficulties.

Brazil is very much the place to be at the moment, and not just for its fantastic beaches and anything-goes Carnival. Multinational companies are flocking to the South American country to reap the benefits of emerging industries that include shipbuilding, ship repair, transportation, and training.

Even with extensive investment, Brazil is not immune to the problems the oil and gas industry faces globally, such as a lack of skilled workers and insufficient infrastructure to support the country's oil and gas resource development. Exacerbating the problems are recent changes to local content rules that require Brazilian projects to include at least 65% local content, including services, people and products.

And yet, Brazil's pre-salt potential remains a topic of unending interest.

Image: Wilson, Sons

An overview of the Brasco (a Wilson, Sons group) logistics support base in Niteroi, one of the largest private port terminals, which serves IOCs such as Statoil and Chevron, as well as service providers M-I SWACO and Halliburton.

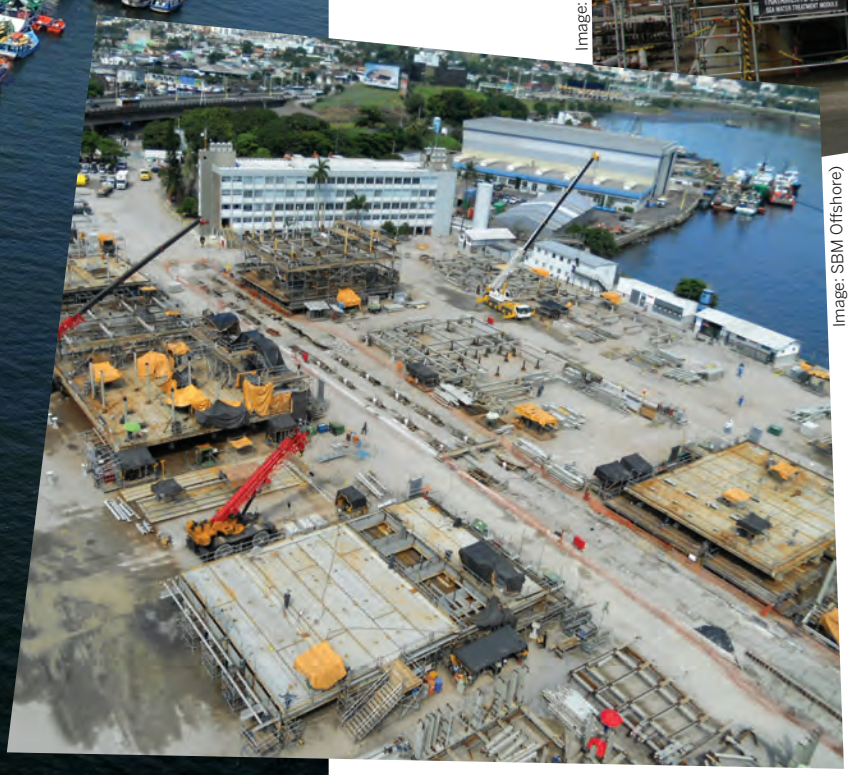

Image: SBM Offshore)

Overview of modules under construction at the Brasa yard in Niteroi.

Image: Audrey Leon/OE

A water treatment module that is currently under construction at SBM Offshore's Brasa yard in Niteroi, Rio de Janeiro.

The country's National Petroleum Agency (ANP) is gearing up for its latest licensing round, which will begin later this month. ANP reports that 71 companies have already entered the ring, including ExxonMobil, BP plc, Chevron Corp., Petrobras, and Brazilian-based independents HRT and OGX.

Although there has been steady foreign investment, Petrobras controls the majority of the market and many service and vessel-operating companies find themselves dependent upon contracts from the state-owned firm.

Pre-salt production

Petrobras says its E&P investments for 2013-2017 will be US$147.5 billion. Petrobras is focusing its efforts on four main projects: Sapinhoa, Roncador, Baleia Azul, and Papa Terra.

The company is currently pumping 300,000bo/d from its Campos and Santos pre-salt basins. It took seven years to reach record production with 17 wells.

By all accounts, 2013 is a busy year for Petrobras in the pre-salt, with three production systems already on-stream, and a fourth to follow this month.

Petrobras connected the FPSO *Cidade de São Paulo* to the Sapinhoa field in the Santos Basin in January and quickly followed suit with the FPSO *Cidade de São Vicente* in Sapinhoa Norte in February.

Also in February, Petrobras connected the FPSO *Cidade de Itajaí*, which arrived at the field in December, to Well 9-SPS-88 at the Bauna field in the southern Santos Basin. Petrobras estimates that the well can produce up to 12,000 b/d. The company will eventually connect 10 more wells – 5 production, 4 water-injection, and 1 gas-injection – to the FPSO, reaching peak production by August.

Petrobas says all three units will add an additional 200,000 b/d to its production capacity.

Of course, Petrobras is not yet done. The company expects to install

Images: Audrey Leon/OE

Left - Petrobras' Cenpes technology research center at Ilha do Fundão in Rio de Janeiro.

Below - Petrobras headquarters in downtown Rio de Janeiro.

the FPSO *Cidade de Paraty* to the northeast area of the Lula field in the Santos pre-salt. The FPSO has a capacity to process 120,000b/d and five million cu m/d of natural gas.

Petrobras says it aims to exceed one million bo/d in production by 2017, and it intends to do that by installing 11 additional platforms from 2014-2016. Ten of those will be located in the Santos Basin. Currently, Santos provides 43% of Petrobras' pre-salt production, approximately 129,000 b/d.

On the horizon

One of the next FPSOs to be installed in the Northern Sapinhoa field, in the Santos Basin, is the FPSO C*idade de Ilhabela*. The unit is owned by a shareholding consortium comprised of SBM Offshore, Queiroz Galvão Óleo e Gás (QGOG) and Mitsubishi Corp., which also owns FPSO *Cidade de Paraty*. The FPSO's hull is being converted at CSSC Shipyard in Guangzhou, China, from a 400m long and 70m wide tank vessel.

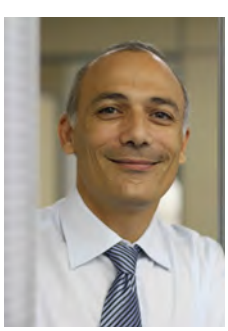

Image: SBM Offshore

Phillipe Levy, managing director of SBM Offshore Brazil

Ten topsides modules for the FPSO are under construction at SBM Offshore's BRASA yard in Niteroi, which is surrounded by Guanabara Bay. The BRASA yard is a 50/50 joint venture between SBM Offshore and Synergy. The company refurbished the yard: warehouses, administrative offices, construction facilities, and rebuilt an access bridge in 2012. SBM Offshore says the yard was the company's solution to solve bottlenecks in Brazil. The site also offers a crane barge (the *Pelicano-1*) and integration quayside.

The topside facilities, now under construction, will process 150,000 b/d of production fluids, associated gas treatment for six million cu m/d with compression and carbon dioxide removal, hydrogen sulfide removal, and a water injection facility for 180,00b/d. Integration is expected by April 2014, with first production to follow in September.

"With FPSO *P-57*, we needed 65% local content, and we needed to have a local organization that could handle buying equipment and construction operations," says Phillipe Levy, managing director of SBM Offshore Brazil. "Once Brasfels became backed up, we needed to create our own solution."

Levy says it wasn't politically correct to build anywhere else but Brazil due to local content rules. He says FPSO *Cidade de Ilhabela* will have 65% local content, double that of what was used on FPSOs before *P-57* was constructed.

These days, SBM Offshore's new focus is FPSOs, Levy says.

"Santos pre-salt is very complex," he says. "We're talking about very challenging projects, and we like that."

That attitude must have impressed Petrobras because at the end of March, it awarded SBM Offshore a letter of intent (LOI) for

SBM's barge crane Pelicano 1 at the dock in Guanabara Bay in Niteroi

Image: Audrey Leon/OE

two additional FPSOs to serve the Lula field. SBM Offshore's scope of work will include the conversion of two double-hull sister vessels. The FPSOs will have a storage capacity of 1.6MMbbl each.

The topside facilities of each FPSO weigh approximately 22,000 tons and both will be able to produce 150,000b/d of well fluids and have associated gas treatment capacity of 6MMcu m/d. The water injection capacity of each FPSO will be 200,000b/d.

