

OE

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DRILLSHIPS Ultra-deep
fleet poised to expand **57**

AUVs In search of
full autonomy **62**


TOPSIDES Standardized
approach creates benefits **69**

A New Day Dawns

**Global Market
Forecast**
page 28

Arctic Resources
page 49



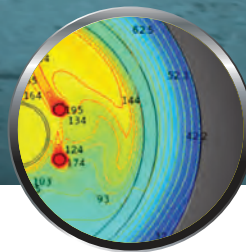


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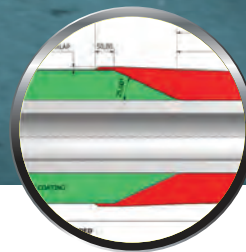
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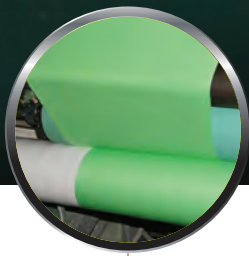
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GEOLOGY & GEOPHYSICS

45 Planning on a better future

The marine seismic community will see steady orders, tightening vessel availability and firmer prices, foretells Andrew McBarnet.

GEOGRAPHIC FOCUS

48 The Arctic – opening an ocean

The industry has been working steadily to understand the potential and sensitivities of the region, report Victor Schmidt and Nina Rach from the Arctic Technology Conference.

DRILLING & COMPLETIONS

53 Fleet expansion

Two yards in South Korea have received a steady stream of orders. More surprising is the volume of orders going to a shipyard in Brazil. Nina Rach explains the details.

SUBSEA

62 The search for full autonomy

Hybrid vehicles are in the works, piggybacking AUV capability onto proven ROV technology, reports Bruce Nichols from the Subsea Survey IRM conference.

ENGINEERING, CONSTRUCTION & INSTALLATION

69 Standardization benefits

A classic, standardized, floating production spar for the Tubular Bells project is expected to bring considerable economic benefits for future developments, reports Perry Fischer.

ON THE COVER

Ice breaker *Oden* cleared ice for ION Geophysical ahead of under-ice seismic operations offshore Northeast Greenland during the summer of 2010. Source: ION Geophysical.



Cover Story

What lies ahead?

Annual change in global oil demand will increase 0.8-1%/year through 2013. However, global energy demand will increase by 35% over the next 30 years, with growth in developing nations offsetting declines in the developed world, reports Perry Fischer in a series of articles.



Expert Access

Cyber Viruses Threaten Oil and Gas Networks

Join us 29 January at 11.00 CST for a Live Presentation and Q&A session on how companies should be reassessing their security concerns to protect their data assets. See page 78 for more information.





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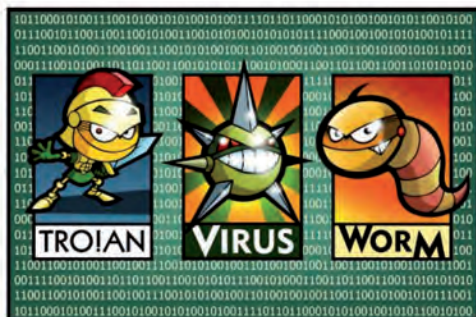
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Departments & Columns

- 11 Inception** Lets get started.
- 13 Voices** What is the biggest challenge facing the global oil & gas industry in 2013? A selection of academic, E&P and service industry professionals give their opinion.
- 15 Publisher's Column** 'To improve is to change,' said Winston Churchill. *OE* Publisher Brion Palmer briefs on the exciting future for the magazine.
- 18 Editor's Column** The most successful designs – and companies – are efficient, robust and flexible, writes Nina Rach, *OE*'s Technology Editor. Should we deliberately build systems that benefit from stress?
- 20 Ebb & Flow** Prof Michael J Economides examines the repercussions of Woodside's purchase of a 30% working interest in the Leviathan project.
- 22 Global Briefs** News from the around the world, including Oceaneering's contract to supply 43km of electro-hydraulic steel tube control umbilicals for Esso's Kizomba Satellites Phase 2 development (Kizomba B pictured).
- 25 Analysis** Gregory Hale and Richard Sale assess potential cyber threats to the offshore industry.



- 74 Solutions** The latest products and services for the offshore industry.
- 76 Activity** Company updates from around the industry.
- 77 On the Move** Promotions and opportunities.
- 78 Company Index**
- 80 Advertiser Index**
- 82 Numerology**



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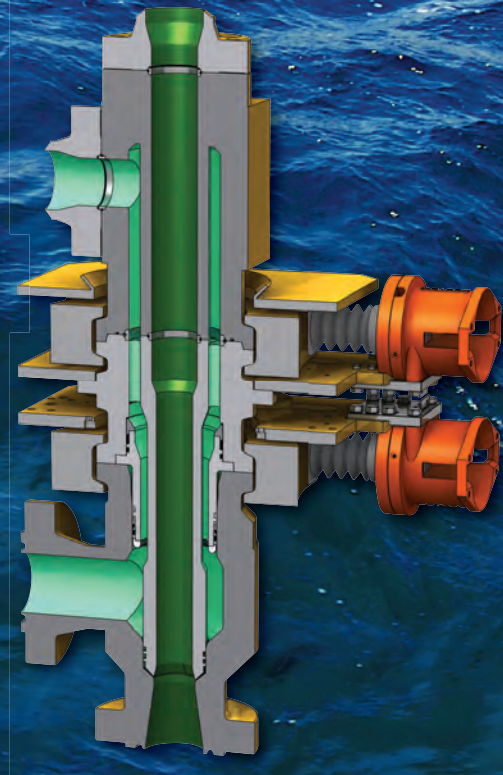
**See pages 42-43 inside
for a preview of featured
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Critical factors in Arctic oil spill preparedness

How do the three main strategies to manage spills work in the Arctic region?

People

EPA head resigns

Jackson to leave after State of the Union address

Statoil joins Brazil license

Statoil works out US\$40 million Espirito Santo farm-in

What's trending

Go to OEDIGITAL and cast your vote on this month's question

Expert Access

Cyber Viruses Threaten Oil and Gas Networks

Tuesday January 29, 2013 11.00AM CST

Increased automation offshore means oil and gas companies have far more systems that are vulnerable to computer viruses. Join **Greg Hale** and **Eric Byres** as they discuss and answer questions on how companies should be reassessing their security concerns to protect their data assets.

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INCEPTION

THE BEGINNING OF AN IDEA



OE magazine began in 1975 and over the years has provided relevant and pertinent data to oil and gas professionals worldwide. In 1976, a young man picked up the magazine and began reading. Since the age of four, he knew he wanted to be an engineer. However, it took sailing yachts across the Atlantic and a chance meeting at a pub before stumbling on the opportunity to start off as a roughneck on a platform in the North Sea. Over time, he worked for various oil and gas companies traveling between the United Kingdom and the United States. All of his hard work and experience paid off when in 2004, he founded WearSox. John Gammage is the true spirit of **OE**; a man who started off reading the magazine thinking “Hey, I’m an **Offshore Engineer**” and decided to take a photograph.

OE has been a trusted and valued resource for oil and gas professionals since 1975. This means the magazine has been with our readers on the job and in remote locations around the world. We wouldn’t want it any other way.

Send us a picture of you reading **OE** and description of your location. If we publish your photo in the magazine you will earn a **\$100 American Express Gift Card** compliments of our editorial staff. You can either email us your picture or post them on our Facebook page.

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Voices



As the O&G industry faces deeper and harsher challenges, the industry needs to increase safety throughout the value chain. This can be obtained by a risk-based approach and solid offshore standards.

Remi Eriksen, CEO, DNV Maritime and Oil & Gas



A significant challenge facing the Gulf of Mexico market is in being able to ramp up while maintaining best in class policies, standards and procedures toward securing a safe and environmentally friendly work environment. In light of recent failures in our industry, the light is clearly cast on our ability to capture learnings and mitigate risk from potential future incidents. Every aspect of our operations must be put under the microscope.

Steve Hardwick, President, Swire Oilfield Services North America



The largest hurdle is figuring how to increase recoverability so that productivity is higher and per unit cost is lower. The economics of many deepwater plays could become challenged if prices soften at all. This becomes particularly problematic as firms increasingly allocate capital to highly productive onshore unconventional oil plays in North America.

Prof. Kenneth B. Medlock III, Senior Director of the Center for Energy Studies, James A. Baker III Institute for Public Policy, Rice University



There are several key challenges. First, ensuring that our industry is able to attract and retain the best and brightest people who continue to

bring forward great ideas. Second, to see continued improvement in advancing the stability and predictability of fiscal and regulatory regimes; and third, to see the accelerated development in advanced technology that ultimately enables operators to discover, produce and maximize recovery from highly complex, ultra deepwater fields.

Jason Nye, Senior Vice President, US Offshore, Statoil ASA



The biggest challenge in 2013 will no doubt continue to be the shortage of expert technical professionals in the volume required to execute the number of major capital projects

currently ongoing. The shale boom in the US, surge in capacity globally for deepwater drilling and large number of projects in the execution phase means that technical specialists are busier than ever, driving rates for their expertise up in the market and in turn, escalating project cost.

Katie Potter, Division Lead, Exploration & Production, NES Global Talent



Our industry must learn how to more aggressively manage environmental and safety risks without slowing the pace of adoption and deployment of the new technologies necessary to exploit ever more challenging deepwater reservoirs.

Mark Mitchell, Group Vice President, Drilling Optimization Services, Weatherford International

The greatest challenge is having enough qualified personnel to conduct the necessary work. The industry has a gap of experience and qualified personnel, especially with many senior personnel retiring and not as many coming into the industry.

Tom Fulton, President, InterMoor Inc, an Acteon company



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EDITORIAL

Technology Editor

Nina Rach
nrach@atcomedia.com

Geosciences Editor

Andrew McBarnet
andrewmcbarnet@dc.rr.com

Director of Integrated Content

Victor Schmidt
vschmidt@atcomedia.com

Asia-Pacific Editor

John Mueller
jrreports@hotmail.com

Associate Editor

Audrey Leon
aleon@atcomedia.com

Contributing Editors

Professor Michael J. Economides
Meg Chesshyre
Bruce Nichols
Perry Fischer
Jennifer Leahy

ART

Production and Layout

Ian McInnes
imcinnnes@offshore-engineer.com

CONFERENCES & EVENTS

Events Manager

Sandy Basler
sbasler@ieimail.com

Exhibition/Sponsorship Sales

John F. Lauletta, Jr
jlauletta@atcomedia.com

PRINT

RR Donnelley & Sons,
Pontiac, Illinois, USA

EDITORIAL ADVISORS

John Chianis, *Houston Offshore Engineering*
Susan Cunningham, *Noble Energy*
Marshall DeLuca, *Wilson Floating Systems*
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(International): +1 763 746 2785
email: subservices@atcomedia.com
web: oedigital.com

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Brion D Palmer

'To improve is to change' – Churchill

Sometimes, change can be very hard to accept, much less embrace. We all like our routines and the aura of comfort they provide.

By now, you have realized *OE* has changed. Over the past six months, the company has gone through an extensive process to identify opportunities and develop solutions which will increase the value of *OE* to the offshore oil & gas industry – our readers.

This process included a review of the editorial product, the design of the magazine, and all of our *OE* brand extensions – conferences, websites, eNewsletters, etc.

Ultimately, our role as an information provider is to develop high-quality, trusted and credible content and deliver it across a variety of platforms – print, digital, research, and in person. You, the reader, will decide which format(s) you wish to access, consume, and share, and to use this information.

We want your experience with *OE* to be meaningful, productive, and unique.

There are many new elements within the magazine which enable you the opportunity to elevate the quality of your experience with our content. One, Expert access, is a prescheduled, live 'Q&A session' with subject matter experts associated with specific articles in each issue. Our first Expert access is scheduled for 29 January – turn to page 78 for more information.

Other enhancements include new departments and design treatments tactically executed to help you quickly find the information you want and need. Time is precious and valuable and we understand and respect that dynamic.

Additionally, *OE* is launching a dedicated website – WWW.OEDIGITAL.COM. This new site features a variety of unique daily content along with the historical archives of the magazine.

I encourage you to see what the 'new *OE*' has to offer you and tell us what you think – good, bad or indifferent. Please email comments to bpalmer@atcomedia.com



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Colloquy

Nina M Rach

Antifragility: Can this industry thrive with disorder?

Despite the widespread pop-culture interpretation of the Mayan calendar, the world did not end in an apocalypse on 21 December 2012, just as the Y2K date bug did not cause utilities and other critical infrastructure to fail on 1 January 2000. Scaremongering predicted disorder, but the ensuing paranoia led to Y2K preparation that apparently resolved date coding issues in an orderly way.

Engineering in the oil & gas industry generally benefits from predictable circumstances. Project planning and implementation are based on in-depth studies and well-reasoned forecasts, subject to policies, ordinances, laws, and ultimately, contracts. It may be impossible to foresee every possibility, but we rationally prepare for the most likely and probable scenarios. We build in safety factors and contingencies for unexpected and emergency situations. The most successful designs – and companies – are efficient, robust and flexible.

The multidisciplinary, 2012 book by Nassim Nicholas Taleb, *Antifragile – Things that Gain from Disorder*, suggests a different perspective for success – that we should deliberately build systems that can benefit from stress. When we remove stress from a system, it can weaken and become fragile. Taleb's 2007 best-seller, *The Black*

Swan, focused on improbable, unexpected events, but didn't offer solutions for the world's unpredictability and volatility. In *Antifragile*, Taleb says that 'black swan' events are likely to increase, due to globalization and other factors, and that we should

The concept of antifragility is that certain things can improve and even grow stronger when subjected to stress or turmoil.

plan for unpredictable, highly-consequential events by making our systems 'antifragile'. Although he doesn't cite any examples from the petroleum industry, many of the concepts are applicable.

Fragility, durability

Fragility 'is the quality of things that are vulnerable to volatility', Taleb writes. 'The opposite of fragile . . . isn't robust or sturdy or resilient – things with these qualities are simply difficult to break. To deal with black swans, we instead need things that gain

from volatility, variability, stress and disorder . . . this crucial quality is "antifragile". We have been fragilizing . . . almost everything [by] suppressing randomness and volatility.'

Increasing complexity and interconnectedness can lead to more vulnerable systems, subject to failure through myriad pathways – the trick is to figure out the fragility of a system. 'Not seeing a tsunami or an economic event coming is excusable; building something fragile to them is not,' says Taleb. This industry favors cost-effective, durable solutions, characterized by their ability to exist without significant deterioration; they are not easily altered or broken, they are not fragile or tenuous. But antifragility is beyond robust; the aggressiveness is driven by paranoia, pressing forward toward a big reward, while minimizing exposure to risk.

But the pursuit of greater efficiency can introduce fragility. Lean production practices and supply chains remove all slack from the system and may optimize flow, but they remove the operating safety net and increase risk.

Disorder

On a global scale or in the geologic time-frame, it's hard to grasp the notion of disorder. The laws of physics dictate movement and

change. Order is inherent, even at the subatomic level. 'Disorder' is a human-scale notion, usually meaning confusion or lack of an intelligible or discernible pattern: randomness. The concept of gaining from disorder, in the engineering realm, could be something as simple as creative solutions arising from basic (non-directed) research. There is much potential in randomness. Blue-sky thinking is not always pragmatic, but is often fresh, new and original.

'Knowledge . . . in complex domains inhibits research,' Taleb says, and we lose the potential of randomness when researchers are too specialized, studying increasingly narrow fields. Major oil companies have whittled away their R&D facilities, in favor of directed research at universities.

Among those poised to gain from the fear of disorder are transactional attorneys (solicitors) who craft contracts addressing as many contingencies as possible, in an attempt to remove uncertainty.

Hormesis, Eustress

'What doesn't kill us makes us stronger,' wrote Friedrich Nietzsche.

The concept of antifragility is that certain things can improve and even grow stronger when subjected to stress or turmoil. Taleb mentions hormesis – a generally favorable biological response to low exposures of toxin or other stressors – to address historical improvements in safety. Tragic disasters such as the Titanic (1912), Piper Alpha explosion (1988), sinking of the *P-36* platform (2001), and the Macondo blowout (2010) have led to step-changes in offshore designs and operational practices.

'Eustress' (good stress) refers to a positive response one has to a stressor. Some teams work well under stress and will rise to a challenge.

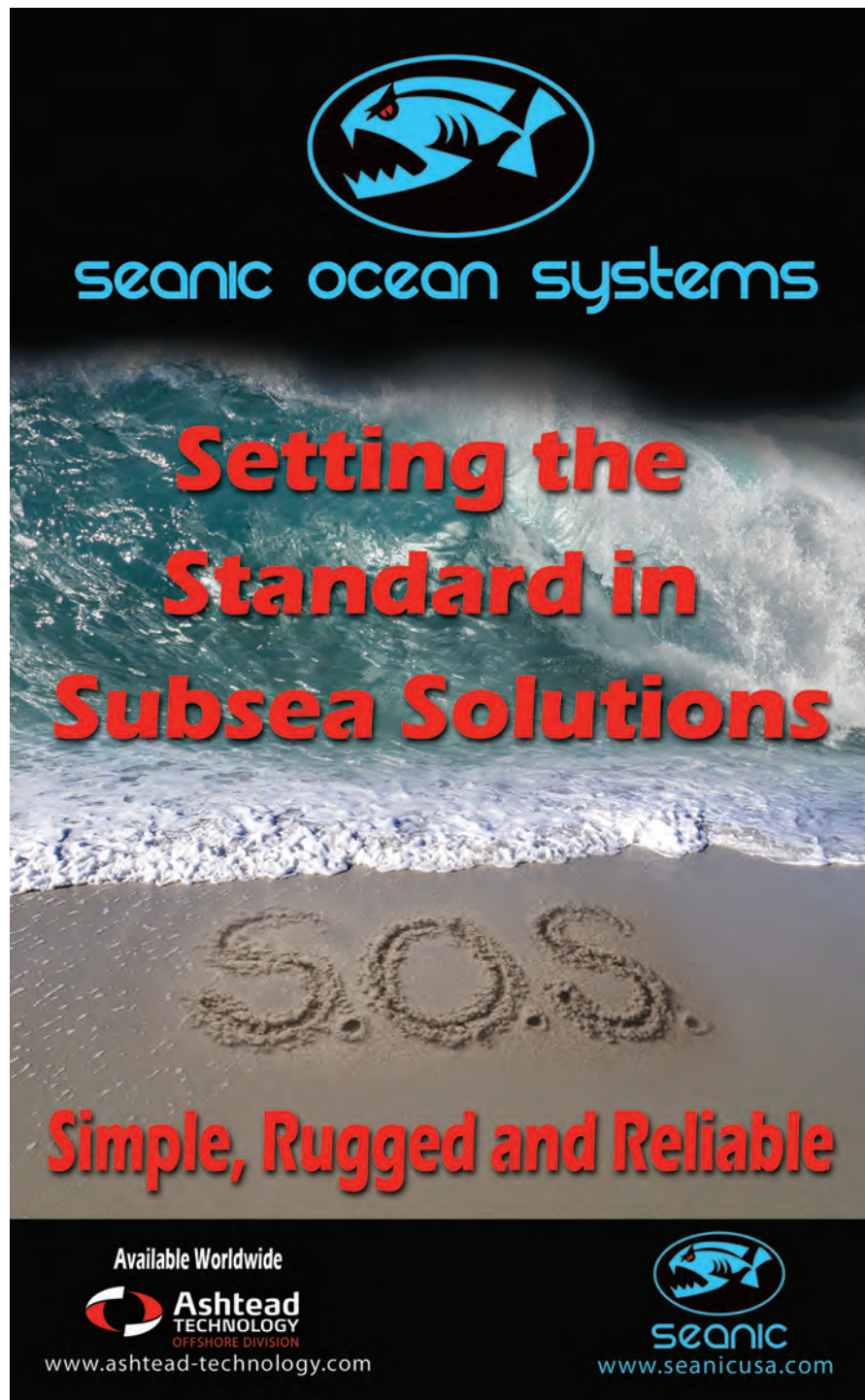
Likewise, 'necessity is the mother of invention', meaning difficult situations encourage novel solutions. When there's a critical

need, someone will think of a way to solve it. From the Industrial Revolution to the Manhattan Project, to the advances in petroleum engineering and marine architecture, solutions have always arisen.

When news broke of the 2010 Copiapó mining accident in Chile, this industry contributed crucial technology, including rigs from the US and Canada. Management at Center Rock, in Berlin,

Pennsylvania, knew they had the tools that could help rescue the Chilean miners. So did the owners of Drillers Supply in Cypress, Texas and Antofagosta, Chile, who coordinated the logistics so that Center Rock could successfully enlarge the borehole for the rescue capsule.

We need to be prepared for what we can't predict – and become antifragile. **OE**



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Ebb & Flow

Professor Michael J Economides

Sale of the century

Last month, Noble Energy, the Houston company that has played a vital role in confirming massive deepwater natural gas deposits in Israeli and Cypriot waters, announced that the partners in the Leviathan project agreed to sell a 30% working interest to Australia's Woodside Energy for about US\$2.5 billion.