Chevron wins Frade restart

Chevron's luck in Brazil is beginning to change. The ANP authorized the supermajor to restart production at its troubled Frade field last month, allowing Chevron to produce from four wells for a period of 12 months. As **OE** goes to press, Chevron had not confirmed Frade's startup date.

Production at the ultra-deepwater Frade field, located in the northern Campos basin, has been suspended since November 2011 when oil seeps were discovered in the area. Approximately 2400-3700 bbl of oil were spilled into the Atlantic Ocean during the incident.

The green light from ANP comes just months after a Brazilian judge dropped criminal charges against Chevron and Transocean related to the incident. While the criminal portion of Chevron of Brazilian legal troubles are put to bed, civil suits are still pending.

Recent Discoveries

In early March, Petrobras encountered 28° API oil at its 3-RJS-706 well, located in Block BMS-11 of the Iara area, in the Santos Basin. The well is 226km off the coast of Rio de Janeiro and 6km from the discovery well at depth of 2197m.

In February, Petrobras announced two oil discoveries. The first at its Florim well (1-BRSA-1116-RJS), which encountered 29° API oil. Florim, in the Santos Basin pre-salt, was drilled to a depth of 5498m in water depths of 2009m. The well sits 206km off the coast of Rio de Janeiro state. The second discovery came at Petrobras 1-SPS-98 (Sagitário) well. The company found 31° API oil at the Santos Basin pre-salt well. Sagitário is the first well to be drilled in the BM-S-50 block and is located 194km off the coast of the state of São Paulo in 1871m of water.

FPSO *Cidade de Itajaí* arrived at Petrobas' Bauna field in December and began producing from well 9-SPS-88 in early February (Source: Teekay Corporation).

In January, Petrobras encountered good quality oil in the Tupi South area of the Santos Basin pre-salt. Petrobras said the well encountered reservoirs of excellent quality in carbonate rocks below the salt layer. Preliminary tests indicate that Tupi South could be linked to Lula field. Tupi South is located south of Lula field, 302km off the coast of Rio de Janeiro in a water depth of 2188m.

In December, Petrobras touted a fourth oil discovery, this time in the Muriú well, in the ultra-deepwaters of the Sergipe-Algoas basin, 85km off the coast of Aracaju. Tests confirmed the presence of a 67m light oil column in the Calumbi formation of the Muriú well.

In October, Petrobras identified a 176m oil column at the Jupiter Nordeste extension well, located 7.5km from the main Jupiter discovery well inside ultra-deepwater Block BM-S-24. The well sits 275km off the coast of Rio de Janeiro.

Australian explorer Karoon Oil & Gas along with partner Pacific Rubiales announced the discovery of a 25m light oil column at their Kan-

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Maersk Training will open a facility in June to train Brazilian workers.

Training facility aims to lessen local content woes

Maersk Training, a division of Maersk Group, is set to open a new training facility next month, in Barra da Tijuca on Rio de Janeiro's southwest side. Maersk says its goal is to deliver the necessary training to operate in Brazil as an oil company, rig or vessel owner or operator.

One issue of frequent concern to many companies operating in Brazil is local content requirements. The global oil and gas industry as a whole is struggling to find enough properly skilled workers, but in Brazil the problems are exacerbated by lack of experience and language issues.

garoo-1 exploration well on Block S-M-1101 in the Santos Basin. The well intersected the Eocene reservoir section 300m down dip from the trap crest. Karoon estimates that the entire trap holds a potential gross hydrocarbon column of approximately 350m.

In a follow up to its 2009 discovery, BP completed flow tests on the Itaipu-1A pre-salt well is located in Block BM-C-32 of the Campos Basin. The well test achieved flow rates as high as 5600bo/d for 32 hours through a 40/64in. choke from a limited perforated interval in late March. BP operates BM-C-32 with 40% equity. Its partners include Anadarko Petroleum Corp. (33.3%) and Maersk Energia Ltda (26.7%)

Setting up shop

Several large firms are choosing to build brand new facilities around

"There is a shortage of highly-skilled labor, and even more so in terms of very specific skills such as those we are looking for in technical instructors," says Hans Dürke Bloch-Kjaer, Managing Director at Maersk Training Brasil.

Bloch-Kjaer says language barriers make it difficult to find qualified instructors for the training center.

"The working language of Maersk is English, and we expect to have at least some non-Brazilians participating in our courses, and we require all our instructors to be able to communicate fairly fluently in English as well as Portuguese," he says. "Unfortunately, highly-skilled workers in Brazil tend to not need English skills to find good jobs, and don't feel a real need to learn a second language.

"Many otherwise excellent candidates have been rejected just because they don't speak English."

Bloch-Kjaer usually has to match offshore salaries just to get the high-skilled workers to join as trainers. Bloch-Kjaer noted, jokingly, that he is part of the problem when it comes to poaching in the industry.

"When you find these people who speak English and have knowledge, they are very expensive," he says.

Despite the challenges, the Barra da Tijuca facility currently employs 15 local instructors and one senior Danish instructor. By the end of the year Bloch-Kjaer expects to have 30 instructors. The inaugural session, which will have a maximum of six native Brazilian students, will feature a course on Advanced Dynamic Positioning using Maersk's DP simulator, which was supplied by Kongsberg. In addition to DP, the facility will be able to conduct drilling and bridge simulations.

Maersk will also offer public short courses, company-sponsored trainee programs and tailor-made services at the Barra da Tijuca center. Maersk says its training program with will count toward investment in local content requirements.

Rio de Janeiro to both assist in satisfying rigid local content requirements as well as to stay close to clients in the Latin American region.

BG Group, a multinational firm that is currently exploring off Brazil's coast, plans to invest US$1.5-$2 billion in Brazil, including constructing a new global technology center that will serve all of its research and development activities worldwide.

The center will be located near Petrobras' CENPES technology park on Ilha do Fundão near the Federal University of Rio de Janeiro. BG Group joins neighbors such as equipment and services providers Baker Hughes, FMC Technologies, and Schlumberger, who have all chosen to create technology centers on the island.

Construction began on BG's facility in early March and is expected

An illustration of the completed *Cidade de Ihlabela* FPSO.

to be completed by mid-2014. BG says the decision to place its global technology center in Brazil reflects its on-going investment in the country as it develops oil and gas reserves offshore in the pre-salt Santos Basin.

Finland's Wärtsilä announced plans for a new €20 million manufacturing facility that will span 4000 sq m and boasts its own waterfront and quay. Construction on the plant commenced last month and is scheduled for completion in mid-2014. The facility will be located 300km north of Rio de Janeiro in the Açu Superport Industrial Complex in São João da Barra *(See page 130)*.

Wärtsilä's CEO Björn Rosengren announced back in March that the decision to build grew out of a need to be close to the company's customers.

"Our presence in Brazil is now further strengthened to respond to the ongoing demand for Wärtsilä power solutions, and to meet the set local

content requirements," he says.

Wärtsilä's facility will handle the assembly and testing of the company's generating sets and propulsion products. Wärtsilä plans to hire some 100 workers.

Acteon companies InterMoor and Seatronics are also constructing new facilities in Brazil. InterMoor plans to join Wärtsilä by building its own service base at the Açu Superport Industrial Complex north of Rio. Construction started last month at a 52,000 sq m plot at the right bank of the terminal's inland channel. InterMoor has not said when construction is expected to be completed on the project.

Aberdeen-based subsea marine equipment rental firm Seatronics completed the startup phase of its new facility in Macaé, Rio de Janeiro, earlier this year. The center will serve as an office, workshop and warehouse facility for sales, rental, engineering, and cable molding activities. OE

Drilling rigs in Brazil

In mid-April, there were 122 offshore drilling rigs in Brazil, including 29 under construction and 93 others: 26 drillships, 52 semisubmersibles, 8 jackups, and 7 platform rigs. The status of the rigs not under construction: 77 drilling, 8 on workovers, 1 platform rig being used for production, 1 rig waiting on location, l rig under inspection, 2 being modified, 1 ready-stacked semisub, and 2 cold-stacked jackups.

Under construction

There are six semisubmersible rigs under construction for Sete Brasil S.A.: *Botinas,* to be managed by Odebrecht Oil & Gas; *Frade* and *Portogalo*, to be managed by Petroserv SA; and *Bracuhy, Mangaratiba,* and *Urca*, to be managed by Queiroz Galvao Oleo e Gas S.A.

An amazing 23 drillships are under construction in two Brazilian shipyards: Estaleiro Atlântico Sul (EAS) yard established in 2005 in Pernambuco state, and the Estaleiro Jurong Aracruz (EJA) yard established in 2011 in Espirito Santo state.