Under the terms of the deal, Noble Energy will sell 9.66% of the total rights in the license for \$802 million. The other partners, the Delek Group, controlled by Yitzhak Tshuva, will sell 15% of the rights for \$1.281 billion and Ratio will sell 5% of the rights for \$417 million. These are some nice chunks of cash and Woodside's reach, so far away from its base in the remotest city of all, Perth, is newsworthy on its own merit. But there are other things to contemplate.

The prices are firesale bargains for Woodside. Assuming that Leviathan contains 17tcf of recoverable natural gas as reported by Noble, 30% of that (more than 5tcf) has just been purchased for \$0.50 per thousand standard cubic feet. Such a price is probably the lowest paid last year anywhere in the world for gas in the ground, including the US which arguably has had the lowest retail natural gas prices anywhere, less than \$4/thousand cubic feet. In Europe prices hovered around \$8 and in Asia topped \$15. Australia, thanks to a large extent to Woodside's work offshore Western

Australia, is poised to overtake Qatar as the world's leading LNG exporter.

For Woodside, getting gas so cheap in the Mediterranean and being able to control it in a world market into which it has already established a large and ever increasing presence is a no brainer. It is also clear that the Israeli sellers wanted cash, any cash, asap.

Woodside in Israeli waters is of course an important event. The company is somewhat of a maverick, a different breed from the traditional conservative Australian company and carrying the imprint

Such a price is
probably the
lowest paid last
year anywhere in
the world.

of its long-time American CEO Don Voelte who has just been replaced by long-time ExxonMobil alum Peter Coleman. Voelte, who took over Woodside when the company was tiny, was often derided by some Australians naturally averse to a foreigner, but his astute decisions established Woodside in a commanding position in both oil and LNG.

Woodside had to fill a vacuum in Israel; major multinational oil companies would not enter Israeli production for fear of antagonizing their Arab cohorts. Large company

aversion to invest in Israel is a situation that has lasted since the creation of the state in 1948.

There is a second element to the Woodside entrance and that is the shutting out of Gazprom, Russia's massive monopoly. Gazprom has been circling the area trying to buy into Israeli and Cypriot gas in what can be blatantly considered as a Trojan horse-kind of relationship. Gazprom would not want Mediterranean gas to be threatening its hegemony over Europe. There have been constant rumors that Russia would be even willing to throw Iran off the proverbial bus had Israel let Gazprom in.

Israel, on its own, has very limited options for massive exports of gas. Pipelines through Arab countries or through Turkey are not politically feasible. LNG is the only answer and a liquefaction facility in Cyprus is the obvious choice.

Where do the recent maneuvers leave Cyprus? Not much has changed other than the price. However, what is valuable is the establishment of long-term sales contracts where supply is guaranteed. Cyprus is embarking on a drilling boom and the country's petroleum future, properly managed, can lead the way in the region. **OE**

Michael J Economides is a professor at the Cullen College of Engineering, University of Houston, and editor-in-chief of the Energy Tribune. The views expressed in this column do not necessarily reflect OE's position.

A high-angle photograph of two young children playing on a sandy beach. The child on the left, wearing a yellow shirt, is bent over and drawing a large circle in the sand with a stick. The child on the right, wearing a green shirt, is standing and looking towards the camera while also holding a stick. The sand is covered with various other drawings, including lines and shapes. The text "Safeguarding life, property and the environment" is overlaid in white on the upper left portion of the image.

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MANAGING RISK



Global Briefs



A Field of Green

Helix Energy Solutions Group has encountered 100ft of high-quality net oil pay in the Wang exploration well, 93 miles off the Louisiana coast in Green Canyon block 237. Drilled to a total depth of 18,300ft, Wang will tie-back to the Helix Producer 1 FPU. First production is expected by 2Q 2013.

B Umbilicals for Kizomba

Oceaneering will supply 43km of electro-hydraulic, steel tube control umbilicals for Esso Exploration's Kizomba Satellites Phase 2 development off Angola. The cables used at Bavuca and Kakocha fields will tie back to the Kizomba B FPSO, while cables used at Mondo South field will tie back to the Mondo FPSO. Manufacturing will begin 2Q 2013.

C Fourth time's a charm

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

D Western Isles approval

The UK has approved Dana Petroleum's US\$1.6 billion Western Isles project, which seeks to develop the Harris and Barra oil fields. The nine-well northern North Sea development is expected to produce 40,000b/d in 2015. Both fields hold an estimated 45 million barrels.

E Durban study

ExxonMobil has acquired a 75% stake in Impact Africa's Tugela South Exploration Right off the eastern coast of South Africa.

ExxonMobil has also secured a one-year permit to study the hydrocarbon potential of the deepwater Durban Basin, which covers approximately 12.4 million acres.

F Crown Jewel

Santos discovered 61m of net gas pay in the Jurassic Montara, Plover and Malita reservoirs in its Crown-1 exploration well in the Browse Basin off Western Australia. The well is located about 500km north of Broome, 60km west of Ichthys field, and 20km east of Poseidon.

G Exploring Indus

Eni has acquired a 25% stake and operatorship in an ultra-deepwater block off Pakistan. Block G in Pakistan's Indus Basin comprises approximately 7500km². Eni currently holds participating interest in adjacent Indus block C (60%) and block N (70%).

H Striking Thai oil

Salamander Energy announced first oil at its Bualuang Bravo platform in the Gulf of Thailand. The *Atwood Mako* drilled the development well BB-04-H, which is expected to produce 1500b/d. With a 15-well development planned, Salamander expects production to increase to around 14,000b/d in 2013.

I Home Run

Cobalt has hit several hundred feet of net oil pay at its deepwater North Platte prospect in the Gulf of Mexico. Drilling was a long time coming for the company after operations were postponed following the 2010 moratorium. The well was drilled to 34,500ft TD in Garden Banks block 959.

J Caribbean pact

Anadarko and state-owned Ecopetrol have announced a 50:50 venture to explore the Fuerte Norte and Sur blocks off Colombia in the Caribbean Sea.

K Grane install

Reef Subsea will install a full seismic system at Grane in an effort to increase oil recovery at the field, located 185km off Haugesund, Norway. The contract includes the installation and burial of nearly 200km of seismic cables. The contract, awarded by Statoil, is worth US\$35.8 million and is expected to span 2013/14.

L New Zealand block winners

Anadarko was a winner in New Zealand's offshore block offerings in 2012. Anadarko walked away with two permits in the Pegasus Basin south of Wellington. Shell and partners OMV and Mitsui came away with one block in the Great South Basin off Dunedin.

M Cutting steel

Heerema Fabrication Group has cut first steel for the US\$2.26 billion Cygnus gas field located

in the southern North Sea. The steel will be used in the 1600t Cygnus Alpha Wellhead Platform, the first of four. GDF Suez E&P operates the Cygnus partnership with 39.75% interest. Its partners include Centrica (48.75%) and Bayerngas (12.5%).

N Ob River delivers

The Gazprom-chartered *Ob River* LNG carrier has successfully completed the first-ever delivery through the Northern Sea Route. The carrier's journey began in early November at the Snohvit terminal in Hammerfest, Norway, and ended at the Tobata terminal in Japan in December. Russian nuclear icebreakers assisted the carrier through the Northern Sea Route in mid-November.

• See feature, page 49.

O Exploring the Arctic Circle

Faroe Petroleum has won acreage in the Dreiki area on the Icelandic Continental Shelf. Faroe will operate seven license blocks south of the Jan Mayen Ridge inside the Arctic Circle northeast of Iceland. Faroe will hold 67.5% interest in blocks IS6708/8, 9, 10, 11 and 12 along with partners Petoro (25%) and Iceland Petroleum. Faroe will operate blocks IS6708/1 and 2 with 90% interest with Iceland Petroleum (10%).

P Lukoil goes horizontal

Lukoil has conducted a four-well horizontal drilling campaign at the Yu Korchagin field in the northern Caspian Sea.

Initial flow rates tested between 4000b/d and 10,000b/d. Recoverable oil reserves at the field are estimated at 360 million barrels.

Q Jacket bound for Iran

Iranian Offshore Engineering & Construction announced that its 3300t jacket is bound for South Pars field. The 67m high jacket will be installed 115km off Asalouyeh, Iran, in 61m of water.

R Yacheng field snapped up

BP has pulled out of Yacheng gas field in the South China Sea, selling its 34.3% stake to KUFPEC, a subsidiary of KPC, for US\$308 million. Pending approval by CNOOC, the deal is expected to close 2H 2013.

S Guinea partner

Tullow has farmed-in on 40% of Houston-based Hyperdynamics' offshore Guinea concession. A new drilling program, testing a deepwater fan prospect, is slated to begin 1 April 2014. Hyperdynamics and Dana Petroleum hold 37% and 23%, respectively.

T Dual hits

Chevron and its 50:50 joint partner Shell have scored two gas finds in the Exmouth Plateau of the Carnarvon Basin off Western Australia. Pinhoe-1, drilled to 13,396ft TD, encountered 197ft of net gas pay in the Barrow and Mungaroo Sands. The Arnhem-1, drilled to 9557ft TD, hit 149ft of net gas pay in the upper Mungaroo Sands.

Contract Briefs

Subsea 7 won a

US\$150 million EPCI topsides contract for Chevron's Lianzi field offshore Congo and Angola. Subsea 7 will provide a 200t module hosting a high-voltage generation system for the new subsea electrically heated pipeline cable, 80t flow-meter deck extension, and platform upgrades.

Expro has landed its first subsea supply contract in India. The three-year contract involves the supply of two 7³/sin electro-hydraulic completion landing strings systems and two sets of topside controls equipment.

Wartsila has been contracted by China Oilfield Services to supply designs for six new ships, two platform supply vessels, and four anchor-handling tug supply vessels for the South China Sea and Bohai Bay.

Aker Solutions has landed more Ichthys LNG work. McDermott handed the firm a US\$90 million (Nkr500 million) contract to deliver a subsea tie-in connector for the Western Australia project. Delivery is expected 2013/14.

EMGS has signed a US\$12 million data acquisition contract extension with Brazil's Petrobras. Data acquisition is underway and should be completed by the end of this month.

Rosneft and ExxonMobil have established a joint project to assess the commerciality of tight oil reserves in the Bazhenov and Achimov formations of Western Siberia. ExxonMobil will provide financing up to US\$300 million for the program. Drilling is to begin in 2013.

Maximize MTBM

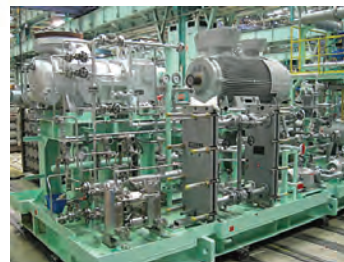
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Analysis



Cyber war opens new front

Increased automation offshore means oil & gas companies have far more systems that are vulnerable to computer viruses. Gregory Hale and Richard Sale investigate how onshore attacks have led companies to reassess security concerns.

Major oil companies, already under extreme pressure from computer viruses such as Stuxnet

and Shamoon also now have to come to grips with the possibility of a targeted attack in the offshore environment.

With increasing connections between onshore and offshore networks, the chances of cyber attack increase dramatically.

Experts say oil companies have improved offshore safety in the wake of Macondo, but they have been slow to implement more stringent information

security. The glaring lack of security comes on the heels of major oil companies such as ConocoPhillips, Marathon, Chevron and Baker Hughes continuing their struggle against increasingly sophisticated cyber attacks. These companies also were infected by the Stuxnet virus that has attacked computers in countries from Germany, Indonesia to Kazakhstan.

In the offshore environment, several

experts say virus attacks have led to electronic equipment becoming unstable, and while personnel undergo scenario training to reduce risks, such training is seldom employed in the field of information security.

This becomes especially dangerous with the current trend of increased automation, which leaves equipment more exposed to attack. Ludolf Luehmann, manager of IT

at Shell, Europe's largest oil company, says: 'We see an increasing number of attacks on our IT systems and information, and there are various motivations behind it: criminal and commercial,' perhaps focusing on research and development to gain a competitive advantage.

Sophisticated hackers

Cyber war experts like James Lewis, of the Center for International & Strategic Studies (CSIS), are aware that most industries operate on computers vulnerable to attack. Hackers are increasing in number, becoming more knowledgeable and skilled, and making more daring attacks on systems.

'The Chinese have been very successful,' Lewis says.

Oil companies are warning that the worst-case scenario would be one in which valves were accessed, which could set offshore rigs on fire, kill personnel and halt production. The cost of downtime on a typical offshore rig is \$6.3 million/day, say experts. The financial loss could be huge.

Stuxnet, which crippled the nuclear centrifuges

in Iran's Natanz facility, shows the potential devastation of a worm created to cause damage. Experts say this kind of attack could occur on oil producing offshore rigs.

Riener Brower, head of IT security at Abu Dhabi Company for Onshore Oil Operations, says the oil industry has avoided any damaging incidents so

Lewis says 'thousands of places around the world were infected but only one was damaged', the Iranian facility at Natanz.

'Stuxnet is an interesting weapons design. You need to introduce the virus and then you need to trigger it. It only works against a specific configuration,' explains Lewis. The

version was launched. The second version had a different trigger.

Chevron was one of the first oil companies to fall victim to the Stuxnet virus.

Blair Nicholas, of the law firm Bernstein Litowitz Berger & Grossman, based in San Diego, says: 'To the extent that there aren't adequate procedures in place to protect the



far, but he warns 'the oil companies in charge are no longer really in control'.

Chevron victimized

California-based oil giant Chevron has confirmed its computer systems were infected with Stuxnet. Chevron spokesman Morgan Crinklaw says the company was protected from major damage to its network, adding the company makes 'every effort to protect our data systems from those types of threats'.

According to US officials, any industrial component is liable to be targeted by such sophisticated attacks.

first stage of the virus used a 'beacon' that performed surveillance of the target, mapping an electrical blueprint of Iran's centrifuges. The second stage, a trigger, took advantage of a series of 'zero-day exploits' that ended up causing physical damage. The virus was only configured for Iranian nuclear facilities. Apparently, it wasn't designed to spread.

But it did.

Researchers at Symantec and Kaspersky Labs stated Stuxnet had two versions. The first, launched in 2010, had a 21-day period after which the virus would be null and void. Shortly thereafter, a second

companies' crown jewels and somebody gets the key to the jewelry box, there is certainly potential for shareholder derivative liability.'

Besides Chevron, no other corporate victims have disclosed attacks in filings with regulators.

Some companies have already been victims of Chinese-backed industrial espionage assaults like Night Dragon that have cost them billions of dollars in plans and intellectual property, sources say, and some of the attacks remained undetected for years.

In the Night Dragon attack, Exxon Mobil, Royal Dutch Shell, BP, Marathon Oil, ConocoPhillips

Expert Access

Join Gregory Hale and Eric Byres on 29 January at 11.00AM CST for a Live Presentation and Q&A session on how companies should be reassessing their security concerns to protect their data assets. See page 78 for more information.



and Baker Hughes fell victim to an advanced persistent threat that targeted 'project-financing information with regard to oil and gas field bids and operations,' according to a report from cyber security software provider McAfee Inc. In attacks on Baker Hughes and Shell Oil, the Chinese targeted bid data as well as project plans and financial information.

Conoco and Exxon experienced similar breaches, but they went unreported because of client confidentiality. Studies have already been done of malware aimed at seizing data in the computers of a drilling rig working on a ConocoPhillips project, sources say.

Retaliatory attacks

The latest attack was last August's onslaught of Shamoon, which wiped out the hard drives of more than 30,000 computers at Saudi Aramco. While Saudi Aramco says the attacks did not affect production, the idea of a virus hitting and destroying that many systems so quickly has its business partners worried the virus could propagate into their systems.

The attack did not get into the company's production environment because security professionals installed security programs. But the issue is that attacks, whether they are on- or offshore, will continue as long as systems remain relatively unguarded and easy to hack into.

As Saudi Aramco president and CEO Khalid Al-Falih said after his company suffered the Shamoon attack: 'Saudi Aramco is not the only company that became a target for such attempts, and this was not the first nor will it be the last illegal attempt to intrude into our systems, and we will ensure that we will further reinforce our systems with all available means to protect against a recurrence of this type of cyber attack.' **OE**

Gregory Hale is founder/editor of *Industrial Safety & Security Source* (www.issource.com).

Richard Sale was *United Press International's* intelligence correspondent for 10 years and at the *Middle East Times*, a publication of UPI. He is the author of *Clinton's Secret Wars and Traitors*.

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	2009	2010	2011	2012
Shallow (<500m)	113	93	104	63
Deep (500-1500m)	37	28	24	17
Ultradeep (>1500m)	32	32	20	34
Total	182	153	148	114

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	34	3788.25	13,760.00
Deep	19	3950.00	1880.00
Ultradeep	41	14,491.20	21,270.00
United States			
Shallow	17	64.65	1401.50
Deep	30	2817.37	2510.78
Ultradeep	26	3596.75	4060.00
West Africa			
Shallow	169	3836.60	20,272.81
Deep	52	8305.00	12,640.00
Ultradeep	19	2885.00	3390.00
(last month)	407	43,734.82	82,087.09
	(356)	(32,452.80)	(55,007.94)

Greenfield reserves 2013-17

Water depth	Field numbers	Liquid reserves (mmbbl)	Gas reserves (bcf)
Shallow (last month)	1367 (1207)	81,068.74 (70,621.15)	853,004.33 (657,452.75)
Deep (last month)	189 (157)	19,036.24 (15,039.49)	111,716.48 (63,989.74)
Ultradeep (last month)	107 (82)	21,676.95 (13,325.25)	70,487.00 (46,761.00)
Total	1663	121,781.95	1,035,207.81

Global offshore reserves (mmbob) onstream by water depth

	2011	2012	2013	2014	2015	2016	2017
Shallow (last month)	10,380.86 (10,380.86)	10,415.50 (27,174.35)	70,813.34 (54,027.11)	34,943.15 (35,127.05)	40,923.08 (41,002.59)	30,028.02 (29,574.05)	55,109.50 (-)
Deep (last month)	1316.73 (1316.73)	2618.75 (2740.33)	4039.46 (3514.17)	6518.12 (5930.50)	6124.80 (7337.77)	6627.05 (6832.18)	15,456.26 (-)
Ultradeep (last month)	35.26 (35.26)	1686.30 (1686.30)	2636.00 (2636.00)	2682.61 (2682.61)	3143.82 (3049.72)	11,515.05 (11,515.05)	14,135.35 (-)
Total	11,732.85	14,720.55	77,488.80	44,143.89	50,191.70	48,170.12	84,701.11

Pipelines

(operational and 2012 onwards)

	(km)	(last month)
<8in		
Operational/installed	41,020	
Planned/possible	23,000	
Total	64,020	(63,526)

8-16in

Operational/installed	76,407
Planned/possible	47,300
Total	123,707

(122,696)

>16in

Operational/installed	87,393
Planned/possible	47,725
Total	135,118

(135,145)

Production systems worldwide

(operational and 2013 onwards)

	(last month)
Floating	
Operational	266
Under development	45
Planned/possible	325
Total	636

(623)

Fixed platforms

Operational	9794
Under development	139
Planned/possible	1485
Total	11,418

(11,227)

Subsea wells

Operational	4307
Under development	425
Planned/possible	5928
Total	10,660

(10,428)

WHAT LIES AHEAD?

2



A lot of predictions have been made but most agree on an underlying reality. Global energy demand will increase by 35% over the next 30 years, with growth in developing nations offsetting declines in the developed world, reports **Perry Fischer** in this series of articles.

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Overcoming the global weakness

During the past few years, annual change in global oil demand has been running 0.8-1%/year and the International Energy Agency (IEA) forecasts it to continue in that range in 2013 – well below the previous 20-year 1.5% average annual increase seen before the global banking crisis. The weak global economy, which likely grew by about 3.3% in 2012, accounts for much of the restrained oil-demand growth. Improvement to 3.6% is forecast in 2013, slanted toward the second half. Energy efficiency improvements account for some of the subdued global demand growth, especially in OECD countries, where demand growth continues to be negative. In these regions growth was -1.1% in 2012 and is forecast to drop 0.7% further to -0.4% in 2013, with the US leading the decline, despite improving economic conditions. Demand outside the OECD is strong, likely growing at 2.8% last year, and is forecast by the EIA to rise 2.6% this year.

ExxonMobil just released its 2013 forecast *The Outlook For Energy: A View to 2040*. One of the key findings is that the company agrees with the forecasts of IEA, the US and others regarding oil demand and the OECD. Basically, the developed world will see negative demand growth for many years to come, but this will be more than offset by increased demand in the developing nations, mostly due to relentless population growth. The net effect is that energy demand will increase 65% in developing nations, but because of negative OECD growth, only 35% globally



over the next 30 years. The biggest increase will occur in the electricity sector. That bodes well for natural gas, which will overtake coal as the second-most-consumed fossil fuel. In the forecast, natural gas use quadruples in (primarily heavy and marine) transportation use to 4% from today's 1%.

'All liquids' oil demand will rise to 113mmboe/d by 2040 – a 30% increase from 2010. This is just under 1% average annual growth. About 70% of that increase is in the transportation sector, entirely due to boats, planes, trains, and heavy freight. Within the light transportation sector, the number of vehicles is expected to double over 30 years but, in terms of fuel consumption, remain essentially flat due to efficiency gains. This will also be true for overall energy usage in OECD countries, as they will 'keep energy use essentially flat, even as OECD economic output

grows 80%', says the report (*Figure 1*).

Even more far-reaching, the forecast says that 'around 2030, the nations of North America will likely transition from a net importer to a net exporter of oil and oil-based products'.

According to Barclay's Capital, since 2000, global oil production has grown 14% and gas production 34%, but industry E&P expenditures were up 387%, to an estimated \$614 billion in 2012.

John Westwood, group chairman of the Douglas-Westwood research and consultancy firm, comments: 'In short, each year we are spending more and more dollars to recover less and less oil. Much of this trend is due to the decline of conventional production, even in what we nowadays regard as "shallow water" such as the North Sea, where oil production is down 48% since its peak in 2000, and

globally reservoirs are depleting three times faster than they were 20 years ago. The result is a drive to exploit unconventional reserves, both onshore and in deepwater. But such oil will be high-cost oil.'

In a general way, the ratio of energy that is produced from a well versus the amount put into a well has been decreasing over the long term. Getting 100 barrels out for every 'barrel of energy' put into a well was common 80 years ago, now it's 20 barrels or less produced for each barrel input.

2012: Peaker's Lament

Despite the underlying demand fundamentals, higher and more volatile prices, more spending for less energy return, the rise and dominance of the NOCs (national oil companies) and their associated resource nationalism, 2012 was a remarkable year for the oil and gas industry.

A few years ago the peak oil community believed that 2005 was the peak production year, and that 72 million b/d of crude was the most that the planet would ever produce (Simmons) and that 86 million b/d was the most in 'all liquids' terms (Pickens). IEA now forecasts that 2013 oil production will be augmented by 830,000b/d to a total of 90.4 million b/d. The future supply picture looks bright. While noteworthy in its own right, what makes that amount even more striking are the extraordinary events of the past year.

In 2012, as the IEA said in its year-end *Oil Market Report*, 'rarely have so many things gone wrong in the oil patch at the same time'. Shut-ins during 2012 included Brazil, Oman, Yemen, Buzzard Field (UK offshore), an oil strike in Norway, a war-torn Libya trying to regroup, wars in Syria and Sudan, together with a dramatic increase in Japanese demand for anything that burns. These events would have rattled markets to their core in 2004-08, but last year markets were relatively stoic, calming even as the

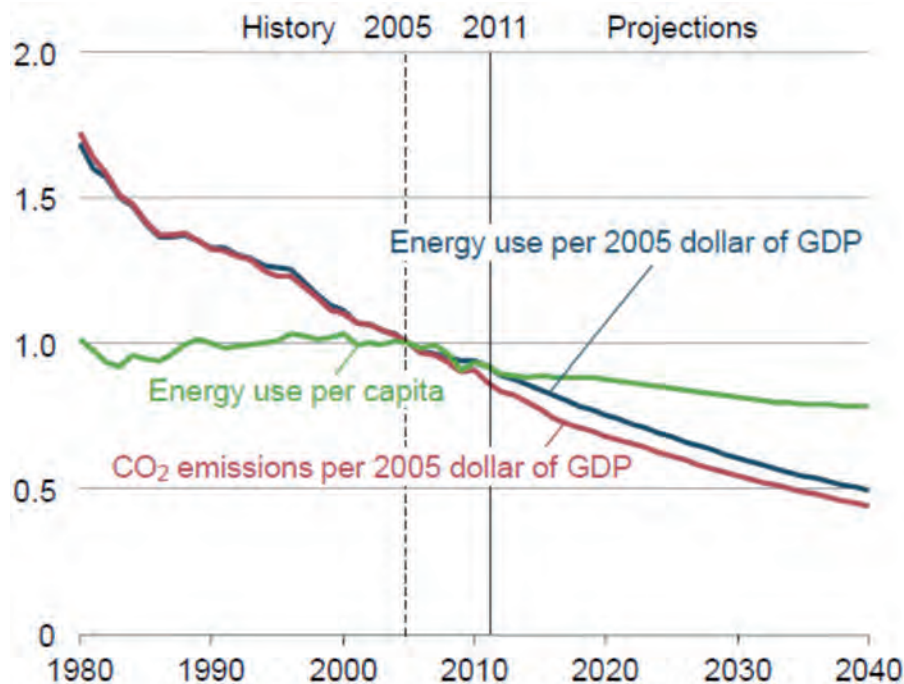


Figure 1. No matter how you measure it, the US is doing more with less, typical of the OECD countries. Note especially the energy intensity improvement, ie energy use/US dollar GDP. Source: EIA AEO2013

disruptions grew (although the full-year daily range for WTI was \$78-108, achieved from March to June 2012). In 3Q 2012, global events cut crude supply by a hefty 1.3 million b/d, and that doesn't include a drop of more than 1 million b/d in Iranian production with on-going sabre-rattling accompanied by an undercurrent of potential action by Israel.

Saudi Arabia stepped up production to 30-year highs, US production surged and the rest of the world more than held its own, with strong gains in Iraq, Russia and a surprisingly quick Libyan turnaround. The supply disruptions not only failed to impress markets, but OECD inventories actually increased against the normal seasonal decline in 3Q. The mediocre global economy helped the situation, as did improving energy intensity in the OECD. As this article goes to press at year end, traders are lowering their bets on crude prices. Incredibly, oversupply is a concern.

Adding to supply optimism is the fact that recovery factors still have room to grow from their

present global average of ~35% to as much as 50% – easily making improved recovery the largest 'reservoir' on Earth. This is more easily achieved with higher prices. Statoil's successful EOR projects, US CO₂ projects (which are growing and now add more than 350,000b/d to supply), Middle East water-flood projects, improving heavy oil recovery on Alaska's North Slope and numerous other recovery enhancement projects are adding to supply.

Longer term, the finite nature of the fossil-fuel resource will eventually play out. But a lot can happen before 'eventually' comes along.

Oil prices

Andrew Lebow, SVP of energy derivatives at Jeffries Bache, forecast oil prices to range \$75-100 a barrel in 2013, with Iranian geopolitics responsible for \$7-\$10 of that. This represents a 10% lowering of his previous forecast. Lebow expects that supply will be 'much higher' than demand.

George Littell of the forecasting firm Groppe, Long & Littell noted

that globally, one of the problems for oil demand is all of the competition from natural gas. 'It competes by displacing residual fuel for electricity generation and, in quite a few places, it displaces distillate as well. Both the Chinese and Indians initially built their electricity-generating capacity on oil. What they'll do now is convert to gas.'

When asked for a price forecast, Littell hinted that OPEC held a lot of the supply cards, noting that 'Saudi Arabia is putting out 10 million b/d, which is at the top of their normal 8-10 million b/d range. There's plenty of room for them to cut back production. There's no reason for oil prices to go down a lot, but it's not a smooth process. I'd expect them to range in 2013 about the same as they did in 2012.'

Global Offshore

Underscoring the importance of the sector, offshore E&P now accounts for over 30% of global production. Its vast investments now include 11,698 vessels – 13% of the global fleet, notes John Westwood.

Douglas-Westwood finds that capital expenditures in deepwater projects are forecast at \$232 billion, with the US, Brazil and West Africa accounting for 72% of that. Subsea technology will garner \$135 billion for hardware installed over the next five years, which means a 33% increase in subsea support-vessel days at a cost exceeding \$77 billion, with deepwater operations being the biggest driver.

Floating production systems (FPS) are well established as a cost-effective method for producing oil and gas. Douglas-Westwood forecasts that between 2013-17, \$91 billion will be spent on FPSs – which is double the preceding five-year period. Reasons include a larger proportion of newbuilds and conversions, a greater degree of local content (resulting in increased costs) and general offshore industry cost inflation. Douglas-Westwood

forecasts that 63% of the money spent worldwide on FPSs will be in deepwater.

FPSOs are by far the largest segment of the market, with 94 installations to be added and capex commanding 80% of all FPS expenditures 2013-17. FPS semisubmersibles account for the second-largest segment (10%), followed by tension-leg platforms (TLPs), then spars.

Latin America will have 29% of the forecast installations and 37% of the projected capex. Petrobras-operated fields off Brazil have seen the most installations to date and this is likely to continue, albeit substantial delays are expected for Petrobras' offshore E&P investment. Asia is the next-most active region, with 24 units to be added, while Africa should attract a forecast \$18.2 billion in capex.

Mobile drilling rigs are expected to increase by 286 units during the next five years as demand for offshore drilling increases.

Remarking that any forecast could go awry, Westwood notes that the fracturing and horizontal well technologies sweeping the US could spread worldwide and impact the development of expensive environments such as arctic oil and gas.

Westwood points out other risks: '... industry costs have doubled since 2000 – skill shortages and spiralling cost inflation will continue to be an issue, as well as industry over-reaction to market cycles causing oversupply, something partially associated with vessel owners.'

Westwood's final caveat is one of optimism: 'The offshore business is busier than it has ever been; many offshore technology companies report record backlogs and/or orders so the industry needs to consider supply-side constraints and plan accordingly.'

For the foreseeable future, clearly, the offshore environment, led by deepwater, is the place to be for growth. **OE**

Data Integrity

OE talked to **Steve Knowles**, president and CEO of Wood Group Mustang, asking 'what will be the most important things in the coming years?'

Knowles: I think that, although it's not the expected subsea technology of big projects, rather, it's data integrity associated with the projects. We need to focus on 'What is the ease of being able to input changes to facilities?' 'What is the ease of being able to retrieve that information and what is the ease of updating it?' 'How can we get our information delivered in a digestible manner?'

We see a major trend toward assurance. And, the regulatory bodies [are] moving in that direction, as well as the operators, including the engineering and design firms. That brings more robust quality systems, more emphasis around competencies. Having the right people with the right backgrounds, doing the work that you've given them to do. And then, checking that [work]. It's finding a balance between getting the assurance right and getting these facilities completed in an economic and timely basis.

I see a lot of trends in the direction of looking at the appropriate safety cases, looking at the competency of our folks, and ensuring that we have the tool systems and procedures that will drive integrity. We've all known for many years that safety was our business but we've been getting better and better at implementing that. And then, we're seeing the metrics of that [process] start to improve.

I know these things are less fascinating than say, subsea separation, subsea pumping and underwater facilities, FLNG and so on, but underneath those things are these core competencies that we've got to continue to address and see that those move along with it.

OE: But those technologies are still important to firms such as yours?

Knowles: Yes, definitely. Brazil, for example, continues to be on the cutting edge of HPHT. They're using 20,000psi systems now. That will unlock those HPHT discoveries.

In terms of big themes, we're seeing a trend-line toward mega-projects: mega-FLNG, mega-FPSOs, and more behind that if you look at stranded gas.

It's cold. It's harsh. And it takes a lot of cash.

The challenges of drilling in the Arctic have become so multifaceted it's hard to know what position folks line up behind. If it were just the usual environmentalist vs oil companies – and that fight is perennial to be sure – things would be clearer. But the Arctic environment brings so much risk – business, technical, environmental, political – that any diehard advocate can quickly do an about-face.

There's also competition from 'easy' gas, which is just about anything that's not arctic gas. Shale gas, coalbed methane, massive discoveries off Mozambique, and numerous LNG projects are sending a message to arctic operators to 'focus on the oil!'

Finally, every country surrounding the Arctic has to resolve their border disputes for

hundreds of miles offshore. The Law of the Sea Treaty addresses those issues, but despite wide, bipartisan support from Democrats, Republicans and the military, a small group in Washington has been able to hold up US ratification, calling it the 'L.O.S.T.' treaty. So the US has no seat at the table, and no voting rights to help settle disputes. Admittedly, these issues are mostly pointed farther offshore, and it may be a while before the technology exists to develop those resources. However, in 2007, Russia planted its flag on the seafloor under the North Pole – a clear sign of intent.

In 2003, the US began an Extended Continental Shelf Project (ECS) 'to establish the full extent of the continental shelf of the United States, consistent with international law'. To determine the outer limits of the US ECS requires

data collection and analyses that describe the ECS. The project conducted two scientific cruises last year and more are scheduled.

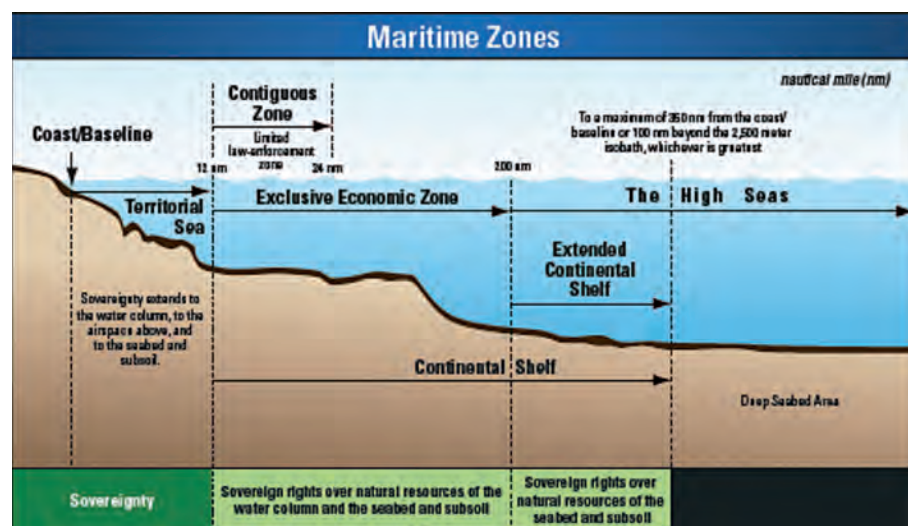
If scientists at the US Geological Survey are correct, the resources are there. USGS says the Arctic contains over a fifth of the world's undiscovered, recoverable oil and gas resources (*see map*).

Exploitation Efforts

In Russia, the Prirazlomnoye platform came online in late 2012 – Russia's first Arctic offshore oil field and the first arctic-class, ice-resistant production platform in the world. Commercial drilling began last year. The field is located in the Pechora Sea, east of the Barents Sea.

ExxonMobil, ENI and Statoil have signed deals to explore for oil in Russia's Arctic waters. Statoil recently pulled out of the Shtokman development in the Barents Sea, giving its 24% interest back to Gazprom after spending \$336 million. Total, which kept its 25% in Shtokman, warned against drilling in the Arctic.

In an interview with the *Financial Times*, Christophe de Margerie, Total's chief executive, said the risk of an oil spill in an environmentally sensitive area such as the Arctic was simply too high. 'Oil on Greenland would be a disaster,' he said in an interview. 'A leak would do too much damage to the image of the company.' However,



De Margerie said that in principle, he was not opposed to Arctic exploration. In practice, since Total has kept its 25% stake in Shtokman, this is confusing. De Margerie's explanation was that since Shtokman was a gas field, gas leaks are easier to deal with than are oil leaks. The environmental watchdog organization, Greenpeace, was undoubtedly heartened by De Margerie's comments.

USGS says the US Arctic continental shelf area contains nearly 30 billion barrels of technically (*ie* not necessarily economically) recoverable oil. Nearly three dozen wells were drilled in the Chukchi and Beaufort seas between 1982 and 1997. The huge, undelineated Burger gas field, discovered in 1989, may contain 2-65tcf of gas and millions of barrels of petroleum liquids; its structure is a major focus.

During the last seven years, Shell has spent \$4.5 billion preparing for and answering the now-routine barrage of legal challenges oil companies face when trying to drill off Alaska's northern coast. The company towed two drillships and moved more than 20 support vessels to Alaska's northwest coast in 2012. When the flotilla arrived, fog and sea ice clung to Alaska's shores, keeping the drillships from getting to their shallow-water drill sites. Then, the drillship *Noble Discoverer* briefly floated out of control, dragging its anchors near Dutch Harbor, Alaska. It turned out that the *Noble Discoverer* could not satisfy some of the air-pollution regulations (for which they were eventually given a variance).

Next, after waiting months on numerous construction delays, Shell's novel oil-spill containment system aboard the barge *Arctic Challenger* suffered damage to its undersea containment dome during testing. The first-of-its-kind spill-response system was built to comply with federal regulations. The delay caused the company to postpone full drilling operations

until this year. In order to salvage what was left of the season, Shell drilled the top-hole sections on two wells, one each in the Chukchi Sea (Burger-A well) and the Beaufort Sea (Sivulliq well). Top-hole sections do not require a containment dome.

As if practicing for even more serious events, the *Discoverer's* eight anchor connections and its drill pipe were pulled when the drillship was forced off location just one day after spudding the Chukchi Sea well, due to a massive 30x12-mile passing ice floe.

Shell has staked out a big position in US Arctic waters, with 408 federal drilling leases. Shell hopes to drill up to four wells over two years in the Beaufort Sea and up to six wells over two years in the Chukchi Sea using two drillships.

Shell's knowledge from earlier drilling and from 3D seismic surveys of the Chukchi Sea have led company geologists to believe that a large subsurface structure exists that could have a multibillion-barrel potential. Then again, it could be mostly gas – all of which would be stranded without a pipeline.

Meanwhile, seismic contractor ION has been acquiring a substantial amount of multi-client Arctic data, including 23,000km in the Beaufort Sea, 3000km in the Chukchi Sea, and 12,000km off northeast Greenland, in addition to airborne data. Clearly, there is operator interest, with several other companies watching and waiting to follow Shell, including ConocoPhillips, Statoil and Repsol. Statoil said it would be 2015 at the earliest before it would drill on its own leases in the Chukchi Sea.

Cairn Energy spent \$1 billion



* US Geological Survey estimates 2008.

exploring off Greenland, but despite seeps and shows, did not find commercial volumes of oil. Cairn may return to Greenland in a couple of years with partner Statoil.

Norway's Statoil drilled five wells in the Barents Sea last year; three were discoveries. Statoil's recent discoveries of Havis and Skrugard fields are believed to have recoverable oil volumes of 400-600 million barrels, together. Skrugard and Havis are the northernmost field developments on the Norwegian shelf. Statoil holds a 50% stake as operator of the license, with partners Eni (30%) and state holding company Petoro (20%). Statoil says it will triple its arctic technology research budget, including the continuing development of a dedicated arctic drill unit.

The company will drill nine Barents Sea wells this year, including four wells at the Nunatak prospect, near Skrugard, and the world's northernmost offshore drilling with two or three wells planned for the Hoop frontier exploration area. Statoil contracted Seadrill's *West Hercules* drilling rig for five years, which is now being prepared for arctic conditions.

Last year, Statoil and Russian oil major Rosneft signed a major agreement for joint development of Perseyevsky and other fields in the northwestern corner of Russia's sector of the Barents Sea. **OE**

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The big picture

US crude and condensate production has been falling since 1972 with only a couple brief periods of respite or flattening downward. Most analysts felt that the decline was irreversible. The decline flattened in 1991, 1997 and 2001 and, as a result of a dramatic jump in oil prices, production began a steep upward climb in 2007. While the financial collapse of late 2008/09 pulled rigs and cut back production, operators in areas needing a lot of fractured, horizontal wells, especially those with short lease terms, continued to drill, especially in the Bakken. With recovering economics, that trend continues and is forecast to rise sharply this year, according to the EIA, with annual production growth averaging 234,000b/d through 2019, when production reaches 7.5 million b/d (*Figure 1*). After about 2020, the EIA forecasts production to decline gradually

to 6.1 million b/d, as depletion of the sweet spots that were drilled first gives way to less productive acreage.

Offshore, crude oil production is forecast to undulate between 1.4 and 1.8 million b/d. Development activity will quicken as large projects in the deep and ultra-deepwater areas of the Gulf of Mexico are brought online.

The final leg of the Keystone XL pipeline will provide a major new supply line. Although much of the crude will be refined and shipped overseas, the rest of the gooey Canadian bitumen will add to US supply. Interestingly, George Littell of the forecasting firm Groppe, Long & Littell gave *OE* this insight: 'If the Keystone pipeline were to get cancelled, it would probably be the best thing for Canada, because it would force the Canadians to build the pipeline to their West Coast, which is a necessity that they

should have started five years ago. It's clearly in their best interest to do so, to open up access to Asia.' Most experts, however, expect the Keystone will be completed to the US Gulf Coast.

It should be stressed that the above numbers refer to crude and lease condensate only. When including all liquids, that is, crude, condensate, natural gas liquids (NGLs), refinery gain, biofuels and others, the 'all liquids' supply jumps to more than 11 million b/d – well over half of US consumption. A similar measure of 'liquid fuels supply' shows imports below 45% and rapidly falling – an unthinkable thing just five years ago when it appeared a certainty that imports of 60% were headed much higher (*Figure 2*).