In March 2012, South Korea's Samsung Heavy Industries Co. sold its 6% interest in the EAS yard, and it is now wholly owned by local construction firms Camargo Correa SA and Queiroz Galvao SA. The EAS yard is now building drillships for Petrobras through Sete Brasil Participacões SA, some of which will be managed by Etesco.

Sembcorp Marine's subsidiary Jurong Shipyard opened the EJA yard in late 2011 after building 18 platforms for Brazilian oilfields. The first drillship order came in February 2012, from Netherlands-based Guarapari Drilling BV, a subsidiary of Sete Brasil. In February 2013, the EJA yard announced that it would build seven drillships for Sete Brasil that will be managed by Odebrecht Oil & Gas and Odfjell. The first drillship is scheduled to be delivered in Q2 2015.

Time delays in projects and high manufacturing costs due to competition are proving to be unfavorable to the Brazilian offshore rig construction industry.

-Nina Rach

The Açu Superport is a private, mixed-use port complex being built on the northern Rio de Janeiro coastline; it will have 17km of piers, with up to 47 mooring berths.

Brazil hungry for infrastructure investment

Brazil-Açu Superport, largest port infrastructure in Latin America, bets on Petrobras' participation. Peter Wertheim provides the details.

According to a recent study by Booz & Company cited by Brazil's National Petroleum, Gas and Biofuels Agency (ANP), there are either few or no Brazilian suppliers in about 80% of the equipment categories that will be procured for pre-salt development, particularly for high-technology equipment. In addition, significant opportunities exist for a wide variety of service providers focused on the maritime and energy sectors, such as subsea engineering, installation services, and vessel support services.

Due to the Brazilian Government's strict local content policies, which are expected to become only more stringent over time, smart US companies are considering establishing production facilities in Brazil, either alone or in partnership with Brazilian companies. Many US companies are already on the ground, such as Baker & Hughes, FMC, and General Electric. This trend is creating additional opportunities for US companies all along the maritime and oil and gas supply chain, especially those engaged in design and engineering, materials fabrication, and vessel construction.

Brazil is investing heavily in new infrastructure, with a significant amount focused in the State of Rio de Janeiro. Rio State forecasts US$102 billion in investments from 2011 through 2013, in oil and gas, energy, shipbuilding, steel production, ports and roads, sports complexes and hotels. Environmental investment in the Rio State's oil and energy sectors is forecast at $75 billion. Brazil is also investing heavily in a Superport at Açu, forecasted to handle 350 million tons a year.

Largest port investment

Brazilian billionaire Eike Batista

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founded LLX, the logistics division of EBX Group, in March 2007 to provide Brazil with integrated infrastructure and logistics facilities, mainly in the port sector. LLX's ventures are strategically located and are designed to handle the largest vessels, using the latest port technology.

The company is currently building the Açu Superport in São João da Barra, Rio de Janeiro. It is the largest port infrastructure investment in Latin America, claim LLX officials say.

Recently the project got a boost when Maria das Graças Foster, president and CEO of Petrobras, and Marcus Berto, president of LLX, confirmed that negotiations are advanced for Petrobras to install itself in Açu, and use the port as a basis for offshore support for petroleum platforms.

According to the executives, this is the first step, which will be expanded in the future for offloading and warehousing petroleum.

Berto says that the negotiations offer a strategic advantage for LLX and Petrobras. The Superport has been under construction for the last six years.

Açu Superport details

With two terminals - one offshore and one onshore, the Açu Superport is a private, mixed-use port complex being built on the northern Rio de Janeiro coastline, near the area responsible for 85% of Brazil's oil and gas production. It will have 17 km of piers, with up to 47 mooring berths.

LLX officials say that the port is an innovative project boasting modern engineering, construction, and operating practices. The port will be comparable with the most modern and efficient ports in the world, such as those in Asia and Europe. It is being prepared to receive large vessels such as Capesize and Very Large Crude Carriers (VLCCs), which carry up to 320,000 tons of cargo, and Chinamax carrying up to 400,000 tons, Berto told OE.

About $2.5 billion will be invested of which one billion is being provided by LLX Minas-Rio (responsible for implementing the iron ore port terminal) and $1.5 billion by LLX Açu (responsible for handling other cargo such as steel products, petroleum, coal, granite, slag, pig iron, and liquid and solid bulk). LLX says that $500 million will be invested in 2013.

Occupying a total area of 90sq km, construction began on the port in October 2007. Since that date, $2 billion has been invested in Açu, LLX officials say.

The port will have two terminal complexes: TX1, an offshore terminal with a depth of 3km (to be expanded to 26m), a three-kilometer access bridge, a tugboat pier, nine oil and iron-ore piers, an approach channel, and turning basin. Of these, two iron ore piers, the tugboat pier,

approach channel, and turning basin are complete. TX1 will be able to handle up to 100 million tonnes of iron ore a year and 1.2MMbo/d. The other terminal, TX2, is an onshore terminal being built around a 6.5km-long, 300m-wide approach channel. TX2 will boast a wharf line of over 13km, where liquid and solid bulk, coal, pig iron, slag, and granite will be handled, in addition to steel products.

The port has been designed to handle 350 million tons a year of exports and imports, especially oil, which ranks it among the largest port complexes in the world. The Açu Superport is forecast to become operational in 2013.

Industrial Complex

The port will boast an adjacent industrial district, in addition to a stockpile yard for the products being handled.

This industrial complex will house offshore industries, a metalworking cluster, a bulk liquid storage base, a shipbuilding yard of OSX (EBX Group's offshore and shipbuilding equipment and services division), an oil treatment and storage facility, a thermal power generation facility of MPX (an energy company of EBX Group), logistics yard, iron-ore pelletizing plants, cement mills, IT firms, and steel mills, among others.

The project also embraces cargo consolidation and distribution centers, facilities for vessels supporting offshore activities, and clusters for processing ornamental rocks, coatings, and ceramics.

Oil facilities

Located just 150 km from Campos Basin, the port will also meet the logistics and supply requirements of the oil and gas production and exploration activities in Campos, Santos, and Espírito Santo Basins, Berto says. The venture is strategically positioned to handle and treat oil, provide support to offshore E&P operations, and house a metalworking cluster dedicated to the oil and gas industry.

The port will have an oil treatment facility (OTF), which is now licensed for 1.2MMb/d. The OTF will enhance the quality and the commercial value of the product by lowering the water and salt content in the oil through centrifuge and decantation.

The port may also be connected to gas pipelines, especially from the Santos Basin, to supply natural gas to steelworks, the MPX thermal power plant, and other industries located in the industrial complex.

Commercial

LLX is engaged in negotiations with companies from various sectors wishing to set up or handle cargo at the port. NOV, who acquired NKT Flexibles, is installing a flexible-pipe production plant. At an advanced stage of production, the plant is

located on the right bank of TX2 and will have a production capacity of 250km of flexible pipe a year, in addition to a material testing and storage facility. The company envisions an investment of $200 million with the creation of 400 direct jobs. This plant is forecast to come into operation in 2013, Berto adds.

LLX also signed an agreement with Technip Brasil for the installation of a flexible-pipe production plant. With production forecast to begin in 2013, this plant will be built at TX2. In February 2013, InterMoor was awarded a construction license for a plant offering specialized services and logistical support. That plant is forecast to come into operation at the end of 2013 and will be located on the right bank of TX2. It will provide a range of services to meet the specific needs of its clients, including Petrobras, Shell, and OGX, as well as other oil and gas companies operating in Brazil. The plant will have a 90m wharf line and total area of 52,302sq m. OGX is the oil and gas division of EBX and has the largest offshore acreage after Petrobras.

OSX is building the Açu shipbuilding yard, UCN Açu, which is set to become the largest shipyard in the Americas. With a processing capacity of 180,000 tonnes per year, expandable to 400,000 tonnes per year, the shipyard is a joint venture with Hyundai Heavy Industries. OSX has the largest portfolio of orders in the world with 60 offshore units worth a total of $31 billion. Some 4500 people are currently working on UCN construction, which is forecast to come into operation at the start of 2013.

LLX has also signed a contract with GE do Brasil (GE) for the construction of a plant in the metalworking cluster. The plant will occupy an area of 322,498sq m, primarily to serve the oil and gas, and power generation sectors. The contract has a term of 30 years and is renewable for a period of up to 30 years. Construction of the production plant is still subject to the licenses and permits normally required.

ASCO Brasil Participações Ltda., a company of ASCO Group, will provide logistics services to oil exploration and production companies and their suppliers. "This arrangement means Açu Superport will offer comprehensive and integrated logistical solutions of international standard, with state-of-the-art technology, able to satisfy the highest requirements for efficiency, safety, and environmental protection of the oil and gas industry; 1,400 jobs are expected to be created in the logistics services sector ," Berto says.

NFX (Navigation Fuels X), a company to import, export, sell, and distribute marine fuels under the BP Marine brand, elected Açu Superport as the best location to build its terminal. It will be located in TXl and will have the entire infrastructure necessary to distribute marine fuel. This fuel center will meet the requirements of ships of a range of sizes and activities, such as PSVs (platform supply vessels), cabotage, and long distance

vessels, providing them with marine gas oil and intermediate fuel oil.

Anglo American will also ship iron ore through Açu Superport. The port is initially forecasted to handle 26.5 million tons of iron ore a year, from the second half of 2014. The iron ore will be transported from Anglo American's mine in Minas Gerais to the port, down a 252km slurry pipeline currently being laid by Anglo.

Wärtsilä Brasil signed a contract for the construction of a facility to assemble and produce generating sets and propulsion products. Occupying 29,300sq m in the TX2 channel (onshore terminal), the facility will also offer solutions and services for the marine propulsion and energy sectors. The contract has a term of 30 years and is renewable for a further 30 years.

Accessing the port

Açu Superport has been included in two railway lines under the Logistics Investment Program, announced by the federal government on August 15. One of the railway sections connects Uruaçu (GO) to Campos dos Goytacazes, in northern Rio de Janeiro just 43 km from the port. The railway will also cross Brasília (DF), Corinto, Conceição do Mato Dentro and Ipatinga (all in Minas Gerais state). This section will make it possible to connect Açu Superport to Brazil's central western region, in addition to part of the southeast, creating a new route for exporting several products, primarily grain and iron ore.

The other section will connect Vitória (Espirito Santo state) to Rio de Janeiro (Rio de Janeiro state), crossing Campos dos Goytacazes. A railway line is projected in this section that will connect the port to the Brazilian railway network, thereby connecting the venture to the southeast and south of Brazil.

The port will also be served by Brazil's main highways, such as BR 116 (Rodovia Presidente Dutra), BR 101, and BR 040 (Rio - Juiz de Fora). A 400m-wide, 43km-long logistics corridor will be built to access the Açu Superport. This will consist of four highway lanes, two railroad lines, and three transmission lines (135kV, 345kV, and 500kV). The logistics corridor has been designed to transport 200 million tons a year, with up to 100,000 vehicles a day in circulation.

Over 8000 people are currently working on the port's construction, 50% of whom live in Campos or São João da Barra.

When the port and industrial complex are operational, it is expected that roughly 50,000 jobs will be created. The port is also expected to attract investments of some $50 billion to the region, Berto says. OE

Peter Howard Werthem *is an independent journalist based in Rio de Janeiro who covers Latin America's oil and gas sectors. He can be reached at:* peterhw@frionline.com.br

Aerial photo of the new fabrication site

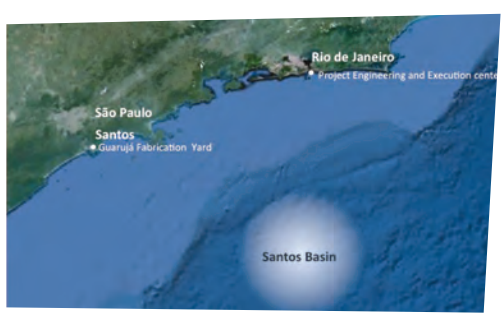
Heading the Offshore Brazil challenges

Saipem is constructing a new fabrication yard in Brazil close to the Santos basin. Pier Alberto Viecelli and Andrea Intieri of Saipem share the details and scope of the investment.

As the global offshore oil & gas industry makes giant steps towards ultra-deep waters, an important contribution arrived through last decade's tremendous discoveries by Petrobras in the pre-salt Santos basin. Overall, the Brazilian giant is planning to invest around $240 billion over the next five to 10 years.

As a result, this market is one of the most challenging from three points of view: the high-technology required, the necessity for a local skilled workforce, and the need for infrastructure. Saipem is facing this challenge by further expanding its presence in the country.

This includes the wide utilization of top-of-the-class pipelaying and offshore construction vessels, the development of a strong engineering and project execution center in Rio de Janeiro, and a major investment in a new fabrication yard.



The CTCO yard is 300km from Santos basin

The latter is currently under construction in Guarujá (state of São Paulo) and located nearby the pre-salt Santos basin. It will cover 350,000sq m for an overall annual capacity of 30,000 tons. It will represent a strategic facility for the flourishing Brazilian oil & gas market.

The facility, Portuguese Centro de Tecnologia e Construção Offshore (CTCO), is designed to serve pipeline, and subsea umbilical riser and flowline (SURF) projects, and will also support the overall deep-water industry.

The CTCO is already supporting important offshore projects for Petrobras, Rota Cabiúnas Gas Export Pipeline, Sapinhoá Norte and Cernambi Sul Riser System, and represents a big opportunity to develop the local

workforce and entrepreneurship. All challenges for Saipem under the motto "definitivamente aqui" (meaning "definitely here").

Strategic position

The CTCO is located at the entry of the left bank of the Santos harbor (the first port in Latin America) and is only one kilometer from the open sea.

Saipem's choice is important not only for the overall oil and gas potential linked to the nearby Santos pre-salt basin - only 300 km away from the yard facilities - but also for the attractiveness of the state of São Paulo, which is willing to develop conditions for the enhancement of the local economy.

A broad mission

The yard layout was conceived to serve contracts already acquired, as well as future developments linked to the pre-salt basin exploitation. The CTCO will provide a wide range of services to support the growth of the offshore industry.

Among them will be marine base services, pipe laying support, double/quadruple joint fabrication complete with coating, spool prefabrication and base services, as well as light fabrication services for subsea components like pipeline end terminations (PLET), pipeline end manifolds (PLEM), suction piles, jumpers, risers, spools, etc. It will also carry out heavy fabrication for components such as buoyancy tanks, their accessories, and large anchor piles.

The CTCO is designed to allow efficient operations: the material flow has been studied for high standard productivity from incoming reception (raw steel materials arriving mainly at the service jetty) up to fabricated items load-out from the main quay.

The facility will be equipped with different workshops. One will be dedicated to the fabricating double/quadruple joints (5,400sq m). This onshore activity will allow an optimization of offshore pipelaying by reducing the number of welds and related non-destructive tests (NDT) performed onboard. Other workshops will be used mainly for the prefabrication of subsea components. The main workshop, with a covered area of 13,100sq m and equipped with various overhead cranes, will be used to manufacture structural items from raw steel materials by means of flame cutting, beveling, rolling and welding, Table 1.

Another workshop will be dedicated to piping prefabrication with specific material segregation systems. In the prefabrication sequence, all items will be sent to the coating/painting shop in a fit for purpose area equipped with ventilation and air filtering systems. Afterward, the items will be sent to the main assembly area where they will be handled using various cranes (including a 350ton tower) before the load out. The CTCO will also include a welding and NDT training center, large office facilities, parking area, and canteen. All operations will be conducted in accordance with Brazilian law and to the most stringent quality, health, safety, environment, and sustainability procedures.

Saipem's flagships, the *FDS* and *FDS2* offshore Brazil.

Construction work in progress at the site.

The main quay will allow a wide range of load outs with a dedicated reinforced area for heavy items. The quay's sizing allows future berthing of most Saipem vessels, including its flagships and the vessels often operating in the South Atlantic such as the *FDS* and *FDS2*, without interference with the Santos port activities.