Gas Production Softens

The US gas glut hangs over the domestic E&P industry, and a

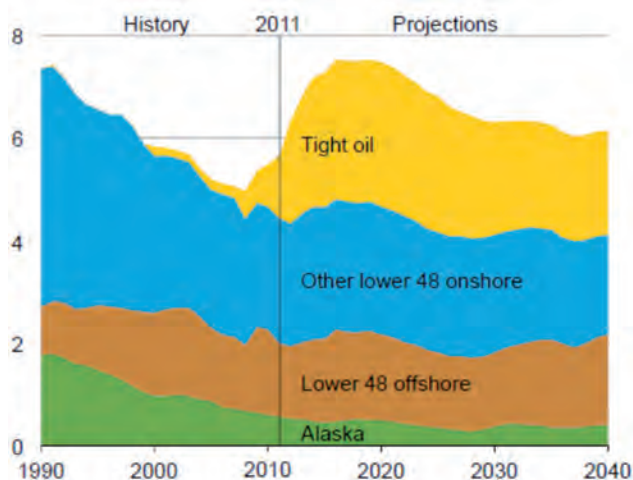


Figure 1. US crude oil production 1990-2040 (million b/d). Source: US EIA.

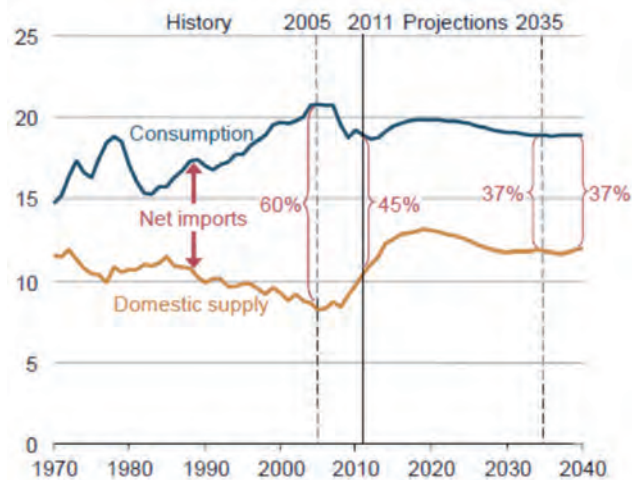


Figure 2. US liquid fuels supply (million b/d). Source: EIA.

warm winter thus far is not helping matters. As Littell quipped: 'In the gas industry you can never escape the weather.'

Drilling activity has held up fairly well despite low gas prices, in part a result of high crude oil prices, which improve the economics of natural gas plays that have relatively high liquids content. Conversely, these high GOR wells will cause the falloff in gas production to be slower than might otherwise be indicated by the gas-directed rig count. Still, a number of producers have cut back or shut-in gas production – a luxury that most offshore operators just don't have – to alleviate the glut that developed at the beginning of last year. By February 2012, gas prices had dipped below \$2 per thousand cubic feet, cheaper than coal by any measure. A cash-based pricing system with mandatory shut-ins was narrowly avoided by the beginning of last summer as the US approached maximum storage levels, and prices have improved since then to over \$3 per thousand cubic feet.

As *Figure 3* shows, total US gas production should remain relatively flat for the next two years as industry works out the oversupply problem.

Offshore US gas production is forecast to be mostly steady the next few years at about 1.8tcf, and then is expected to reverse a year-long overall decline by about 2015. Thereafter, it should increase to 2.8tcf by 2035. Larger-volume development projects, particularly in the deepwater Gulf of Mexico, remain directed principally toward liquids rather than gas. The big story is the radical about-face with LNG.

The EIA forecasts the US to be a net exporter of LNG starting in 2016, and an overall net exporter of natural gas in 2020. US exports of LNG from new liquefaction capacity are assumed to start at a level of 0.6bcf/d in 2016 and increase to 4.5bcf/d in 2027, as peak export

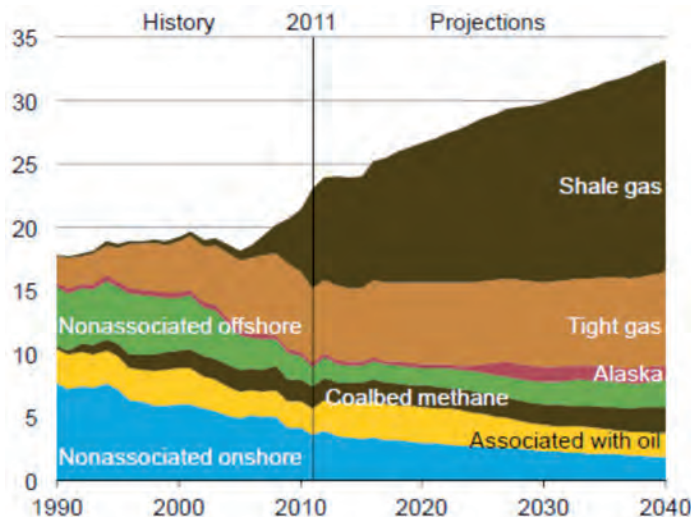


Figure 3. US gas production 1990-2040. Source: EIA.

volumes are shipped out of facilities in the Gulf Coast and Alaska.

EIA says the US will become a net pipeline exporter of natural gas in 2021, as pipeline imports from Canada steadily fall and net pipeline exports to Mexico grow by 387%.

The EIA also assumes that the Alaska natural gas pipeline does not get built, owing to high capital costs and low gas prices.

US Gas Prices

Using a new methodology, the EIA forecasts Henry Hub spot natural gas prices to remain below \$4/mmBtu (in 2011 dollars) through 2018. In other words, it cannot foresee any shortfall of supply and thinks that demand will pick up at least a little.

Littell comments: 'I'd just say that when Henry Hub is trading in the low \$3 and LNG to northwest Europe in the low \$10 – that's a situation that cannot persist indefinitely. The supply/demand gap is clearly visible and there are folks working both sides of it to make it go away. There are recent announcements to export more gas by pipeline to Mexico; we'll build a couple more ammonia plants, we'll run ethylene plants at higher rates, LNG exports, and so on . . . the usual fashion of those things is that they overcorrect.' Maybe that's why the chart (*Figure 3*) shows such an upswing after 2014.

US LNG

Under the heading of 'Tis truly an ill wind that doesn't blow some good', the current low prices and abundant gas production in the US have been a joy of the petrochemical industry, utility industry and consumers in general, not to mention the economy, adding a conservative estimate of \$300 billion. Electricity is cheap, as are all things related to gas. Still, \$3-or-so gas doesn't help a final investment decision (FID), especially with the high gas-oil ratios (GORs) common in deepwater fields and some of the liquids-rich plays on land.

To the rescue (at least for producers and drillers) is the new North America LNG export frenzy. To date, 20 applications have been filed with the US DOE to export 28.67bcf/d of LNG to free trade agreement countries. This equates to approximately 45% of US daily consumption. And four Canadian LNG export facilities have been proposed. Some have begun the lengthy paperwork process; one is about to begin construction. The two that are furthest along are Chenier on the Gulf Coast and Kitimat in British Columbia.

Fighting the US export terminals are the petrochemical and fertilizer industries, consumer groups and resource nationalists that don't want to see natural gas prices increase. They are backed by two

US EIA reports that echo each other, with the just-released January 2013 report stating the commonsense notion: 'Increased natural gas exports lead to higher domestic natural gas prices, increased domestic natural gas production, reduced domestic natural gas consumption and increased natural gas imports from Canada via pipeline.'

Littell adds: 'The Pangea LNG project just got added to the list – there are now 20 export projects proposed. I think that at least two of them will get built. There's definitely a first-mover advantage. I suffer from a long memory and five years ago there were, I think, 37 proposed import terminals.' For the record, five of those actually got built.

NGL Overload

When talking about the US oil production boom, it's good to remember the huge NGL component in these 'fractazontal' gas plays – it's not really the same as oil, nor is it priced the same. The NGLs typically 'break' into seven or eight commonly used oily components, propane and ethane (think: ethylene plastics) being two of the more common fractions. Each component has its own market. And ethane made in America stays in America. Products can be manufactured and shipped, but vapor pressures are problematic in pure ethane.

If you thought that \$2 gas prices in early 2012 were bad, consider the NGL folks. Continued drilling, even for more liquids-rich plays, still produces an abundance of NGLs. And even LNG exports won't help the glut, as NGLs get stripped out in the liquefaction process. 'After this natural gas pricing disaster, another disaster is brewing for the liquids,' says Littell. **OE**

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Chevron joins Kitimat LNG Wartsila in Harvey Gulf supply pact

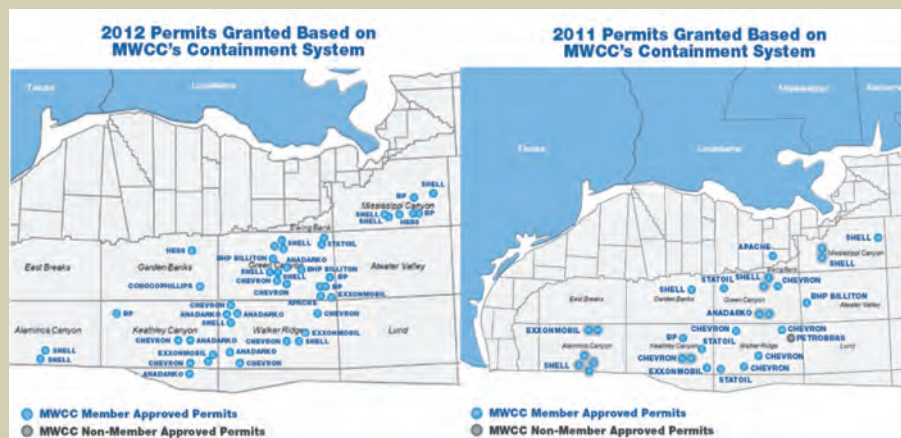


Figure 1. Permits in deepwater numbered 76 by end-2012, enabled by the MWCC system. Source: MWCC.

Containment system soon in operation

In the wake of Macondo, something was needed to lower the risk of recurrence. BP had shown that, given enough time, a system to contain such a well-control incident could be built. Despite the delay, BP eventually did come up with a solution. The Marine Well Containment Company (MWCC) was formed to more carefully create a containment system in the US Gulf of Mexico.

The company has been providing an interim containment system consisting of MWCC-owned and maintained equipment along with access to mutual-aid vessels and equipment. A final version is well along in testing and construction; the last major system test was in mid- and late 2012.

The interim system can cap wells at 8000ft depths and flow 60,000b/d. The final system expands to 10,000ft depths and 100,000b/d. MWCC is working with regulators from the US Bureau of Safety & Environmental Enforcement (BSEE) to ensure all expectations were met and that the new system would safeguard operations in the Gulf of Mexico, allowing new permits to be issued.

The interim version has been cited in 76 deepwater permits as of year-end 2012 (Figure 1). It is scheduled for completion this year (Figure 2). While it is intended for use primarily by its members (currently 10), non-members – and there have been a few – may also use it under certain conditions. The system is housed at an ASCO warehouse along the Houston ship channel. Other components are stored at vendor facilities elsewhere in Houston and in Port Fourchon, Louisiana.

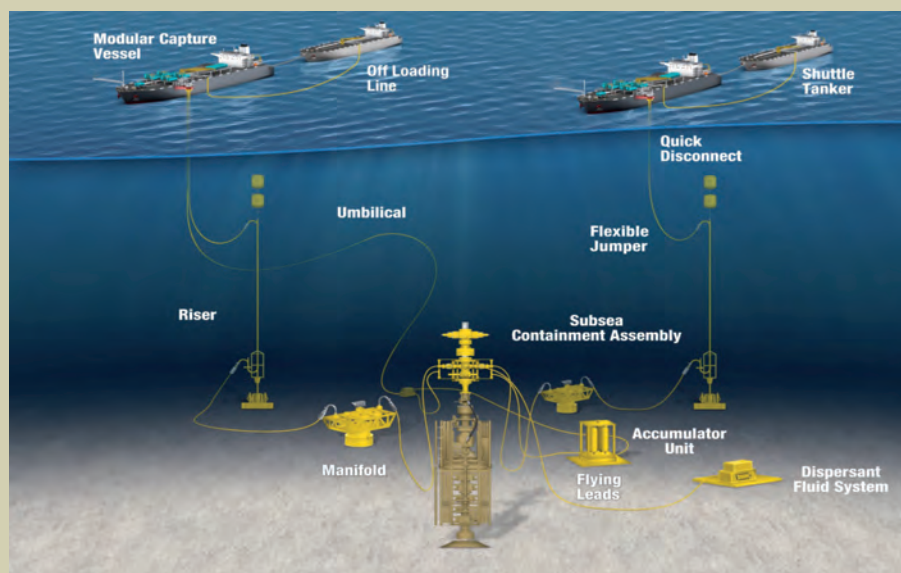


Figure 2. The expanded MWCC containment system should be ready in 2013. Source: MWCC.

A world well-supplied

Natural gas is still not a global fungible commodity, although the LNG trade steadily grows as projects and the global fleet expand. ExxonMobil thinks that worldwide natural gas use will grow more than any other fuel – by 65% over the next 30 years. Increasingly, that demand will be supplied by ‘stranded’ gas – from fields afar – and conversion to LNG will get the gas to where it’s needed. Asia and Australia will account for 74% of all the LNG expenditures over the next five years. Douglas-Westwood forecasts that by 2018, \$38 billion will be spent on FLNG vessels and a further US\$15 billion on floating regasification terminals.

On the supply side, nothing is more spectacular than Shell’s Prelude FLNG floating project. Shell officially began construction on the system in October 2012. Development drilling is expected to begin this year in the Prelude and Concerto gas fields in the Browse basin, 125 miles off the northwest coast of Australia. The massive structure will be 488m (1601ft) in length and weigh around 600,000 tonnes, six times more than the largest aircraft carrier; first LNG is scheduled for 2017. Shell intends its FLNG design to be the first of many. There are a few other stranded-gas candidates offshore Australia, such as GDF Suez/Santos’ Bonaparte development, PTT’s Cash and Maple fields, and Woodside’s Sunrise project.

Elsewhere in Australia, there are seven facilities under construction; all are expected onstream 2014-17.

They could provide more than 90 million tonnes/year capacity if they all get built. Note that 35 million tonnes/year is coalbed methane supplied – a first at these volumes.

Meanwhile, the on-again, off-again, on-again massive Shtokman gas field offshore Siberia is . . . well, who knows? Gazprom and partners Total and Statoil made a joint announcement to reporters in August 2012 that ‘excessive costs had made it unfeasible to develop the field’. However, two months later at a press conference, Russian president Vladimir Putin said: ‘The investment decision is planned to be taken in the near future, so we are talking project launch before 2017.’ Then, in mid-December, Gazprom said a tender would be held this month for the construction of a large 30 million tonnes/year

plant to be built on the Kola peninsula.

Statoil gave back its 24% stake to Gazprom in August after spending \$336 million. Total is hanging in there with its 25% stake. A 137tcf gas field is hard to give up, even if it is 375 miles from shore in iceberg-laden waters.

While Russia fiddles, another gas elephant has emerged in the warm waters off East Africa, which may hold at least 100tcf and is still in the discovery and delineation process. Wood Mackenzie estimates that there is at least 80tcf recoverable off Mozambique and 18tcf off neighboring Tanzania. With the expectation that recoverable reserves will eventually rise much higher; Mozambique is likely to become the world’s fourth largest gas holder after Qatar, Iran and Russia.

Australian LNG projects coming onstream 2012-2020.

Name	Operator	Type	Capacity (million t/year)
Pluto LNG	Woodside	Offshore to shore	4.3
Greater Gorgon LNG	Chevron	Offshore to shore	15.0
Queensland Curtis LNG	BG Group	CBM	8.5
GLNG	Santos	CBM	7.8
APLNG	APLNG	CBM	9.0
Wheatstone LNG	Chevron	Offshore to shore	8.9
Ichthys	Inpex	Offshore to shore	8.4
Prelude FLNG	Shell	FLNG	3.6
Browse LNG	Woodside	Offshore to shore	12.0
Bonaparte FLNG	GDF Suez	FLNG	2.5
Cash Maple FLNG	PTT LNG	FLNG	2.0
Arrow LNG	Arrow Energy	CBM	8.0
Gladstone LNG	LNG Ltd	CBM	1.5

Source: Douglas Westwood World LNG Market Forecast 2012-16.

Among the various players, Anadarko and Eni lead consortia that are farthest along. The two companies will coordinate development of their offshore gas fields and an LNG plant in northern Mozambique. The plant will ultimately supply about 50 million tonnes/year, which would be the largest LNG production outside Qatar.

Anadarko plans to establish firm reserves figures in 2013 and hopes to make a final investment decision and award engineering, procurement and construction (EPC) contracts near year-end. First LNG is slated for 2018. Statoil, ExxonMobil, BG and others will continue exploring and amassing reserves off Tanzania.

ExxonMobil is busy building its PNG-LNG export terminal in Papua New Guinea. The \$4.5 billion project has had some setbacks and cost overruns, but should still come onstream by 2016. It's

unclear whether other nearby gas discoveries will become part of PNG-LNG.

The US is in a frenzy to resolve its gas glut and turn import facilities into export facilities (some LNG is already being re-exported from the Gulf Coast). The first LNG export terminal is scheduled for completion in 2016.

In a discussion with George Littell about LNG prices, a partner in the forecasting firm Groppe, Long & Littell, *OE* asked: 'Doesn't there seem to be a lot of LNG projects coming online in the next five years? Will there be enough demand to keep up prices?'

Littell thinks that won't be a problem. 'Globally, nearly a third of all oil is still used for stationary thermal applications, primarily power generation, but also other thermal stuff. There remains a huge section of the oil market that natural gas can displace, so I don't see enough of a demand problem to

push LNG prices down very much. Gas is still relatively cheap.'

On the demand side, China will increase its LNG imports through six terminal projects now under construction. Zhuhai and Tangshan are now in their first phase. Douglas-Westwood says these projects will provide an additional 18 million tonnes/year import capacity.

Japan's unending nuclear crisis helped sop up some of the excess LNG being offered on world markets, firming prices. The country has increased LNG imports 27% year-on-year but the new administration that takes office this month is widely viewed as being pro-nuclear energy, meaning that Japan's 50-plus offline nuclear reactors could be brought back online, depending on political developments. Regardless, the country was already planning eight new import terminals to come online 2013-16. **OE**

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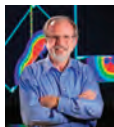


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G&G Notebook

Andrew McBarnet

Planning on a better future

If there was such a thing as an annual horoscope for the marine seismic and related geophysical businesses, then in the coming year we can expect at least some improvement on 2012. In other words, unless there is some totally unexpected destabilizing economic, political or other influence which confounds even the best astrologer, we can probably say that the marine seismic community will see a steady flow of orders, tightening of vessel availability and firmer prices.

The precondition of any optimistic scenario is the prospect of significant E&P spending, and in that department the stars appear to be aligned. The widely quoted *Barclays Global 2013 E&P Energy Spending Outlook* certainly seems to think so. It suggests that global exploration and production spending is set to reach a new record of \$644 billion in 2013, up 7% from \$604 billion last year. Markets outside North America are the main driver, forecast to reach an unprecedented \$460 billion, a 9% increase on the 2012 expenditure.

Sustained high oil prices, the sanctioning of major projects and the delivery of a large number of offshore rigs in 2012/13 are cited as key factors with the increase spread to almost every country with hydrocarbons to exploit. The exception is North America which has been impacted by the over-enthusiastic production of shale gas and the resultant decline in gas prices.

For the marine seismic business major increases in capital expenditure do not necessarily translate into good news. It can just mean that oil company dollars are primarily focused on development projects rather than exploration, which is frustrating. However, Barclays brings some cheer on this front. It reports that the supermajors are basically back in the game after a period of relative abstinence – their 2013 spending is expected to increase globally by 9%, led by active drilling and exploration programs from Chevron (up 17%) and ConocoPhillips, Shell, Total and Exxon (all up by more than 5%).

The precondition of any optimistic scenario is the prospect of significant E&P spending.

Barclays attributes these high spending levels by the supermajors to years of flat spending and under-investment in the early to mid-2000s, resource nationalization resulting in the expansion of deepwater drilling activity (particularly in Brazil and West Africa), and the need to find and replace large pockets of reserves and increase production. Active exploratory programs in emerging offshore markets in West and East

Africa and the continued ramp up in activity levels in frontier markets including Iraq, Colombia and Southeast Asia are said to be contributing to the year-on-year growth.

It's the small print from the review which makes the best reading for geophysical services companies. The outlook for the economics of exploration mostly improves for 2013 versus 2012. International exploration economics continue to be viewed best among the regions in the Barclays survey, with 75% of companies believing that the economics for 2013 would be 'excellent' or 'good', up from 68% in the last survey. The outlook in the US also improved, and the percentage of companies which responded 'excellent' or 'good' moved up to 84% from 57%, while Canada did not fare so well with regard to its exploration prospects.

What seismic companies really want to hear is that E&P companies are expecting service prices to increase in 2013 with nearly a third of respondents indicating they anticipate higher prices across all product lines compared to only 10% of companies who expected higher pricing last year. Elevated levels of utilization will drive prices higher internationally across the full array of service and equipment product lines, Barclays believes.

The icing on the cake is the favorability rating of geophysical applications in E&P. It is not a surprise that for the fifth

consecutive year, fracturing, stimulation and horizontal drilling were most commonly cited among operators as having the greatest impact on their spending plans. However 3D/4D seismic was also highly influential, placing third, reflecting the focus on exploring new, unconventional plays.

Period of stability

2013 could, in fact, be a period of comparative stability for marine seismic contractors, with the market close to equilibrium in terms of survey demand and availability of vessels. This is probably something to celebrate from the contractors' point of view because whenever there is an upturn, it's never long before investors, notably Norwegian shipping interests, decide to make a play. Already there is talk of Rieber Shipping and Sanco both contemplating the construction of new vessels. This may not be entirely a bad idea if the introduction of modern, 3D vessels prompts the retirement of less efficient vintage.

No one would be at all surprised if Dolphin Geophysical, which has only been in business for a couple of years, emerges as a potential buyer for any newbuilds on offer. It came up with the money to charter the last two vessels which Sanco began to construct without a named buyer – *Sanco Swift* due out this year and *Sanco Sword* due out in 2014. The intention is to enable the company to move more seriously into the high-end, 3D seismic market. The same rationale could see Dolphin purchase more new capacity if the financing can be found.

CGGVeritas estimates that it will be 2015 before there is any significant increase in the global vessel count – 75 vessels compared with 60-odd right now. It will be interesting to see whether Dragon Geophysical is part of the mix by then. This looks to be a classic, speculative venture launched during an upturn in the fortunes



Coming soon: *Sanco Sword* for Dolphin Geophysical.

of the industry. In this case, the prime mover is David Lamb, who was, until mid-2011, CEO of Reflect Geophysical, a subsidiary of Singapore-based shipping company Otto Marine.

The plan is a variation of many similar start-ups. Dragon Geophysical is actually part of three distinct business units in Dragon Energy Holdings. Dragon Offshore will be responsible for the construction operations and systems integration of four, ultra-modern, 16 streamer seismic vessels. Dragon Maritime will provide worldwide maritime operations for the vessels; and Dragon Geophysical will provide seismic acquisition survey services including non-exclusive surveys and data processing services. The intention is to expand the non-exclusive business to generate cash-flow for the company while the vessels are under construction. The exclusive data acquisition service will commence on the delivery of the first two vessels, of which there is no sign of an order yet. The management team is all said to have over 20 years' experience in the sector. Lamb himself was at one time involved in Multiwave Geophysical, an earlier Norwegian investor-backed marine seismic company which also ended up being bought by CGGVeritas.

The Dragon Geophysical start-up moves, whether fruitful or not, merely serve to underline that the business climate is favorable for marine seismic and therefore propitious for investment. One

of the few start-ups which seems to have crossed over to the mainstream, the Dubai-based company Polarcus, may soon start making noises about building more vessels. If the company can afford it, this seems to make sense. Its original game plan was to go big from the start and launch, as quickly as possible, a fleet of eight vessels, so that it would have the capacity to compete across the globe.

The Polarcus fleet is actually down to six available vessels under its management. The two smallest newbuilds in the fleet, which are only capable of towing six to eight streamers, have been off-loaded. In 2011, the Russian company Sovcomflot took the Ulstein SX133 X-Bow design *Polarcus Selma* on a five-year bareboat charter, renaming the vessel *Vyacheslav Tikhonov* after a well-known Russian actor. More notoriously, Vladimir Putin, at the time Prime Minister of the Russian Federation, accepted the role of guardian of the vessel at a naming ceremony in the Russian Black Sea city of Sochi.

Late last month, Polarcus was in the final throes of negotiating with the Turkish Petroleum Corporation (TPAO) for the sale and reflagging of the *Polarcus Samur*, augmented with the provision by Polarcus of seismic data acquisition, management and crewing services for the vessel. TPAO plans to use the 3D vessel to conduct extensive seismic exploration of the offshore continental shelf off Turkey in both the Black and Mediterranean Seas.



Turkey negotiates to buy the *Polarcus Samur*.

For Polarcus, the two transactions are revenue-earning opportunities to unload the two least-profitable vessels in its fleet, leaving it with a set of larger, more productive vessels to meet the demand for 3D seismic surveys many of which are quite substantial in size these days. Additions to the family may therefore be in the cards in the not-too-distant future, financing probably being the main hurdle. Any new vessels would probably be based on the distinctive Ulstein design which is also a feature of some CGGVeritas and WesternGeco vessels. The forthcoming WesternGeco vessels from a German shipyard, however, will be unusually designed specifically for seismic rather than adapted from a more multi-purpose platform.

Improved imaging

Out in the market for survey vessels, it has been clear for some time that companies must be able to offer some form of broadband seismic capability for improved imaging of complex subsurface geology. The big three – WesternGeco, CGGVeritas and Petroleum Geo-Services (PGS) – have been putting it about for some time that their proprietary marine data acquisition systems for broadband seismic differentiate them from the competitors and can command premium prices. WesternGeco believes that its IsoMetrix system, launched with much fanfare last June, offers a further step-change in 3D seismic acquisition, so better than all the rest. Yet, with all

companies reporting good backlogs, the evidence would suggest that the market is not that differentiated – which is what you would expect. Historically, big technological leads have not lasted very long, and both Polarcus and Dolphin, who make

All forecasts on the future of an industry with such rapidly evolving technology is fraught with peril.

up the numbers in the big five, claim to be at least broadband-capable.

Similarly, in the field of marine controlled-source electromagnetic (CSEM), the technology monopoly established by Electromagnetic Geoservices (EMGS) could, this year, be in jeopardy as a result of some pressure from PGS. This is if the towed streamer EM survey technique pioneered by PGS lives up to its promise. At the end of last year the company was reporting that multi-client and exclusive data surveys acquired in 2012 over seven known fields/prospects with a variety of geological settings were successfully concluded, and that inverted EM data was acquired in November over the Norwegian offshore fields of Bentley, Bressay, and Kraken. PGS has been sufficiently encouraged to be planning a minimum of three months EM acquisition for the North Sea and Barents Sea this year.

The 2012 operations took place

in water depths of 100-350m, surveying target depths at 1300-2200m, with production figures said to be in excess of 110 vessel-km/day. Minimal downtime and acquisition in variable sea-states were other highlights. All these performance statistics are part of PGS' insistence that its towed streamer EM solution amounts to a technology leapfrog over the existing CSEM method used by EMGS, based on placing retrievable recorders on the seabed. If the data quality is as good as PGS claims then the increased rate of productivity alone would be attractive. But of course it is much more than that. PGS can offer a combined seismic and EM towed streamer package with simultaneous acquisition of data. This is definitely one to watch as it could be the start of a significant revenue stream for PGS with no obvious competition in sight.

Technology stargazers will be focusing some attention on the trends in ocean-bottom seismic surveys. In 2012 there was certainly a growing interest in the use of nodes, although not to the exclusion of seabed cable. Responsibility for a lot of ocean-floor seismic technology operations and future R&D, including permanent reservoir monitoring systems, now resides with the new seabed joint venture between Fugro (60%) and CGGVeritas (40%). How this evolves in 2013 may well provide a clue to the bigger question of how CGGVeritas will adapt to life after its US\$1.2 billion acquisition of Fugro's Geoscience division. That is not easy to predict.

Indeed, all forecasts are fraught with peril. For example, should we allow for an overdue Mayan Doomsday, not to mention the Chinese Year of the Snake? Only time will tell. **OE**

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(check one box only)

- ☐ 01 Executive & Senior Mgmt (CEO, CFO, COO, Chairman, President, Owner, VP, Director, Managing Dir., etc)
- ☐ 02 Engineering or Engineering Mgmt.
- ☐ 03 Operations Management
- ☐ 04 Geology, Geophysics, Exploration
- ☐ 05 Operations (All other operations personnel, Dept. Heads, Supv., Coord. and Mgrs.)
- ☐ 99 Other (please specify) _____

2. Which of the following best describes your company's primary business activity?

(check one box only)

- ☐ 21 Integrated Oil/Gas Company
- ☐ 22 Independent Oil & Gas Company
- ☐ 23 National/State Oil Company
- ☐ 24 Drilling, Drilling Contractor
- ☐ 25 EPC (Engineering, Procurement, Construction), Main Contractor
- ☐ 26 Subcontractor
- ☐ 27 Engineering Company
- ☐ 28 Consultant
- ☐ 29 Seismic Company
- ☐ 30 Pipeline/Installation Contractor
- ☐ 31 Ship/Fabrication Yard
- ☐ 32 Marine Support Services
- ☐ 33 Service, Supply, Equipment Manufacturing
- ☐ 34 Finance, Insurance
- ☐ 35 Government, Research, Education, Industry Association
- ☐ 99 Other (please specify) _____

3. Do you recommend or approve the purchase of equipment or services?

(check all that apply)

- ☐ 700 Specify
- ☐ 701 Recommend
- ☐ 702 Approve
- ☐ 703 Purchase

4. Which of the following best describes your personal area of activity?

(check all that apply)

- ☐ 101 Exploration survey
- ☐ 102 Drilling
- ☐ 103 Sub-sea production, construction (including pipelines)
- ☐ 104 Topsides, jacket design, fabrication, hook-up and commissioning
- ☐ 105 Inspection, repair, maintenance
- ☐ 106 Production, process control instrumentation, power generation, etc.
- ☐ 107 Support services, supply boats, transport, support ships, etc
- ☐ 108 Equipment supply
- ☐ 109 Safety prevention and protection
- ☐ 110 Production
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Two Russian icebreakers create a wide path for the LNG carrier, *Ob River*, across the open Northern Sea Route to deliver LNG from Russia to Japan.

Conference delineates steady effort to open the Arctic

The Arctic is the next major region opening for the oil & gas industry. It covers 6% of the Earth's surface and may contain 25% of the world's undiscovered oil and gas. To date, 174 fields have been discovered, holding an estimated 17.2 billion barrels of oil.

While fear mongers condemn the 'race' to grab resources, there is no headlong rush to seize acreage positions. Rather, the industry has been working steadily since the 1980s in multi-company, multi-national consortia to understand the resource potential and environmental sensitivities of the region.

Eight countries hold territorial rights in and around the Arctic Ocean. Activities are governed

by the 1982 United Nations Convention on the Law of the Sea, as there is no land mass within the ocean. This international treaty has been a major driver in the exploration and definition of the continental shelves underlying the frigid waters, encouraging countries to explore the limits of their respective continental margins to define potential extra-territorial claims. Meanwhile, the industry continues to develop procedures, infrastructure, and technologies to preserve life and perform work safely in the ice-bound environment.

The region has been under steady research, exploration and development since Alaska's Prudhoe Bay was opened in the

Delegates at the Arctic Technology Conference, held recently in Houston, examined the potential of the region to the oil & gas industry.

Victor Schmidt and **Nina Rach** listened in.



late 1970s. If anything, Arctic development requires the stamina and perseverance of a marathon by both companies and governments.

Industry experts gathered in Houston in December at the Arctic Technology Conference to review progress and share recent developments. The conference opened with a plenary session that provided an overview of technological advances and perspectives on future activity.

Norway

The Consul General of Norway, Jostein Mykletun, was the opening speaker and his plenary speech focused on the forces driving, and strategy behind, the Norwegian government's High North Policy.

Mykletun said there is no energy 'race' in the Arctic, nor a 'sprint' for the Arctic Ocean. On the contrary, he said, Norway is cooperating with neighboring countries to sustainably develop arctic resources 'based on sound environmental stewardship'. Norway aims to be a responsible actor in the region, which the Consul General characterized as 'High North–Low Tension'.

He discussed the importance of the UN Convention on the Law of the Sea, the Arctic Council, and the interest of non-Arctic countries seeking observer

status in the Arctic Council. The promise of energy reserves and the uncertainty of climate change are driving widespread interest in the Arctic, he said, exemplified by the formulation of arctic or high north policies in many countries.

The invitation extended to the Consul General was appropriate, as Norway plays an important role in arctic development, particularly with regard to natural resources. It is the world's third largest exporter of natural gas and the fifth largest exporter of oil. According to the Royal Norwegian Consulate General, more than 140 Norwegian companies are established in Houston, the largest concentration of Norwegian energy companies abroad.

Various Norwegian companies were represented at the conference, including Statoil (also a sponsor), DNV, Axess, Aker Solutions, Frank Mohn Houston, Kongsberg Oil & Gas Technologies, MARINTEK and TECHN1. Norwegian institutions represented included the University of Stavanger, the Petroleum Safety Authority (Ptil), INTSOK, Innovation Norway, and the Royal Norwegian Consulate in Houston.

Ilulissat Declaration

In May 2008, Canada, Denmark, Norway, Russia and the US

signed the Ilulissat Declaration, following the Arctic Oceans States Conference in Ilulissat, Greenland. The Declaration has four main goals: to safeguard stability and predictability in policy; to create sustainable management of the region; to strengthen international cooperation and legal order controlling its use; and to strengthen value creation and employment to support development.

Key elements to achieving the Ilulissat Declaration's goals involve: planning for continual presence (including new settlement patterns), ongoing industry activity, continued research, and knowledge gathering to expand factual understanding of the region and its challenges.

These challenges include environmental sensitivity, low exploration activity due to limited data, political decisions regarding sea boundaries and territorial jurisdiction, economics of operating in the Arctic conditions, competition for resources, and the harsh environment in which people and equipment must operate.

Barents 2020 Project

In September 2010, Russia and Norway signed a treaty on maritime delimitation and cooperation in the Barents Sea and Arctic Ocean, removing a serious impediment to future development and demonstrating that longstanding differences can be resolved. The treaty was ratified by a Russian State Duma vote in March 2011.

Barents 2020 (B2020) is a project between Norway and Russia that had four phases, according to Sigurd Robert Jacobsen, principal engineer at Petroleum Safety Authority Norway (PSAN, www.ptil.no). The project recommended uniform safety levels, a predictable HSE framework and improved basis for future cooperation in the Arctic, and identified areas that need updated standards, documented in position papers and reports. In phase four,

the project expanded to include French, American and Dutch specialists. The final Barents 2020 report is 'an assessment of international standards for safe exploration, production, and transportation of oil and gas in the Barents Sea'.

Jacobsen said that the overall aim of these initiatives is to find common standards and define a predictable HSE framework for the Norwegian and Russian continental shelf. PSAN follows up on B2020 recommendations, now constituting 130 different guidelines.

B2020 was directly followed by the Circumpolar Knowledge Sharing project, financially supported by the Norwegian Foreign Ministry. The first seminar for operators and safety regulators took place in Stavanger in May 2012, with seminars planned for Russia and Canada in 2013. Future seminars will be held in the US and Greenland.

Jacobsen also mentioned an industry initiative: the Norwegian Oil & Gas Association northern areas work group is engaged in a project to develop new survival suits for the Arctic.

One overarching principle in Norway is that the operator is always responsible and accountable. Non-operating partners also have a duty 'to see to', he said.

New shipping routes

The ice cap is shrinking, which has opened high-latitude shipping opportunities. Using new routes where ice is thinner can save up to 40% in travel time compared to current routes through the Suez Canal or Panama Canal, and save as much as 20% in fuel, due to the shorter routes along the southern edges of the Arctic Ocean.

The Arctic will be developed because of strong oil demand worldwide, strong gas demand in Asia, and retreating sea ice that is opening the Northern Sea Route to shipping. Last November, this opportunity was demonstrated by



ATC

Above left: Shawn Rice and Joe Gagliardi (center) accepted the award for ION. Presenting the award are OTC Board of Directors Chairman Steve Balint (left), Shell, and OTC Board of Directors member Joe Fowler (right). Above right: Igor Kolesnikov and Svetlana Kamaeva (center) accept the award for Transkor. Presenting the award are OTC Board of Directors Chairman Steve Balint (left), Shell, and OTC Board of Directors member Joe Fowler (right).

Arctic Technology Awards

Two companies received special recognition for their contributions to Arctic exploration: ION Geophysical for its under-ice seismic acquisition system and Transkor Group for its Aqua MTM technology. These companies are the first to receive Spotlight on Arctic Technology awards, bestowed by the Arctic Technology Conference (ATC). A panel of E&P professionals reviewed entries and selected the award recipients based on five criteria: new, innovative, proven, broad interest, and significant impact.

ION's solid streamer design can withstand arctic temperatures and polar magnetics without degradation of equipment or data quality. Its proprietary

towing system deflects the ice from damaging the cables in tow, keeping streamers within the planned fairway. The data gathering operation uses a dual-vessel system: a polar-class icebreaker to clear a path and a seismic vessel pulling the under-ice seismic acquisition system.

Transkor's Aqua MTM (Magnetic Tomography Method) was developed by its R&D Center in Russia in a joint effort with Petronas (Malaysia). It is designed to assess the deformation state of ferromagnetic pipelines offshore. The technology is based on remote detection of a pipeline's background magnetic field using an ROV. It can make measurements from up to 15 pipe diameters away.

ION





the LNG carrier *Ob River*, which shipped an LNG cargo from the Snøhvit terminal in Hammerfest, Norway to the Tobata terminal in Japan. It discharged the cargo in early December. Russian nuclear icebreakers cleared the icy route ahead of the vessel.

Expanding Knowledge

More needs to be done to define the ocean's underlying geologic structures and this work is being carried out as part of the Law of the Sea's requirement for countries' extraterritorial claims beyond the exclusive economic zone (EEZ), which extends up to 200nm from the coast.

Seismic data grids now cover a large part of the Arctic shelf, though the top of the world is hidden by a polar ice cap. Definition of the sediments and country borders under this pack ice await subsea data collection and analysis. Data collection has been performed in multiple campaigns. The first wave of activity was driven by Cold War security concerns and done under military auspices from ice islands and from submarines on classified missions.

A second wave occurred through public access mapping under the Scientific Ice Expedition (SCICEX) surveys of 1995-99. This program was a collaborative effort between the US Navy and academic researchers from many universities, using nuclear-powered submarines for scientific studies. The goal of the program was to

acquire comprehensive data about Arctic sea ice, water properties, and bathymetry, to improve understanding of the Arctic Ocean basin and its role in Earth's climate.

The need of the nations around the Arctic Ocean to define their continental margins to claim territory under the Law of the Sea Convention set off a third wave of activity in 2004. This legally binding process allows nations to extend their margins beyond the standard 200nm EEZ. Much of this data has been collected using submarines.

A fourth wave is now underway, as multi-year sea ice melts and allows access to formerly ice-bound seas. In particular, recent seismic acquisition in the Canadian Basin has included both open water surveys and surveys done with tandem vessels – an icebreaker plus survey vessel.

Personnel Needed

One of the reasons the Arctic is being developed at a glacial pace is the shortage of arctic specialists. According to Prof Anatoly Zolotukhin of the Gubkin Russian State University of Oil & Gas, Russia is currently producing up to ten arctic specialists each year. But the need is much greater, with more than 100 new professionals required each year to work this region.

In addition, there is no significant infrastructure to support arctic operations. Environmental response specialists are needed to quickly address spills because of the

sensitive nature of the high-latitude environment.

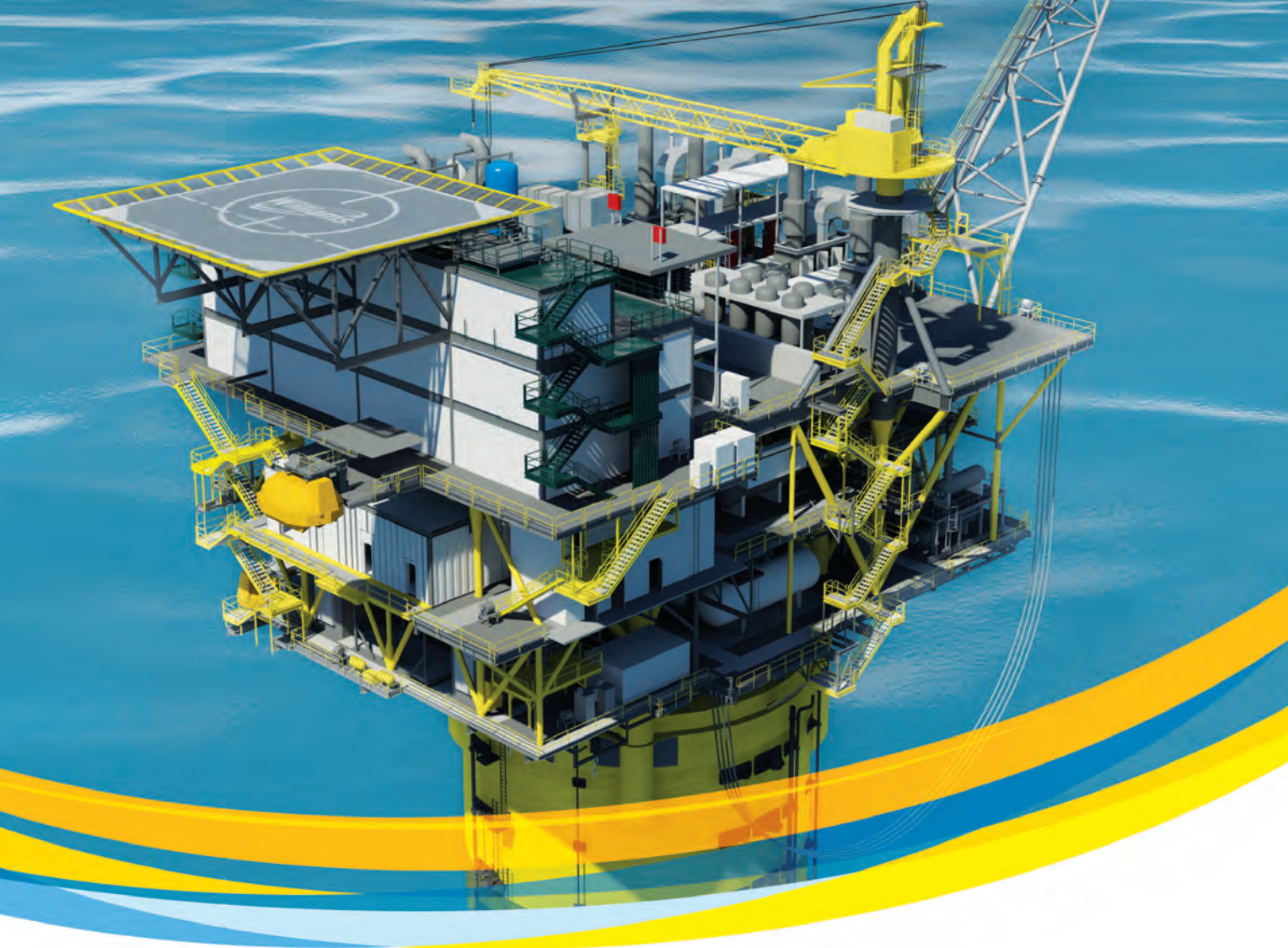
Because weather changes quickly across the region, forecasters and trackers are needed to keep operations personnel informed. FPSOs and other floaters operating in the Arctic will need new capabilities for quick disconnect of flow lines and risers to respond to shifting sea ice and attendant loads.