A sustainable framework

As part of the development of the CTCO, Saipem is maintaining very good relationships with the local

Table 1. Yard Statistic

Annual Fabrication Capacity	30,000t
Annual Direct Manhours	2,400,000h
Total Area	350,000sq m
Main Covered Fabrication Workshop	13,100sq m
Light Structural Steel & Piping Fabrication Covered Shop	960sq m
Heavy Structural Steel Fabrication Covered Shop	5,700sq m
Exotic Piping Fabrication Covered Shop	960sq m
Double / Quadruple Joint Fabrication Covered Shop	5,400sq m
Uncovered Assembly / Erection Area	130,000sq m
Offices & Parking Area	23,400sq m
Main quay length	435m
Service jetty length	75m

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Petrobras projects underway by Saipem

The Sapinhoá Norte and Cernambi Sul fields are located about 300km off the coast of the state of São Paulo, in water depth of 2200m. Saipem will perform the engineering, procurement, fabrication, installation, and precommissioning of the ten SLWRs (steel lazy wave risers) that compose the production and injection system of the Sapinhoá Norte field, and of the gas export FSHRs (free standing hybrid risers) in both fields.

The offshore campaign will be conducted by the *FDS2* between 3Q 2014 and 2Q 2015. The CTCO will fabricate the in-house designed components of the SLWRs (PLET piles, PLETs, 6in. CRA wet insulated double joints) and of the FSHRs (buoyancy tanks, foundation piles, top and bottom assembly structures).

The second project is the Petrobras Rota Cabiúnas Gas Export Pipeline. This includes the design engineering, partial procurement, construction, and installation of a 24in., 380km pipeline connecting the Cernambi field (2250 m water depth) to the onshore Cabiúnas Terminal (TECAB). CTCO will serve as logistics base for the pipes.The offshore campaign will be conducted between Q1 2014 and Q2 2014 by the new flagship pipelayer *Castorone* and by the *FDS2* for the additional construction work.

authorities, including the Prefeitura Municipal de Santos and the Prefeitura Municipal de Guarujá (PMG). Memoradums of understanding have also been signed with the PMG and with the state of São Paulo. A partnership with SENAI (Serviço Nacional de Aprendizagem Industrial) will provide a two-year training program for local people to possibly work in the yard.

The CTCO will also leverage the opening of new local businesses, through a project in progress for the development of a business incubator. It offers opportunities to local entrepreneurs through an ad-hoc observatory composed by representatives of industry, government, universities and unions.

Offshore challenges ahead

Ongoing is the offshore campaign of the EPIC contract for the P55-SCR risers and flowlines to be installed by the *FDS* and the *FDS2*, multipurpose J-lay and construction vessels, in the Roncador field, a challenging deep-water development in the Campos basin in water depths ranging from 1,500m to 1,900m.

In 2011, Saipem started significant EPIC contracts for Petrobras such as the 18in. Sapinhoá (Guará)-Lula offshore pipelines in 2130m water depth and the 18in. Lula-Cernambi offshore pipelines in up to 2232m water depth. The offshore campaign for both projects will be performed by the *FDS2*.

In 2012, Petrobras assigned Saipem two important contracts (see side article) for which the CTCO already started providing its services.

Pier Alberto Viecelli *is assisting the Saipem operations department in Brazil on an overall sustainable plan in liaison with local authorities, and has been training fabrication personnel since 2011. Viecelli is a civil engineer who graduated from Univesidade Mackenzie, São Paulo, Brazil.*

Andrea Intieri *joined Saipem's Business Development deptartment this year. He graduated with honors in industrial engineering from Politecnico di Milano, Italy.*

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Oil Recovery System

Vikoma International Ltd., an oil pollution and environmental technology firm that is part of Energy Environmental Group, launched the OPRS 300 oil pollution recovery system last month.

The OPRS 300's patented discs attract oil, collecting up to 300cu m/hr of oil, including oils with viscosities ranging from 1 to 1 million cSt. OPRS 300 comprises a floating skimmer head, which utilizes Vikoma's tufted discs combined with both an on-board recovered oil discharge pump and thrusters. The unit is operable by a hand-held remote control console.

www.vikoma.com

Remote Tool Tracker

TDW Offshore Services released its SmartTrack remote tracking and pressure-monitoring system to the global marketplace. The proprietary system, which received full ATEX certification for use in Zone 1 hazardous locations from DNV, was used by TDW to carry out pipeline pressure isolation operations in conjunction with TDW's SmartPlug isolation system.

"We made the decision to make the SmartTrack system readily accessible to operators and service companies that want to avail themselves of the wide-ranging benefits it offers," says Enzo Dellesite, Director – Global Market Development Offshore for TDW.

The SmartTrack can remotely track inline tools within pipelines up to a thickness of 50mm. It is also capable of tracking specially-designed pigs in sequences used to flood, clean, and gauge pipelines during pre-commissioning. For subsea operations, transceivers can operate in depths to 3,000m with a maximum cable length of 1,200m.

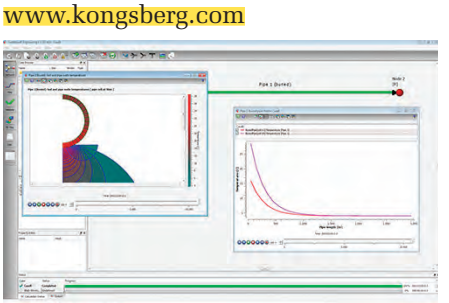
www.tdwilliamson.com

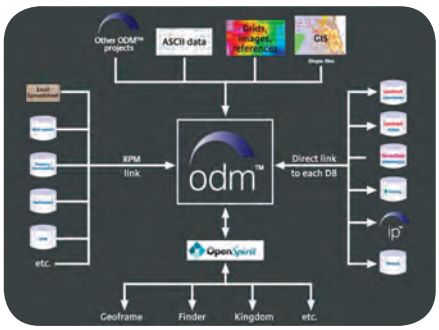
Multiphase Simulator

Norwegian technology supplier Krongsberg Oil & Gas Technologies AS released its new LedaFlow 1.3 transient multiphase simulator for wells and pipelines in March. The software offers new functions such as a separator model, bypass pigging capabilities, black oil PVT definitions, dead oil circulation using custom fluids, standard volume flow rates, and emulsion modules.

Krongsberg boasts an increased speed through the new LedaFlow 1.3, averaging a 70% increase using multi-CPU capabilities. The software was developed to meet challenges found in deepwater, longer tie-backs, and harsh and remote environments, as well as to improve multiphase flow predictions. Development began in 2001 in collaboration with Total, ConocoPhillips, and SINTEF.

www.kongsberg.com





Modeling software

Aberdeen-based Senergy Software rolled out a follow-up to its geosciences-specific Oilfield Data Manager 3.8 (ODMTM) software. Version 3.8 features an improved user interface and comes equipped with new heatmap and analysis sticks features, an enhanced reservoir performance module 3D viewer, and a new method for handling core shifts.

Senergy's suite of ODMTM geological tools enables the user to store, integrate, interpret and present all kinds of well-based data. The improved interface allows for easier navigation and enables a logical sequence of workflows.
www.senergyworld.com

Deepwater tested

US-based Bluefin Robotic successfully tested its unmanned underwater vehicle (UUV) for the Defense Advanced Research Projects Agency (DARPA) in deepwater conditions, the company announced last month. Bluefin tested the UUV off Massachusetts with the *Scarlett Isabella* vessel, conducting six days of operational testing including two 4,450m dives totaling 11 hours.

The tests allowed Bluefin to vet new vehicle capabilities such as their modular UUVs, including an extended operational depth rating, an advanced pressure vessel design, a new power system, a newly available high-powered acoustics transducer system, and a transportable docking head launch and recovery system.

Phase III of the Bluefin's DARPA contract was awarded in March and will fund the full integration of deep sea sonar into the vehicle, as well as fund the production of a second system with sonar to support networked operations.
www.bluefinrobotics.com

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SPE's Offshore Achievement Awards

(L-R) Graham Skinner, trainee rig manager at KCA DEUTAG Drilling was presented with the Young Professional Award and Malcolm Webb, chief executive of Oil & Gas UK with the Significant Achievement Award

Ian Phillips, SPE Board Director and chair of the Offshore Achievements Awards organizing committee, addressing the audience

By Elaine Maslin

Innovation in the offshore industry was one of the key themes at this year's 27th Offshore Achievement Awards.

The event, supported by Offshore Engineer and held at the Aberdeen Exhibition & Conference Centre, was successfully re-launched in 2011 by the Society of Petroleum Engineers (SPE) Aberdeen section.

Ian Phillips, SPE board member and chairman of the OAA organizing committee, said: "The Offshore Achievement Awards are the pinnacle of the energy industry calendar and SPE Aberdeen is very proud to host this prestigious event.

"The caliber of entries we received this year was exceptional. Our judging panel, which comprised senior representatives from sponsoring companies and SPE Board members, faced some difficult decisions, particularly in the Innovator category, where the excellence of the entries led to two companies being declared joint winners along with another being highly commended.