In addition, community liaisons are needed to work with the indigenous populations, to preserve local rights and lifestyles. At the same time, members of these groups need to have the option of being involved with industry activity, so they can share in the rewards that come from Arctic development. To attract companies and capital, business conditions need to offer more favorable treatment, Zolotukhin says. Additionally, students need to be taught in English to take advantage of the industry's primary language.

John Hogg, VP of exploration & operations at MGM Energy in Calgary, and chairman of the Arctic Technology Conference, said 'Careers in the Arctic are mostly associated with development of resources, from labor to technical to professional,' and jobs are quite varied.

Shell's Activities

As knowledge has advanced, the industry has drilled in the higher latitudes. According to Robert Blaauw, Shell's senior advisor for Global Arctic Theme, about



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Shell's oil spill response crews practice laying out nearly 600m (1500ft) of a floating, curtain-like device designed to contain oil from the *Nanuq* response vessel near Valdez, Alaska, in May 2012.



500 wells have been drilled in the Arctic without incident. The company's goal is to find integrated drilling solutions that allow slimmer wells to be drilled faster, and with fewer people. This will limit the footprint of industry and lighten the logistical load required for Arctic operations.

Shell recently drilled topoles for two wells off the north coast of Alaska that required about 2000 people to provide logistical support for the drilling operations, to constantly monitor and practice spill containment procedures, to watch marine mammals, and to provide for emergency and medical care. This comprehensive effort is required because of the lack of infrastructure to support drilling operations.

Susan Childs, Alaska Venture Support Integrator manager, spoke about the lengthy, drawn-out process that characterizes arctic operations and shared details of the 2012 exploration drilling program. She said Shell's exploration plans began in 2007 and it took five years to begin drilling. Site-specific air quality permits require six years,

and oil spill response plans (OSRP), begun in 2007, continue to be modified. Shell's purpose-built oil spill response vessel *Nanuq* will be on standby at all times in the Chukchi Sea.

Shell now has the most robust arctic oil spill response system in the industry, on standby 24/7, with three areas of spill response: offshore, near shore, and onshore recovery. Post-Macondo, the company also made a voluntary commitment to develop an oil spill capping system, designed to capture hydrocarbons at the source. Shell says the capping stack will remain staged in Alaska to allow for rapid deployment.

The company has acquired LOAs and IHAs from NMFS and NOAA (letters of authorization, incidental harassment authorization; National Marine Fisheries Service; National Oceanic & Atmospheric Administration) and has submitted 10 APDs (application for permit to drill).

Childs said that Shell implemented a real-time ice and weather forecasting system in 2012 to support ice management with

around-the-clock ice forecasting using real-time satellite coverage (available through Shell Ice & Weather Advisory Center). The *Fennica* serves as the primary ice management vessel supporting the *Noble Discoverer* drilling rig in the Chukchi Sea. The *Nordica* serves as the primary ice management vessel supporting the *Kulluk* drilling unit in the Beaufort Sea.

There was tight security at a sold-out luncheon presentation by Pete Slaiby, VP of Shell's Alaska Venture. '[The US] is an arctic nation,' he said, as he discussed the impact of dynamic, multi-year ice on operations, the prospect of automated underwater vehicles, the need for timely permits and high operating standards, and the *Arctic Challenger* spill barge. Any energy company that will shy away from its obligation to safely exploit 'shouldn't be working in the Arctic', said Slaiby. **OE**

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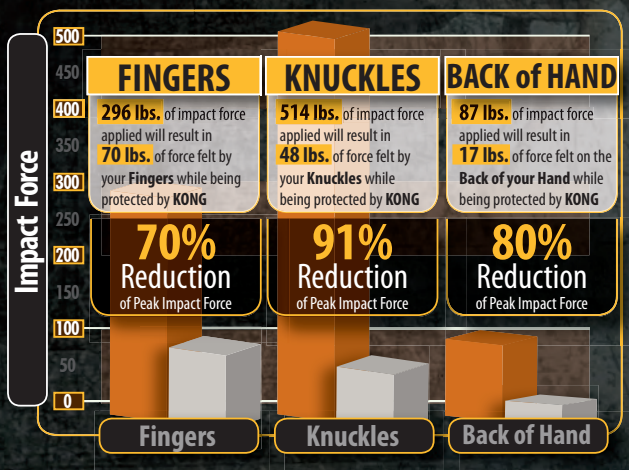


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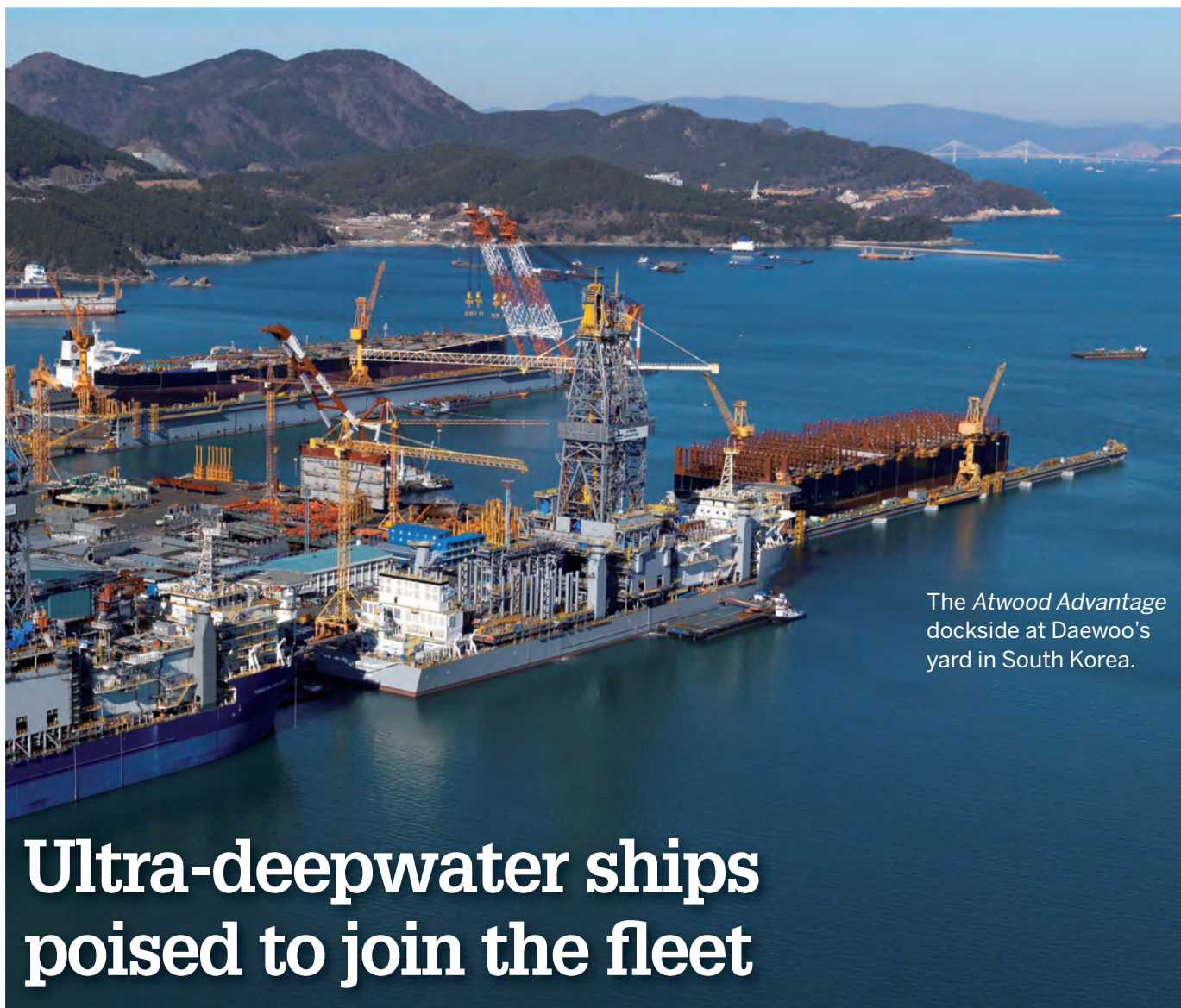


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The *Atwood Advantage* dockside at Daewoo's yard in South Korea.

Ultra-deepwater ships poised to join the fleet

The newest ultra-deepwater drillships joining the fleet this year will be capable of working in 12-14,000ft (3658-4267m) water depths and drilling to 40,000ft. Ultra-deepwater has been defined as water depths of 1500m or greater (deepwater is between 400m and 1500m).

For the five-year period 2011-15, Wood Mackenzie projects that capital expenditure for exploration and production in ultra-deepwater will grow 12% annually. Proven reserves in ultra-deepwater require a drilling fleet capable of operating in these extreme depths, so there is a push to continue newbuild programs.

Two yards in South Korea, Daewoo Shipbuilding & Marine

Engineering (DSME) and Samsung Heavy Industries (SHI), have each received a steady stream of orders. More surprising is the volume of orders going to Sembcorp Marine's new Estaleiro Jurong Aracruz shipyard in Brazil.

Triple order

Houston-based Atwood Oceanics has three ultra-deepwater drillships under construction in South Korea, to be delivered 2013, 2014 and 2015. Atwood's wholly owned subsidiary, Alpha Eagle, entered into turnkey construction contracts with Daewoo Shipbuilding in 2011/12.

The three ships will be dynamically-positioned (DP3), with dual derricks, capable of operating

Two yards in South Korea have received a steady stream of orders. More surprising is the volume of orders going to a shipyard in Brazil. **Nina Rach** explains the details.



Two derrick barges move the *Atwood Advantage*'s drilling derrick into place.

in water depths to 12,000ft and drilling to 40,000ft. They will be classed by DNV and registered in the Marshall Islands.

The first construction contract, for the *Atwood Advantage* drillship, was announced in January 2011, with delivery scheduled for September this year, at a total cost of about \$600 million. The ship will have enhanced technical capabilities: a seven-ram blowout preventer; three, 100 ton-knuckle boom cranes; a 165-ton active-heave 'tree-running' knuckle boom crane; and 200 person accommodation.

In September last year, Atwood announced the first work contract for the *Atwood Advantage*, with Noble Energy. The drillship is scheduled to be delivered from the DSME shipyard in September, after which it will mobilize for about 80 days to its first location in the eastern Mediterranean. The three-year contract with Noble, at

\$584,000/d, is worth \$639 million, and begins after the initial mobilization period.

The second construction contract, for the *Atwood Achiever*, was announced in October 2011, and the drillship is to be delivered June 2014, at a cost of about \$600 million. The *Atwood Achiever* will be similar to the previously announced *Atwood Advantage*.

The third construction contract, for the *Atwood Admiral*, was announced in September last year, and the drillship is to be delivered in March 2015, at a cost of about \$635 million. The vessel will be similar to both the *Advantage* and the *Achiever*, although it will have two, seven-ram BOPs, instead of the single BOP carried on its sister ships.

Rob Saltiel, president and CEO of Atwood Oceanic, comments, 'We are pleased to continue our growth strategy through the

exercising of our option with DSME shipyard, and we look forward to the *Atwood Admiral* joining our high-specification, ultra-deepwater drilling fleet. This rig's state-of-the-art capabilities, and the synergies that result from adding a third drillship based on the same design, make this a solid platform for extending Atwood's market position in ultra-deepwater drilling.'

Atwood has an option to construct a fourth ultra-deepwater drillship at a similar cost to the *Atwood Admiral*, for delivery in December 2015, which requires commitment by 30 June.

Additional four

Ocean Rig UDW has been operating since 2001, and has drilled 135 wells for 25 clients in those 11 years. The company is expanding its fleet with four newbuild ultra-deepwater drillships to be delivered 2013-15, calling

Ultra-deepwater drillships under construction.

Operator/owner	Ship name	Yard	Delivery date	First contract, day rate (US\$)
Atwood Oceanics	<i>Atwood Advantage</i>	Daewoo Shipbuilding & Marine Eng (DSME)	September 2013	Noble Energy Inc., three years, \$584,000/d eastern Mediterranean
Atwood Oceanics	<i>Atwood Achiever</i>	Daewoo	June 2014	–
Atwood Oceanics	<i>Atwood Admiral</i>	Daewoo	March 2015	–
Ocean Rig ASA	<i>Ocean Rig Mylos</i>	Samsung Heavy Industries	July 2013	Repsol Sinopec Brasil SA, three years, \$608,000/d
Ocean Rig	<i>Ocean Rig Skyros</i>	Samsung	October 2013	–
Ocean Rig	<i>Ocean Rig Athena</i>	Samsung	November 2013	'major oil company', Angola, LOI signed
Ocean Rig	<i>Ocean Rig TBN8</i>	Samsung	January 2015	–
Seadrill Ltd	<i>West Auriga</i>	Samsung	March 2013	Unnamed, through September 2020
Seadrill	<i>West Vela</i>	Samsung	June 2013	Unnamed, through December 2020
Seadrill	<i>West Jupiter</i>	Samsung	2014	–
Seadrill	<i>West Neptune</i>	Samsung	2014	–
Seadrill	<i>West Saturn</i>	Samsung	2014	–
Seadrill	<i>West Tellus</i>	Samsung	2013	–
Seadrill/ Sete Brasil SA	<i>Camburi</i>	Sembcorp Marine, Estaleiro Jurong Aracruz	2Q 2015	Petrobras, 15 years, Santos Basin, Brazil
Seadrill/ Sete Brasil	<i>Itaunas</i>	Sembcorp	2017	Petrobras, 15 years
Seadrill/ Sete Brasil	<i>Sahy</i>	Sembcorp	2019	Petrobras, 15 years
Odfjell SE	<i>Guarapari</i>	Sembcorp	2015	Petrobras, 15 years
Odfjell	<i>Itaoca</i>	Sembcorp	2018	Petrobras, 15 years
Odfjell	<i>Siri</i>	Sembcorp	2018	Petrobras, 15 years

them 'seventh-generation'. These will join the existing fleet of six vessels: two semisubmersibles and four ultra-deepwater drillships. All four of the new drillships are being built at SHI's yard in South Korea. Ocean Rig estimates 60 days for mobilization from Korea to drilling locations and acceptance testing.

All the drillships are sister ships, with common equipment, spare parts, and training standards, designed to operate in water depths of 10,000-12,000ft. They will be capable of drilling to 40,000ft, with dual derricks, and will be equipped with six- and seven-ram BOPs.

The first newbuild, *Ocean Rig Mylos*, will cost \$670 million and is due to be delivered in July. Ocean Rig's first contract for the drillship is with Repsol Sinopec Brasil for three years at \$608,000/day, with two additional, one-year options (through 2018). Ocean Rig estimates 92 drilling days for this rig in 2013.

The next newbuild, *Ocean Rig Skyros*, will cost \$669 million and is due to be completed in 4Q 2013, with no work contract yet.

The third newbuild, *Ocean Rig Athena*, will cost \$679 million. The drillship is also scheduled to be delivered late this year, and Ocean Rig has signed a letter of intent for an initial three-year contract and two additional, one-year options (through 2018) with a major US oil company for work in Angola.

In October last year, Ocean Rig announced a new contract to construct a fourth seventh-generation ultra-deepwater drillship at SHI, for \$683 million. This is a sister ship to the three currently under construction, and is scheduled to be delivered in January 2015.

The four newbuilds are being built for an average cost of \$675.25 million each – nearly \$100 million less than the previous four

drillships (sixth generation) delivered to Ocean Rig in 2011, which cost an average of \$772 million each: *OCR Mykonos* (\$784 million); *OCR Poseidon* (\$792 million); *OCR Olympia* (\$757 million); and *OCR Corcovado* (\$755 million). With these reduced construction costs and what seem to be solid day rates, it appears to be a good time to build.

Fleet expansion

Seadrill, established in 2005, manages a fleet of semisubmersibles, jackups and three ultra-deepwater drillships, with two ultra-deepwater newbuilds to be delivered the first half of this year from Samsung's yard, and seven more under construction (four at Samsung and three in Brazil).

Ben Bollinger, director of marketing for Seadrill Americas,



Seadrill's ultra-deepwater *West Auriga* and *West Vela* are sister ships under construction at Samsung Heavy Industries' yard in South Korea.

spoke at INTSOK's most recent US-Norway Technology Partnership Conference in Houston, where one of the themes was 'Stretching the Limits of Proven Technologies'. He said that the challenges post-Macondo include incorporating redundant systems, providing greater load capacities and meeting new requirements for BOPs and ROVs. The company is focusing on eliminating single-point failures in every critical path.

The three most recent newbuilds to join Seadrill's fleet, *West Capella*, *West Gemini* and *West Polaris*, were also built at Samsung and delivered in 2008-2010. The *West Capella*, owned by Mosveld Drilling, is Samsung Saipem 10000 design, capable of working in water depths to 10,000ft and drilling to 37,500ft.



Seven ultra-deepwater drillships are under contract to be built at the Estaleiro Jurong Aracruz shipyard in Brazil.

The *West Gemini* and *West Polaris*, owned by Seadrill, are Samsung SHI S10000 design, capable of working in water to 10,000ft and drilling to 35,000ft.

In November 2010, the company announced that it had placed orders for the two new drillships, with Samsung, in a turnkey contract valued at \$1.08 billion. Seadrill said the total project price per rig would be less than \$600 million, which includes project management, drilling and handling tools, spares, capitalized interest, and operations preparations.

According to Seadrill's *Fleet Status Report*, the *West Auriga* will be delivered in March and in transit through June this year. Sister ship *West Vela*, will be delivered in June and in transit through September. Both ships are apparently destined for as-yet-unannounced, long-term contracts, with the next availability for the *West Auriga* listed as beginning October 2020, and *West Vela* in January 2021.

The *West Auriga* and *West Vela* will be capable of drilling in water to 12,000ft and to a total depth of 40,000ft. Both feature dual derricks and hook load capacity of 1250 tons. They will be the first ships out of the Samsung yard equipped with seven-ram BOP stacks.

Seadrill has four other drillships

at the Samsung yard, all Samsung SHI S10000 design, capable of drilling in 12,000ft water depth: *West Jupiter*, *West Neptune*, *West Saturn* and *West Tellus*.

Seadrill will also manage the three ultra-deepwater drillships under construction at Sembcorp Marine's Estaleiro Jurong Aracruz shipyard in the Brazilian state of Espirito Santo. These are Jurong Shipyard's proprietary Jurong Espadon design, capable of working in 10,000ft water depth and drilling to 40,000ft. They will each feature a 40m-wide main deck, DP3, and offer accommodation facilities for a 180-man crew.

Guarapari Drilling, Netherlands, a subsidiary of Sete Brasil Participações SA, signed the first construction contract, worth US\$792.5 million, with Sembcorp Marine in February 2012, and subsequent contracts in August and in November for \$806.4 million each.

Sete Brasil now has a total of seven drillships on order.

Jason Saw Koon Khim, offshore & marine analyst at DMG & Partners Securities in Singapore, said the first contract price was about 30% higher than drillship prices from shipyards in South Korea, which 'provides sufficient buffer to cater for the additional risk of building a drillship in Brazil'.

All the Brazilian-built drillships will initially work for Petrobras in the Santos Basin, under 15-year contracts.

In the future, Bollinger expects to see more clarity in regulations, more focus on competency assurance and industry standardization, increased drilling equipment capacity, and the phase-out of older drilling platforms from the deep and ultra-deepwater markets. **OE**

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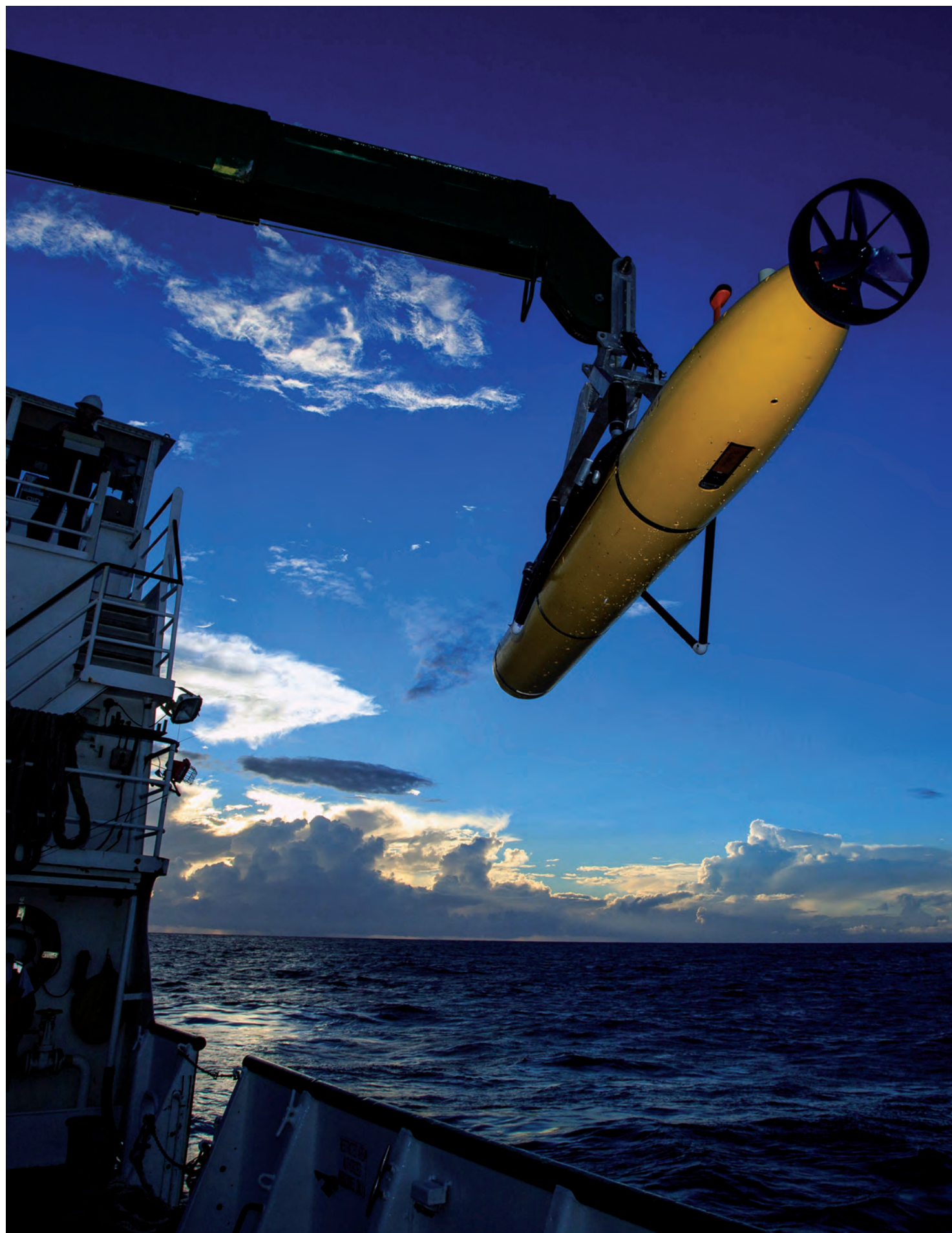
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Surveying the field in the search for full autonomy

The lack of breakthroughs in wireless underwater communication and battery capacity is prolonging the wait for a fully autonomous underwater vehicle (AUV), one that will not need a \$100,000/day vessel and crew, a heavy tether for power and control or hours to complete a task that might take minutes onshore.

But some relief is coming from workarounds to overcome AUV limitations and incremental improvements in 30-year-old ROV technology.

Hybrid vehicles are in the works that piggyback AUV capability onto proven ROV technology. Subsea docking stations, hard-wired to the surface, are being developed to allow AUVs to recharge and deliver data without resurfacing, reducing launch and recovery time. Software and sensor improvements could boost the speed and precision of work done by existing ROVs while keeping a human operator in the control loop.

Lockheed Martin exhibited its programmable AUV, Marlin, which can fly free while staying on what amounts to a software leash. Last summer, the 10ft-long, tear-drop shaped, 2098lb submarine followed pre-set paths to survey 11 platforms and three other sites in the Gulf of Mexico for Chevron (*see panel overleaf*). The data gathered was turned into 3D models that the supermajor can use in planning. 'It was the first commercial,

autonomous inspection of subsea infrastructure for an oil and gas major, bringing AUV inspections into a new reality,' says Lou Dennis, Lockheed Martin business development manager.

Dan McLeod, Lockheed Martin's Marlin program manager, says the Marlin system represents an advance in autonomous technology, though it still must surface to download its high-res data, recharge and receive new instructions.

'It actually interacts with sensor data as it's performing its mission,' McLeod says. 'What that allows is adaptive path planning, so it's optimized to travel around the path that provides the best sensor coverage for the particular mission.'

Autonomous inspection

Massachusetts-based Bluefin Robotics, a Battelle subsidiary, has specialized in defense, environmental sensing, salvage and national security uses of underwater vehicle technology. Now it is offering the technology to the offshore oil industry.

Bluefin subs already autonomously inspect the undersides of ships calling at ports and search for mines in warzone shipping lanes. The capabilities involved are not so different from surveying the legs of an offshore platform or inspecting pipelines.

Bluefin, in September 2011, demonstrated a workaround for limits on submarine battery

The trend toward deeper, more remote offshore oilfields is driving step-by-step automation of subsea operations while the oil industry awaits its science-fiction dream machine – an unmanned, untethered robot that can tend seafloor wellheads and install equipment without human intervention. Creative approaches were on display at the Subsea Survey IRM 2012 conference in Galveston, Texas, in November, and **Bruce Nichols** was there for *OE*.

capacity. It placed a shore-wired docking station on the bottom of Broad Sound in Boston Harbor and used it to recharge and collect data from a battery-powered Bluefin-12 sub after an eight-hour survey mission.

‘We know that AUVs can do certain jobs today. We believe AUVs can do more in the future. The challenge is how do we get there,’ says Omer Poroy, VP of business development for Bluefin, which has delivered more than 80 vehicles.

SAAB’s Seaeye unit is working with Aker Solutions on a seafloor docking station, where an AUV could park and recharge its batteries by induction, as does a battery-powered toothbrush. It will communicate by close-proximity wireless link, possibly optical or radio, while berthed, says Chris Roper, North American sales manager for SAAB Seaeeye.

Underwater communication

Woods Hole Oceanographic Institution is working to advance wireless underwater communication, exploring acoustic and optical technologies and is ‘looking for partners who can help bring the technology into use,’ says Andy Bowen, director of the institution’s national deep submergence facility.

Others are working on advanced radio communication. The challenge for all the modes is simple physics: acoustic, optical and radio waves do not yet travel far enough with wide-enough bandwidth underwater to meet offshore oil industry needs.

SAAB’s Sabertooth system is designed to stay submerged for up to a year and be capable of operation in three modes: autonomous, operator-assisted and manual, a flexibility that might ease the transition to AUV technology. The docking station would stay in place for five years, Roper says.

‘Leaving it down there all the time is not a bad idea,’ says Robert Geoghegan, undersea systems

manager for Battelle. ‘AUVs are often deployed [and retrieved] daily. If that could become weekly or monthly, there’s a lot less launch and recovery involved.’

Total has been working for six years to develop its Swimmer (Subsea Works Inspection and Maintenance with Minimum Environment ROV) system, an AUV piggybacking its own tethered ROV and operating from more than one docking station, with stations miles apart.

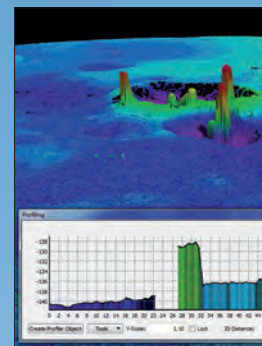
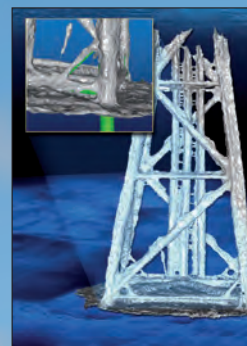
It could stay submerged for three months, roaming from station to station subsea, operating in docked mode or as a free-flyer, sending its tethered ROV out as much as 200m to perform inspections and light tasks such as turning valves.

Herve de Narois, deep offshore manager at Total E&P Research & Technology USA, says he hopes for initial deployment of Swimmer off Angola next year with full commercialization of the system by 2018. ‘Costs are higher and higher for deeper environments, and we have more mature fields, which means you have to have more frequent intervention,’ Narois says.

Hard-wired electric power and fiber optic links are already being installed to serve the Lower Tertiary plays in the Gulf of Mexico. These networks could clear the way to add subsea AUV docking stations to deepwater installations, says Carl Barrett, project manager for 3U Technologies.

‘I don’t think it’s that much of a stretch’ to envision adding subsea communications interfaces to link AUVs to remote operators, he says. Plug-in power stations are also a possibility to provide long duration high-power AUV operations onsite. They are simply ‘add-ons’ to the power and communications networks that are being installed anyway, Barrett says.

Statoil’s drive to develop AUVs stalled with the shelving of the Shtokman project in the Barents Sea, but the company is taking other steps to improve output > *overleaf*



Pre-programmed mission for decommissioning survey

Chevron needed to survey

14 sites in the Gulf of Mexico, most of which were slated for decommissioning, so it hired Lockheed Martin to deploy its new Marlin AUV to assist. Chevron subsea survey engineer Olugbena Esan and Lou Dennis, Lockheed Martin business development manager, talked about the project at the Subsea Survey IRM 2012 conference.

During two weeks last July and August, Marlin surveyed 11 platforms and surrounding seafloor to a radius of



400ft. It also surveyed three partially decommissioned or operational sites, producing 3D geo-referenced models.

The first survey for Chevron was conducted 22 July and the last on 7 August. Marlin and its docking cradle and launch-and-recovery crane were loaded onto 150ft-long utility boat *Lauren LaCoste* in Port Fourchon, Louisiana, and hauled to the sites.

The crane lowered Marlin below the surface of the water for launch. Controllers on the vessel used acoustic communications to start Marlin on its pre-programmed mission. The link

enabled real-time monitoring and a stop command if needed.

Marlin followed a predetermined survey route and used a sensor array to gather point-cloud data as it circled the targeted platforms, spiraling deeper and deeper for complete coverage. It ran 62 hours, and traveled 76 miles in waters 26ft to 125ft deep.

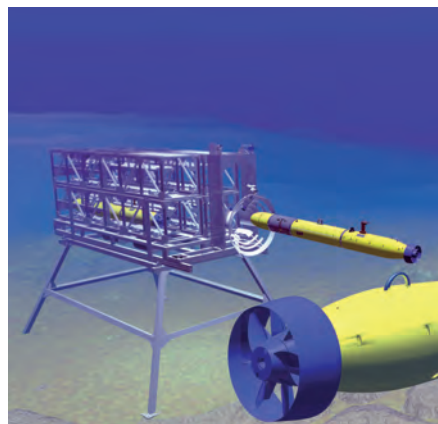
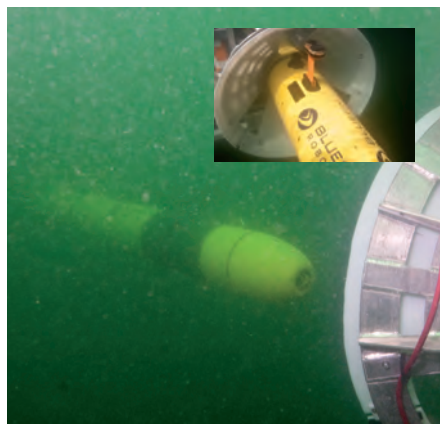
Marlin is rated to operate in waters as deep as 1000ft.

At the end of each survey, the AUV returned to a rendezvous point. There it used a nose-mounted, V-shaped tool to capture the recovery cable autonomously

while underwater. The crane then lifted the vessel and placed it in the Marlin cradle system on the utility vessel's deck.

In the cradle, a hard-wired connection downloaded data Marlin had gathered. Within 24 hours, Marlin software created rough, 3D pictures of what Marlin had seen. On two occasions, Chevron used the early pictures for revisits.

The data also was transmitted ashore, where teams created high-resolution, geo-referenced 3D images that were delivered to Chevron five days later. All final reports were submitted within two weeks.



The Bluefin-12 entering the unmanned underwater vehicle subsea docking and recharging station (*left*) which can accommodate up to four AUVs for wireless power and bi-directional data transfer (*right*).

and reduce the cost of inspection, maintenance and repair, says Kaj-Ove Skartun, section manager for Statoil Subsea IMR. The company is trying to build what amounts to a 'subsea factory'. That means installing equipment designed for less frequent, more standardized servicing, Skartun says.

Standardized projects

The company has 10 standardized projects underway and 20 more planned as part of the effort to boost average field recovery from 55% to 60% by 2020. Better subsea equipment, more modular parts and tighter planning already have helped Statoil in the past year accomplish twice as many missions as in 2006, with fewer vessels, Skartun says.

A key driver of Statoil's search for assembly-line efficiency on the surface and on the seabed is the increasing need for high-powered pressure-pumping to support production from mature fields and more difficult strata, he says. That requires greater durability and maintenance capability.

'It's changing the game as we know it,' Skartun says.

There is still plenty of room for improvement in ROVs without moving to AUVs, and more capable software is as good an answer as fancier hardware, believes Peter MacInnes, VP of sales & marketing

for Schilling Robotics, a unit of FMC Technologies. With a steadily shrinking supply of qualified operators, automating basic functions such as stability control can make it easier to get trainees up to speed and can eliminate the need for a backup operator, he says. Software strain monitoring also can prevent hardware failure due to operator error, he adds.

Automating light interventions such as turning a valve or carrying out a hot stab – plugging a pressurized hose into a subsea facility – can improve the speed and precision of repeatable operations by eliminating the imperfect human hand on a joystick, MacInnes says.

All the operator has to do is guide the ROV into place and push a button, he says. Side-by-side videos illustrated his point, showing a real hands-on operator in an oilfield requiring several shaky attempts to complete the same operation that an automated ROV in a test tank finished in one try.

Also on the tethered operations front, SAAB and others envision disposable, thinner, lighter-weight tethers as long as 10km, which would be capable of low-power data transmission. That would allow ROV operations miles from a hub, in ultra-deepwater or under Arctic ice.

'It has a lot of advantages in hostile areas,' Roper says.

Aside from technology development, there's another hurdle

for the advanced AUVs of the future. Because offshore operations are expensive and risky, oil companies and their regulatory agencies require confidence that an AUV will do what it is supposed to do, where it is supposed to do it, in absolute safety.

Operator demand

To smooth the way, DeepStar, a consortium of industry players including major oil companies and service operators, is studying opportunities to standardize equipment and address regulations to accommodate AUV operation, says DeepStar director Greg Kusinski. A lot depends on operator demand for new technology, which interface standardization and regulatory acceptance could facilitate, he says.

'At the end of the day, it will be up to the operators to deploy them.'

Operator demand has been slow to emerge as steadily improving ROVs keep meeting offshore needs. One indicator: subsea robotics company Oceaneering, which has more than 280 work-class ROVs in service, has been involved in AUV development but has not brought it to the oil industry yet.

'There's a lot of money at stake so decisions tend to err on the side of caution when it comes to adopting new methodologies,' Poroy says.

But as subsea oilfield development grows in complexity, AUVs are likely to develop faster than the 30 years it has taken ROVs to become everyday tools. The right circumstance – perhaps a big, difficult project like Shtokman – could present a business case for AUV use, Statoil's Skartun suggests.

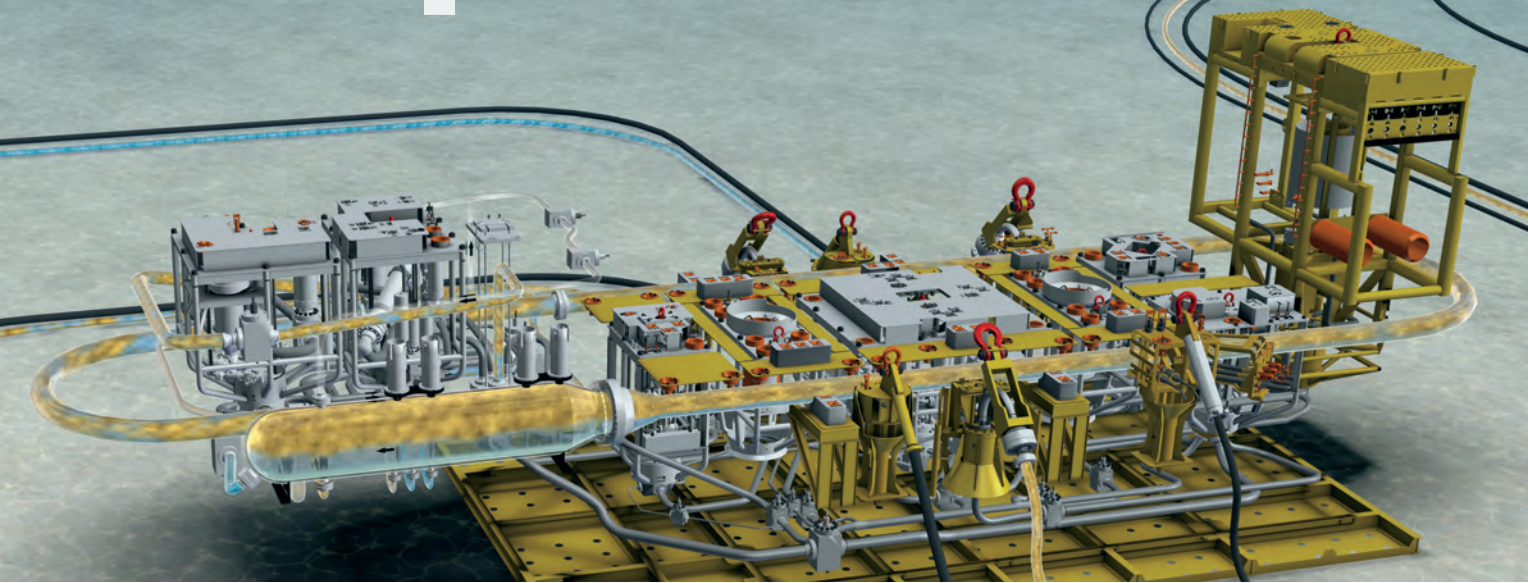
'Once you have a business case, you can start funding it, developing it,' says Jim Jamieson, remote systems manager for engineering, construction and ROV-equipped services contractor Subsea 7. **OE**

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sbasler@atcomedia.com

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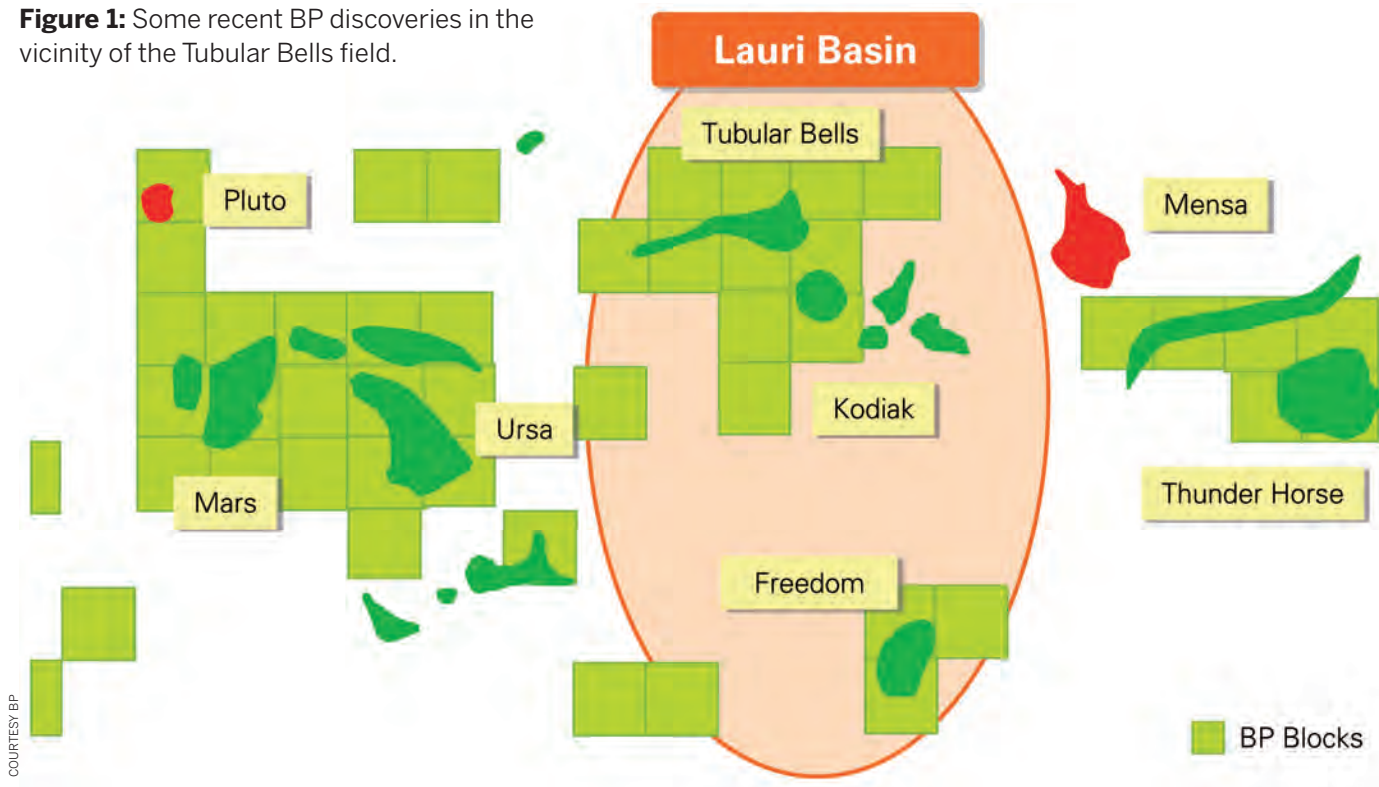
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Figure 1: Some recent BP discoveries in the vicinity of the Tubular Bells field.