"From all of the entries we have seen, it is clear that there is much to be celebrated in the offshore industry, from small companies creating a step change in safety through to huge global organizations that are producing the next generation of industry leaders," added Phillips, also director of CO2DeepStore.

2013 Offshore Achievement Award winners

Significant Achievement:
Malcolm Webb, Chief Executive, Oil & Gas UK

Great Large Company Award:
Axis Well Technology

Great Small Company Award:
ROVOP

Young Professional Award:
Graham Skinner – KCA DEUTAG Drilling Ltd.

Working Together Award:
Maersk Oil/ Technip

Export Achievement Award:
Online Electronics Limited

Safety Innovations Award:
Houlder

Innovator Award: Joint winners - Red Spider Technology and Stork Technical Services
Highly commended – Tendeka

Emerging Technology Award:
Web Rigging Services

Malcolm Webb graduated from Liverpool University and is a lawyer by profession. He began his oil career with Burmah Oil in 1974 and held a series of senior roles for the British National Oil Corp., Charterhouse Petroleum, and PetroFina. He spent three years as director general of the UK Petroleum Industry Association before joining Oil & Gas UK in February 2004, where he has been closely involved in its major change process to make it the leading trade association open to all companies within the UK offshore oil & gas industry. He is a member of PILOT and the Fiscal Forum, the UK government/industry bodies which aim to secure the long-term future of the UK upstream oil & gas industry, and of the Scottish Government's Energy Advisory Board. He is also a director of the industry skills body, OPITO and chairman of Common Data Access Limited, which facilitates access to UK geo-technical data.

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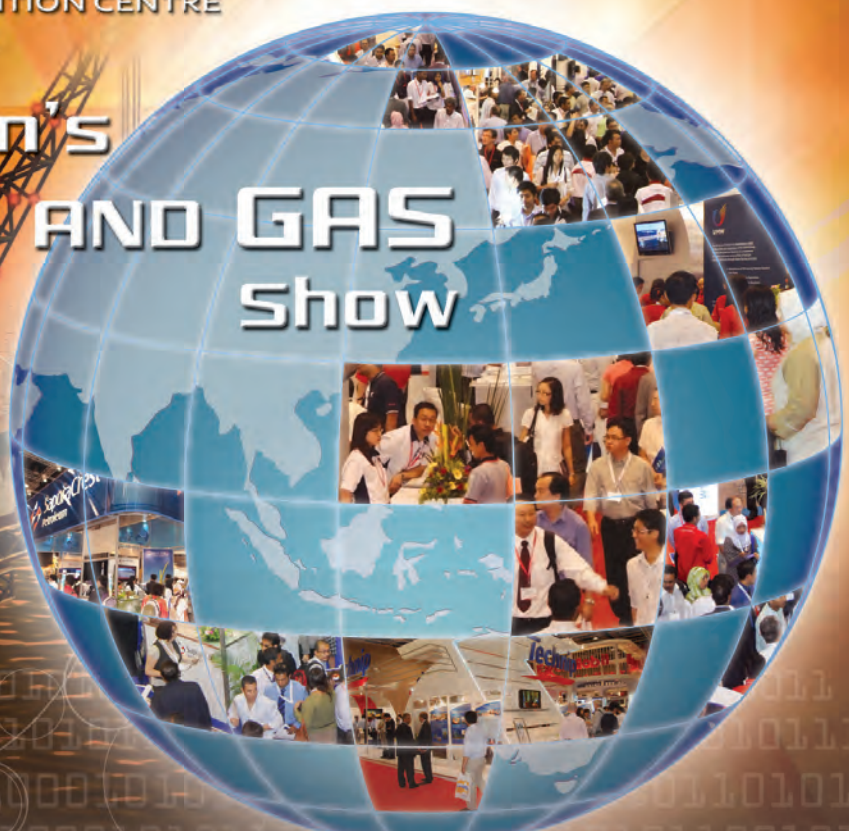

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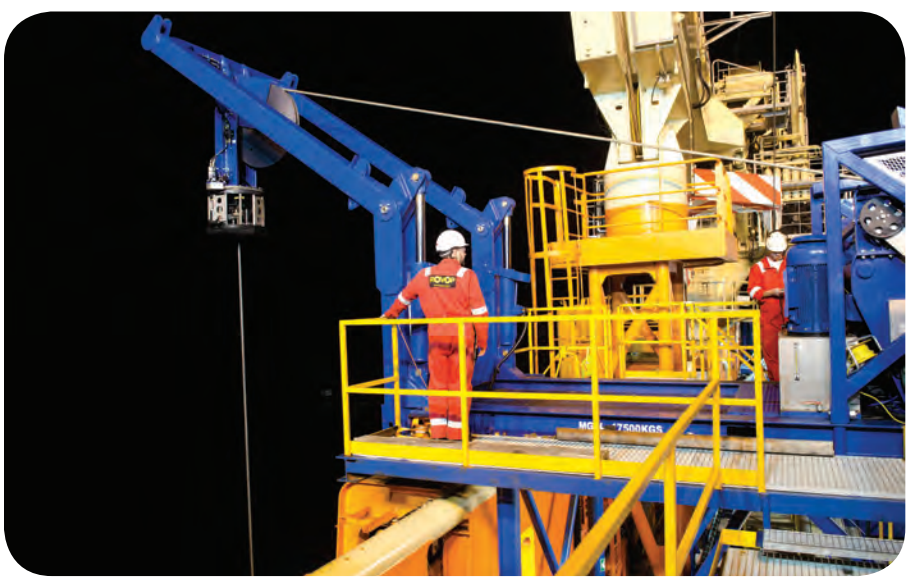
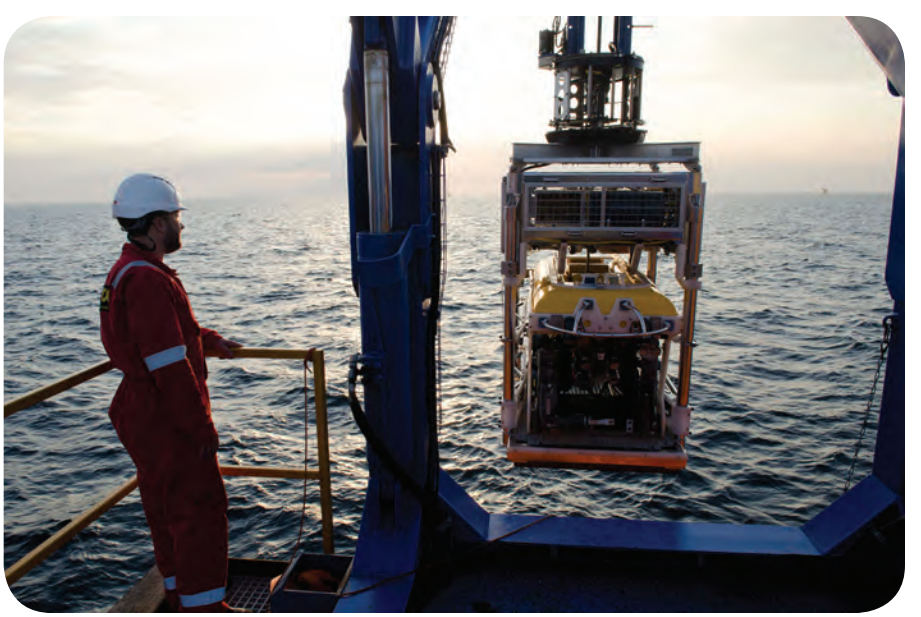
Aberdeen-based **Axis Well Technology** is an independent provider of well technology and reservoir development consultancy services. The company has built up a global portfolio of more than 100 clients with nearly 30% of sales overseas. It provides life-of-asset expertise in management, engineering and supervisory services, spanning the initial phases of field conceptual design to end-of-life abandonment operations. Axis recently set up two new divisions, subsurface and well integrity. Sales have almost trebled in recent years and operating profits increased about 50% in the past year.

Aberdeenshire-based **ROVOP** began ROV operations in 2011. It is currently providing support to jackups, specialized lay vessels and IRM activities. It has committed to £18m of new vehicles, as well as a £250,000 simulator to enable onshore project preparation, scenario planning and training. It has recruited more than 40 personnel in one year. From sales of £3million in its first year, the company is on target to achieve £10million this year. Managing director Steven Gray said: "This industry recognition is a great achievement for ROVOP, particularly in a year when many subsea companies have also enjoyed considerable success. Over the past 18 months, ROVOP's business has grown significantly through a combination of investing in strong, skilled people and developing a cutting edge fleet of ROVs. We have pledged a further commitment of £15m over the next 18 months, which will see the purchase of hydraulic and electric ROVs, creating an additional 60 jobs."

Graham Skinner is a trainee rig manager with Aberdeen-based KCA DEUTAG Drilling. He has worked through drilling positions from roustabout to toolpusher and has qualified as a risk manager and project manager. He is currently working in South Africa as a safety supervisor and will next join the Ben Rinnes jackup in Gabon as assistant rig manager. Graham is working towards his MSc in Drilling and Well Engineering, and serves as an SPE eMentor.

The "one-team" approach by the UK North Sea Gryphon Area Recovery Project Subsea Team, comprising **Maersk Oil, Technip,** Bibby, Fugro and Canyon, put safety at the heart





Left: TROVOP is experiencing constant growth in demand for its services, with new vehicles continually being added to the fleet.

Below left: ROVOP managing director Steven Gray.

Below: A ROVOP engineer launches one of the company's Panther XT Plus Light Work Class ROVs.

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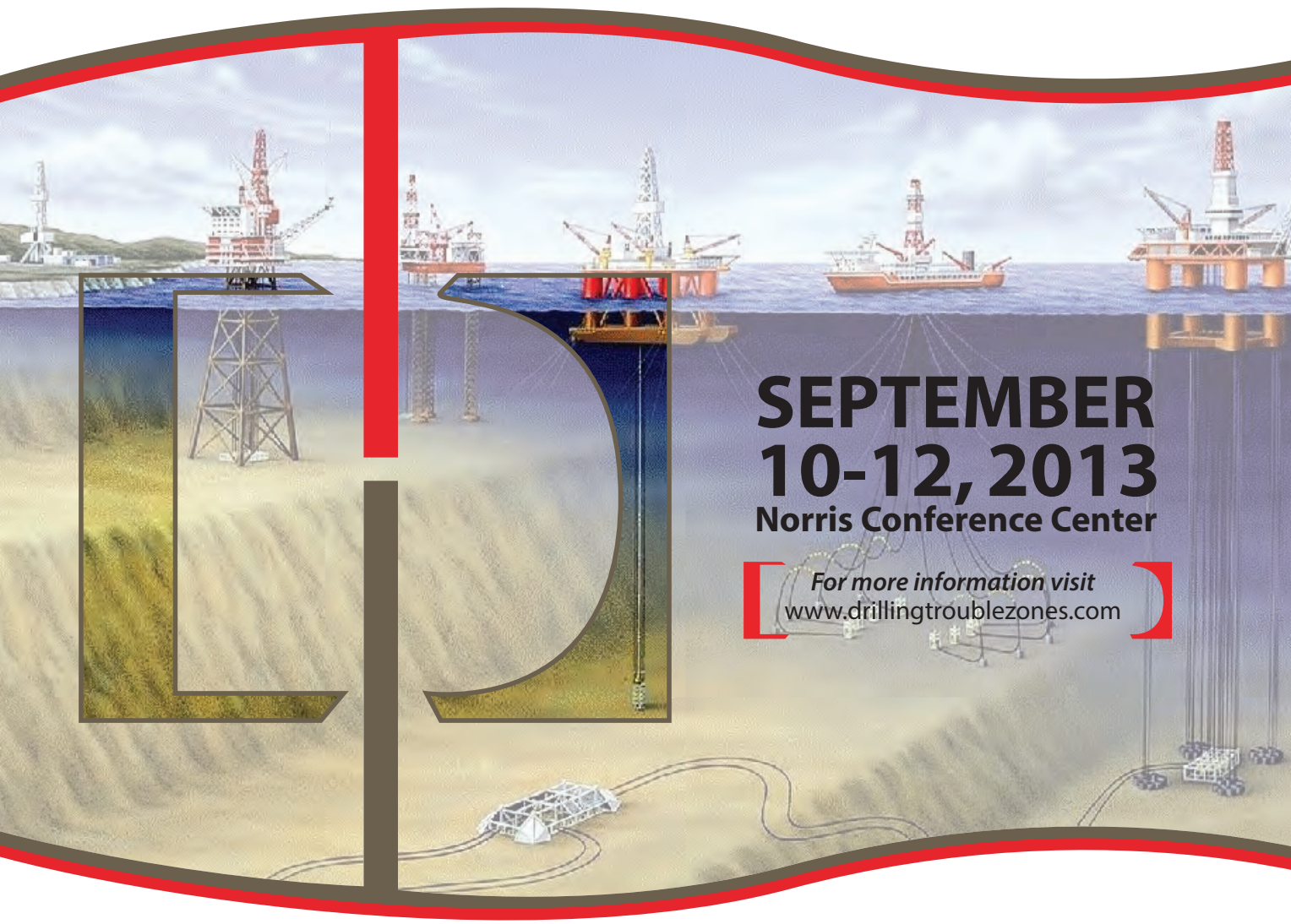

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of a major project. Visible leadership and effective collaboration achieved more than 500 days of subsea construction without a lost-time incident. The teams initial role, in response to storm damage to Maersk Oil's Gryphon FPSO, was to establish a clear vision and a common purpose of safe construction in reinstating subsea architecture.

Aberdeen-based **Online Electronics** specializes in design and manufacture of pipeline pig monitoring equipment and pipeline data communications systems. Over 15 years, it has developed a range of more than 40 products and systems that have become industry standard. Building on its North Sea experience, global exports have increased 40% in the last four years with foreign markets now accounting for more than half of sales annually. It continues its own research and development and has hub operations in Dubai, Singapore, Australia, Houston and Brazil.

London-based **Houlder** and Southampton-based BMT Nigel Gee have developed a Turbine Access System for operations on offshore wind farms. It is a hydraulical, motion-compensated, lightweight gangway providing a stable point on the workboat foredeck. Designed to be retrofitted and used in up to 2m waves, it increases typical operability by 0.5m. The first system was successfully deployed on the Rhyl Flats wind farm. Houlder said: "Analysis from our sea trials calculated a potential annual upswing in workboat operability from 75% to 94% in typical wave conditions. This is based on proven safe access in 1.7m waves. The maximum TAS design parameter is over 2m significant wave height. At today's workboat charter rates and energy prices, an increase to 94% working days on a site such as RWE's Rhyl Flats wind farm equates to a yearly saving of up to £750,000 from workboat uptime and improved turbine operability."

Aberdeenshire-based **Red Spider**'s full-bore ball valve is used during subsea completions. The e-Red-FB is permanently deployed as part of the tubing string. It is a computer-controlled valve that can be repeatedly opened and closed by remote command using a closed-loop hydraulic circuit, powered and controlled by integrated electronics, with no connections to the surface. Operators can install well completions faster, eliminating the need for repetitive and costly interventions, saving about 36 hours per completion – or about $1.5 million per job. Red Spider was bought by oil services giant Halliburton earlier this year.

Corroded stud bolts seriously impact an asset's integrity and unscheduled pressure releases can have a devastating impact offshore. This led to Holland-based **Stork Technical Services** developing a more sophisticated method of removing and replacing corroded bolts. Stork introduced the first Hot Bolt Clamp technology in 2012, with thousands of connections reworked in the North Sea, without shutdown and with 100% success.

Holland-registered **Tendeka**'s wireless gauge allows real-time flow and shut-in data to be transmitted to surface. The gauge has been successfully trialed in the North Sea. Through a unique tool design, a series of short pressure pulses are created using the energy of the well. These pulses are then decoded on surface to provide pressure, temperature, and well status. The gauge can be retrofit to existing wells, can optimize asset performance, reduce costs and is fully retrievable. It is equally effective in oil and gas wells, as well as water injectors.

Edinburgh-based Web Rigging Services' have developed a system for temporary underdeck access for fabric maintenance on offshore structures. The patented Web Deck combines modern, strong, lightweight materials and innovative design. In comparison to traditional, suspended scaffolding, the system has 87% fewer contact points and 75% less volume. The Web Deck is lighter and reduces installation time by up to 80%. OE

BMT and Houlder's access system

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Helping families overcome tragedy

Houston-based **Black Elk Energy and Oilfield Helping Hands** organized a fundraiser for six families affected by the accident at the company's West Delta 32 platform last November. The sporting event, held in Maurice, Louisiana, raised US $130,000 to benefit a higher education fund established for children of the victims. Sponsors of the event included GOL Shooting Range, Grand Isle Shipyard, Phoenix Offshore Solutions, and SEMPCheck.

Ivanhoe Energy and SBM Offshore formed a global strategic alliance to create floating, production, upgrading, storage and offloading vessels (FPUSO). The design, the companies say, will economically produce and upgrade heavy oil from offshore fields with crude oil quality down to 10° API gravity or lower. With engineering support from AMEC, the two companies completed a conceptual design of an FPUSO that will upgrade up to 60,000 b/d.

Aberdeen-based independent **Ithaca Energy** moved to acquire fellow UK explorer **Valiant Petroleum** for US$309 million in early March. Ithaca says the move would establish itself as a leading mid-size North Sea oil and gas operator with 2P reserves of approximately 74MMboe. Ithaca Chairman Jack Lee said the two companies' assets have a strong strategic fit.

Oilfield services company **Expro** opened a new well intervention facility in Aberdeen. The facility will house approximately 200 employees. Combined with renovations planned for the Bruce building, the Carnegie and Young facilities in Dyce represent a US$7.6 million investment over the next year. Expro also plans to invest $20 million in newbuild well testing equipment.

Rosneft partnered with Grubkin Russian State University of oil and Gas to develop a new training program for offshore drilling supervisors. The one-year program includes seven, full-time two-week modules. Courses will include expert lectures, well drilling management practice with original-sized simulators and a two-week internship as an alternate drilling supervisor on Stena Drilling's ships and platforms. After successful program completion, the trainees will receive Drilling Management, IWCF, and IADC WellCAP international certificates.

Fugro Chance, Inc. entered a two-year cooperation agreement with **Coda Octopus Group Inc.** involving the use of the company's Coda Octopus Echoscope, a patented 3D sonar technology. The deal grants CODA the ability to apply the Echoscope in a variety of environments, and gives CODA access to Fugro's data. In turn, Fugro will work with CODA to develop solutions for its clients subsea imagery deliverables.

Engineering company **Alderley FZE**, part of the Alderley Group, opened a new office building in Jebel Ali Free Zone, Dubai, as part of its facilities and production expansion. The 1300sq m, two-story office building includes dedicated training facilities, additional meeting rooms and upgraded IT infrastructure.

Houston-based **Seahorse Platform Partners Ltd.** granted UK-based Sembmarine SLP Ltd., a subsidiary of Sembcorp Marine, an exclusive license to use its SeaHarvester and SeaHorse technology in the design and construction of minimum facilities platforms in the UK's territorial waters. The two companies have also signed an MOU licensing the technology for Southeast Asian and Australasia, excluding Malaysia and Brunei.

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On the Move

By Audrey Leon

Aberdeen-based Dana Petroleum named **Reidar Hustoft** its new managing director for Norway,

effective February 1, replacing outgoing MD John M. Dahlen.

Hustoft, who has 30 years experience in the North Sea, previously served as head of Dana's Netherlands business. Hustoft says the two branches are very different. Whereas the Dutch business maintains a varied portfolio of exploration, production and development activities, the Norwegian side is primarily focused on exploration activity.

"(In Norway) our longer term ambition is to build a balanced portfolio of exploration, development and production assets," Hustoft says. "In the short term we need to build a strong exploration team, deliver attractive exploration prospects and develop the operating capability and safety culture to take on the challenge of developing these opportunities."

While the two countries have different considerations, Hustoft says he has no plans to change his management style.

"Under my leadership health, safety and environmental management is always on the agenda as core values, and we are committed to continuous improvement in providing a safe place of work and performing our activity in an environmentally responsible manner," he says. "In the Netherlands (Dana) built a strong safety culture recognized by the authorities and the E&P industry, and we intend to build on the same principles and with the same commitment as we grow in Norway."

Wärtsilä announced it has selected **Marco Wirén**

to serve as its CFO and executive vice president, effective August 2013. Wirén will replace Raimo Lind, who is retiring. Wirén currently serves as executive vice president and CFO of Swedish steel manufacturing firm SSAB, where he has been since 2008.

Wirén says once he comes onboard at Wärtsilä he will focus on contributing to the company's performance and work to drive value creation.

"We will continuously look for new improvement and investment opportunities that support our strategy, and benefit both the company's global services network and its industrial footprint," he says.

Wirén says Wärtsilä has already demonstrated this with previous announcements such as its joint venture with Yuchai Marine Power regarding the manufacture of medium-speed engines in China, as well as the company's plans to set up a manufacturing facility in Brazil.

Scottish oilfield services provider Glacier Energy Services installed **Mark Derry** as head of its newly created offshore division.

Derry joins the group from Ashtead Technology where he was COO of its offshore brand. He previously held positions with SBS Marine, Hydratight and Fugro. With all of these companies Derry was able to spend time overseas from in the US, Norway,

and Southeast Asia. He believes these experiences made him attractive to Glacier as it plans to grow internationally.

"I've had lots of experience with the cultural difficulties of working in some of these places and developing businesses," he says.

Derry says part of Glacier's plans to branch out internationally will include opening more offices overseas. In addition to new locations, Glacier is also on the lookout for expansion opportunities.

"We're looking to extend our product range and looking to rapidly grow our machining business," Derry says. "At the same time we're looking for complementary services to add on and that growth will be organic and through acquisitions," he says.

Derry has over 25 years in the industry and holds an MBA from The University of Aberdeen.

Gay Huey Evans joins ConocoPhillips as the company's new outside

director, increasing its board of directors to 11. Huey Evans previously served as vice chairman of the board and non-executive chairman, Europe, of the International Swaps and Derivatives Association, Inc. from 2011-2012. She also served as vice chairman of investment banking and investment management at Barclays Capital from 2007-2008. Huey Evans will sit on ConocoPhillips' Audit and Finance Committee.

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Phone: 713-285-5072
rwarren@atcomedia.com

UNITED KINGDOM
Neil Levett, Mike Cramp
Alad Ltd
Ph: +44 01732 459683
Fax: +44 01732 455837
neil@aladltd.co.uk
mike@aladltd.co.uk

NORWAY/DENMARK/ SWEDEN/FINLAND
Brenda Homewood, Alad Ltd
Ph: +44 01732 459683
Fax: +44 01732 455837
brenda@aladltdco.uk

ITALY
Fabio Potesta,
Media Point & Communications
Ph: +39 010 570-4948
Fax: +39 010 553-00885
info@mediapointsrl.it

NETHERLANDS/AUSTRIA/GERMANY
Arthur Schavemaker, Kenter & Co. BV
Ph: +31 547-275 005
Fax: +31 547-271 831
arthur@kenter.nl

FRANCE/SPAIN
Paul Thornhill
Ph: 01732 459683
paul@aladltd.co.ukk

MALAYSIA
Koh Earn Soo,
Market Intelligence (M) Sdn Bhd
Ph: +60 12 389 0675
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SINGAPORE AND AUSTRALIA
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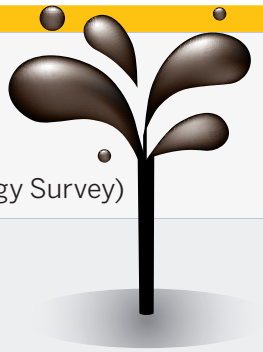
junejonet@thesilverback.com

Numerology

13,500,000,000

Angola's proven oil reserves (Source: BP Statistical Energy Survey)



77%

Of Australia's liquids production comes from offshore Western Australia (Source: Australian Petroleum Production & Exploration Association Ltd.)

336,300

The amount of crude oil, in b/d, that the Philippines imports to meet energy needs. (Source: Shell Philippines)

LOOP, Louisiana Offshore Oil Port, is the only port in the US that can offload deep draft tankers.
(Source: US Energy Information Administration)

2015

First oil from Tyra Southeast development in the Danish North Sea. (Source: Maersk)

31,866

The total depth, in feet, of Chevron's Coronado well offshore Louisiana

▶ Read more on Global Briefs page 26.

71

Companies drawn by Brazil's 11th round offering held later this month.

▶ Read more on Geographic Focus page 122.

8,000

The weight, in tons, of DONG Energy's Hejre jacket destined for the North Sea (Source: Heerema Fabrication Group)

131,000

The number of petrol stations in Europe compared to 121,446 in the US (Sources: Europia, US Census Bureau)

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