Standardized approach creates future infrastructure benefits

Discovered in 2003 on Mississippi Canyon block 725 using Transocean's *Deepwater Horizon* semisubmersible, the Tubular Bells prospect is under development by Hess Corp. Tubular Bells lies mostly on MC726 in the US Gulf of Mexico, about 135 miles southeast of New Orleans in 4300-4600ft of water. Government permits have been finalized for the \$2-3 billion project, all the major contracts have been signed and drilling is underway.

Williams Partners is building a classic, standardized floating production spar called Gulfstar, plus associated gathering and export lines for Hess and its partner Chevron.

The development plan is for two subsea drill centers to tie back to the spar. Nine wells were batch-set in 2012. Hess has contracted the *Stena Forth* drillship to complete the drilling activities. Hess is the operator of Tubular Bells with a

57.14% interest; the remainder is held by Chevron USA.

About the field

The Tubular Bells prospect was discovered in late 2003. The field is in the Lauri sub-basin and is a deep Miocene discovery in an area with many recent discoveries and undrilled prospects (Figure 1). The discovery well – operated by BP, the original major partner before selling its interest to Hess and Chevron in late 2010 – was drilled to a +30,000ft TD and discovered hydrocarbon pay. An appraisal well was drilled in 2006 and found hydrocarbons five miles from the discovery well.

BP drilled two more appraisals (sidetracks) in 2006/07. The results showed an elliptical shaped field that spanned portions of six blocks. The Gulfstar facility has a design capacity for 60,000b/d oil and 135mmcf/d gas production, with

The Gulfstar FPS, a three-deck, wet-tree spar, is a standardized design with oil and gas gathering, production handling, gas processing, and an export pipeline. The design is expected to be used on other projects bringing about considerable economic benefits. **Perry Fischer** reports.

recoverable oil and gas reserves at Tubular Bells estimated at more than 120mmboe.

The geological and geographical setting of the field is such that infrastructure developed for Tubular Bells will be used to develop other nearby discoveries. Only 17 miles of export pipeline from Tubular Bells are required to tie into William's Canyon Chief gas pipeline and the Mountaineer pipeline.

Putting it all together

First and foremost in the project is the central processing facility, which will be installed in MC724. Williams Partners will design and construct the central facility, called Gulfstar FPS – a classic, three-deck, wet-tree spar design (*Figure 2*) – including oil and gas gathering, production handling, gas processing services and the export pipelines. Williams Partners is a diversified MLP (master limited partnership) in the business of processing natural gas and liquids, and transporting



Figure 2. Installing Gulfstar FPS triple-deck topsides onto spar.

oil, gas and NGLs. It currently transports about 14% of US natural gas. It will own the topsides/spar facility while Hess will operate it.

Williams' Stafford Menard, manager for Gulfstar, says the FPS is a 'first' in many respects. Although there has been a cell spar built, it's the first spar, classic or truss, to be

built in the US. Williams expects to deliver the facility by mid-2014.

Helping to achieve the fast delivery, Williams will be building all of Gulfstar's major components on the US Gulf Coast, with more than 90% of the materials and sub-components sourced in the US, and coming from about 20

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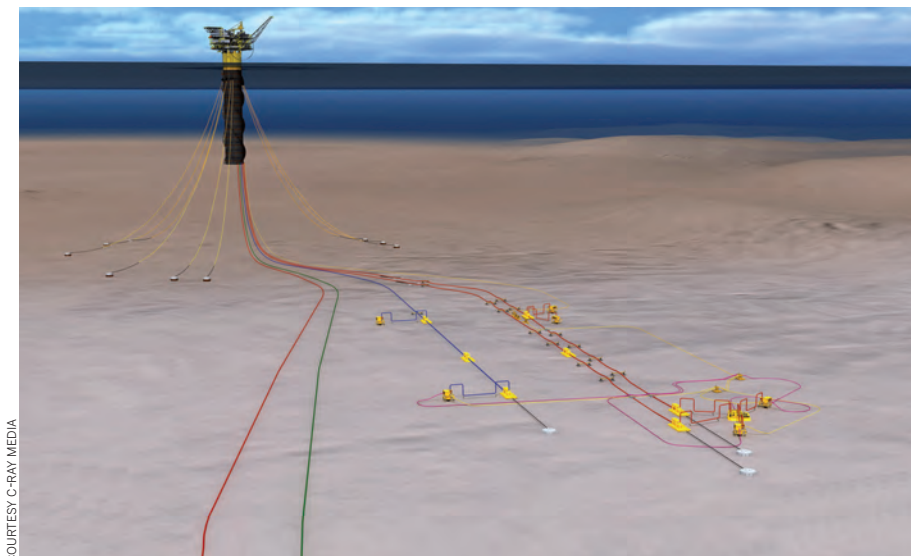
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Figure 3. Subsea layout of Tubular Bells project.

American states. This will create about 1000 jobs. The major components, the hull and topsides, are being built at Aransas Pass, Texas, and Houma, Louisiana, respectively.

Williams expects Gulfstar's standardized design to be used economically on other projects

with design requirements similar to Tubular Bells, including 3000-8500ft water depths and compliance with new maximum storm specifications.

Given the water depths, the long offsets to the hub and substantial length of the flowlines (*Figure 3*), flow assurance will be a significant

design consideration. Gulfstar will have a variety of flow assurance chemicals employed, including onboard storage for over 1100bbl of methanol, and other flow-assurance chemicals such as asphaltene and paraffin inhibitors. There is also storage for more than 10,000bbl of high quality, treated 'dead oil' onboard the spar that can be used to fill and preserve flowline functionality in the event a shut-in is required.

The spar-based FPS will have 60,000b/d of oil handling capacity and 135mmcf/d of gas capacity (with the potential to expand to 200mmcf/d), and provide seawater injection services.

Wood Group's Alliance Engineering was awarded an engineering and design contract for the topside decks and facilities. The three-deck topsides include processing and seawater-injection equipment, utilities, personnel accommodations, pumping and gas compression for export,



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and a helideck. The topsides will weigh about 7000 tons when completed.

A McDermott International subsidiary was selected by Williams for the transportation and installation of the spar hull and its moorings. McDermott's *DB50* vessel will install the moorings before installing the spar and a temporary work deck.

Hess contracted Technip to design, engineer, fabricate and install more than 28 miles of subsea flowlines, pipeline terminations, steel catenary risers, and piles and associated structures. Technip's deepwater pipelay vessel *Deep Blue* is due to complete the work this year.

Animation modeling

It's been recognized that models remove any misconceptions between partners and stakeholders, and are useful to visualize surface and subsurface layouts. Williams used C-Ray Media to model and animate its Gulfstar project. The video, which is posted on Williams.com, highlights Gulfstar's quick construction and other features.

After seeing the Gulfstar video, the project team at Hess commissioned a similar model as a visual tool for internal project management reviews and partner meetings. Hess worked with Williams to combine the offshore campaign and subsea field layout with the existing Williams animation to create a complete project scope. A brief portion of the Hess subsea field animation is captured in the Williams video.

'Collaborating with Hess seemed like a natural fit, since they are one of our biggest customers,' says Stafford Menard, manager of Gulfstar development for Williams. 'The result was a great piece of animation that tells the Gulfstar story visually.' He adds: 'We use it for different reasons, but it's been especially helpful when we do trade shows and for the investment community. We often run into people who have a limited

background in offshore technology, and the animation shows what we're building, how all the parts fit. It puts it into scale and shows why the investment is what it is.'

'Such highly technical, complex animation projects often require more time and research than expected,' says Jason C Olson, senior project engineer for Hess. 'Collaborating helped both companies save valuable time while producing a better end result. I highly recommend that companies consider partnering with their affiliates when working on a large field model . . . start early and take the time to understand your partner's goals and objectives so that you can split and concentrate your efforts.'

Last words

Tubular Bells and Gulfstar FPS illustrate the need for mid-sized field development and standardized design. Similar to the larger Independence Hub project that came before, the general expansion of infrastructure is to develop even smaller fields in the future.

This development is another example of the 'hub and spoke' concept. Williams' Menard puts it this way: 'Infrastructure development is a major part of our philosophy. You put the processing hub in with the same idea as the pipeline. While we needed a commitment from Hess to proceed, the idea is that both the pipeline and the hub will eventually bring other subsea tiebacks onboard.'

'Also, the Gulfstar concept gives us an opportunity to lower engineering costs for other similarly sized discoveries in the Gulf, given that we already will have much of the work flows established.'

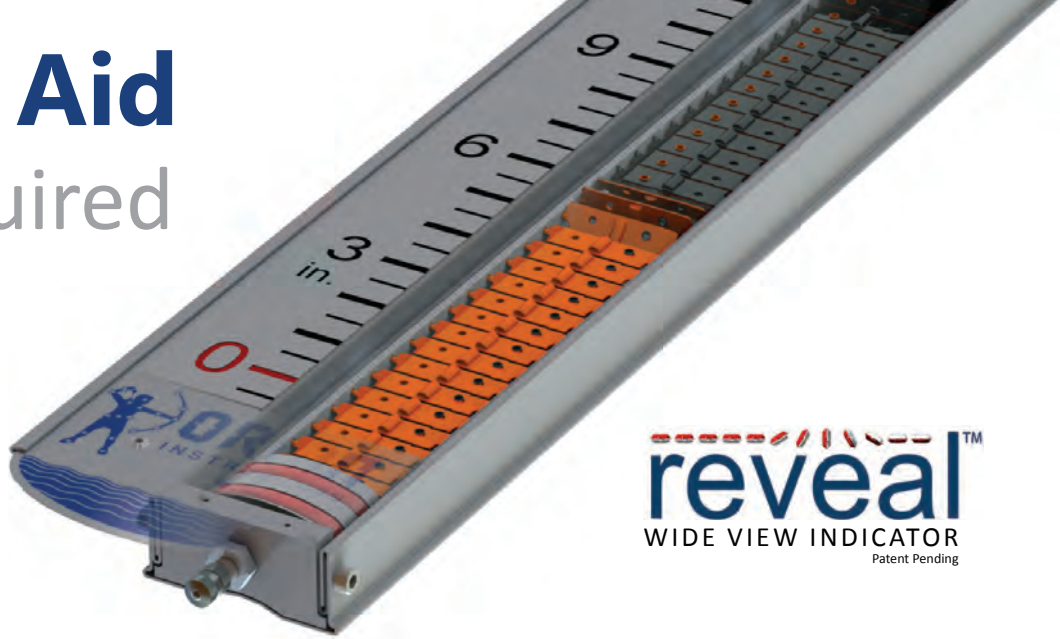
Simply put, its contribution today is important, but its future role could be essential. **OE**

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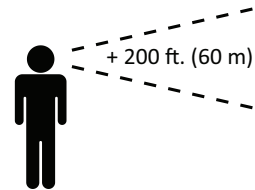
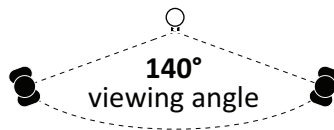
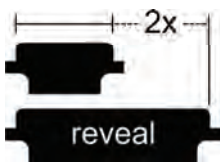
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Knuckle boom subsea crane premier

Liebherr will debut a new subsea crane with knuckle boom, RL-K 7500, at its plant in Rostock, Germany, this month. The crane has both active-heave compensation

and a vertical winch, frame-lifting system. The RL-K 7500 has a lift capacity of 260t and can work in water depths to 3400m. www.liebherr.com



Improving inline inspection

TD Williamson has released Interactive Report 2013, a new proprietary inline pipeline inspection reporting software. The Windows-based data visualization tool provides a variety of customized views, including charts, graphs, and 3D layout, to help locate potential trouble spots.

www.tdwilliamson.com

Water jet propulsion

US-based NAMJet recently provided a propulsion solution for Norwegian shipbuilder Westplast AS's new

seismic survey vessel *WP950*. The vessel is powered by twin 15in TraktorJet TJ 381 water jets, which can propel the vessel to 28 knots



and provide 6393lb of bollard pull. The *WP950*, designed as a global support platform, will also perform streamer cable replacements. To boost performance, the TJ 381 water jets underwent custom modifications, reducing its size by six inches. NAMJet also provided a grease-lubricated bearing pack that will allow the *WP950* to run even when it is out of the water. The vessel underwent successful sea trials last October. Orders for nine similarly vessels are expected to be completed 2013/14.

www.namjet.com



Automated moorings

Cavotec deployed its MoorMaster technology for Dutch private ferry company TESO. The vacuum-based automated mooring technology eliminates the need for conventional mooring lines. Remote-controlled vacuum pads can be mounted to the quayside or on pontoons for easy mooring and release. The technology is currently in use by bulk carriers, container ships, and passenger ferries. Cavotec is interested in bringing the technology to the offshore oil & gas industry.

www.cavotec.com

ROV debuts at OSEA

Singapore's Kreuz Subsea took possession of a new Saab Seaeye Panther XT Plus ROV displayed at OSEA 2012. Saab Seaeye boosted the ROV's power management, offering 50% more power and reduced its size, requiring less deck space. Its 10 thrusters allow operation in currents greater than four knots. The first deployment will be offshore Myanmar.

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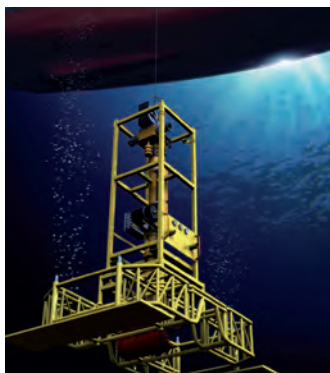


Activity



InterMoor opened a new mooring equipment yard at Loyang offshore supply base in Singapore. The facility provides storage and support for maintenance, preparation and mobilization.

Risk experts and ship classification societies **DNV** and **GL** will unite under the banner DNV GL Group. The new company, to be headquartered in



Pipeline equipment and services provider **TD Williamson** opened its first office in Seoul, South Korea. The new office will enable the company to provide EPC customers with pipeline intervention and isolation technologies.

Norway, aims to increase service offerings and global competence base.

Dredging company **Boskalis** launched a takeover of Dutch marine contractors **Dockwise**, acquiring a 33% stake in the company. The acquisition is backed by Dockwise shareholder HAL Investments, which holds 32% outstanding shares. Dockwise has not yet accepted Boskalis' buyout offer of €18.50/share (approximate total US\$967 million).

Kongsberg has acquired Norwegian subsea engineering firm **Apply Nemo** in an effort to boost its presence in the North Sea and Australian subsea market. Kongsberg expects the purchase to close this month.

Sales and marketing support company **Wellton Energy** has opened a new office in Norwich, UK, to serve the small and medium enterprise sector of the oil & gas industry.

Copper and gold mining company **Freeport-McMoRan** made a play for oil & gas assets by acquiring former subsidiary **McMoRan Exploration** and Houston-based **Plains Exploration & Production** in a US\$9 billion buying spree. Freeport will pay \$6.9 billion for Plains and \$2.1 billion for McMoRan. The deal will give Freeport major assets in the Gulf of Mexico and Eagle Ford shale.



VAM USA expanded its Houston-based Connection Technology Center to 90,000 sq ft, doubling its R&D capacity. The facility conducts harsh-environment testing of premium connections for shale applications and deepwater drilling in the Gulf of Mexico.

Dubai-based **Shelf Drilling** acquired 38 shallow-water drilling rigs after completing a US\$1.05 billion sale with **Transocean**. Shelf Drilling is also expected to pick up as many as 3500 employees from the deal. Shelf Drilling will take control of seven rigs immediately, and will assume full operations on the remaining jackups later this year.

Foster Wheeler has acquired **Three Streams Engineering**, a privately held engineering company in Calgary, Canada. The acquisition is part of Foster Wheeler's strategy to grow its upstream capabilities.

On the Move

BG Group has elevated **Chris Finlayson** to chief



executive officer. He came to BG in 2010 after spending 33 years with Royal Dutch Shell. Finlayson replaces Sir **Frank Chapman**, who has served as CEO of the BG Group since 2000.

Thirty Years' on Thursday, 7 March.



Clay Williams has been named president and chief operating officer of National Oilwell Varco. Williams has served as the company's executive vice president and chief financial officer since March 2005.

Jeremy Thigpen has been assigned to fill Williams' former position.



Ray Frisby (pictured) has been named technical director for TAM

International. Frisby will lead development of new technologies. Company subsidiary TAM Completion Systems has appointed **Jim McGowin** as its general manager. He will be charged with establishing, managing and growing operations and sales for the recently created entity.

Stuart Gilligan has been appointed marine field sales engineer by Outreach, a supplier of marine canes, davits and rescue cranes. Gilligan will

focus on the UK marine and offshore sectors,



and be responsible for field sales of the Palfinger range of marine cranes, including knuckle boom, stiff boom, and telescopic models, as well as Ned Deck's range of davits and rescue boats.

DNV Energy, DNV Maritime and DNV Business Assurance.

Viking SeaTech Survey has chosen **Matthew**



Gordon as its general manager. He will be responsible for the new Survey international business unit.



Will Jephcott has retired as a director of ROC effective immediately. He was a founding director, holding the post since February 1997. Jephcott also served as chairman of the Audit & Risk committee.

David E Roberts Jr has resigned as executive vice



president and chief operating officer of Marathon Oil. The company

has not yet named a replacement.

Bill Gates will speak at CERAWeek 2013. Gates will open the first night of a two-night special session entitled 'Energy: The Next

BP has named **Lamar McKay** chief executive of



upstream. He will lead the exploration, and developments and production divisions with the upstream strategy and integration team. McKay has spent 32 years with BP. Since 2009, he served as chairman and president of BP America, and recently oversaw the company's Gulf Coast restoration efforts.



Stefan Nerpín has been named DNV's new group VP of

communications & external relations. Nerpín will report to CEO Henrik O Madsen. **Rune Torhaug**



is promoted to MD of DNV Research & Innovation. Torhaug has worked in leadership roles at



Eric Toogood, Diskos manager for the Norwegian Petroleum Directorate, and **Espen S Johansen**, vice president marketing



& commercialization – production & completion systems for Weatherford, have been elected to Energistics' board.

Editorial Index

3U Technologies www.3utech.com.....	65	Intermoor www.intermoor.com.....	13
Abu Dhabi Co www.adco.ae.....	26	Jeffries Bache www.jeffries.com.....	32
Aker Solutions www.akersolutions.com.....	23, 50	Kongsberg Oil & Gas Technologies www.kongsberg.com/en.....	50
Alliance Engineering www.allianceengineering.com.....	71	Lockheed Martin www.lockheedmartin.com.....	62
Anadarko www.anadarko.com.....	23, 41	Lukoil www.lukoil.com.....	23
Atwood Oceanics www.atwd.com.....	57	Marathon www.marathon.com.....	25
Axess http://axess.no.....	50	Marine Well Containment www.marinewellcontainment.com.....	39
Baker Hughes www.bakerhughes.com.....	25	MARINTEK www.sintef.no/home/marintek.....	50
Barclays group.barclays.com.....	31, 45	McDermott www.mcdermott.com.....	72
Bayerngas www.bayerngasnorge.com.....	23	MGM Energy Corp www.mgmenergy.com.....	52
Bluefin Robotics www.bluefinrobotics.com.....	62	Mitsui www.mitsui.com.....	23
British Petroleum www.bp.com.....	23, 26, 69	NES Global Talent www.nesglobaltalent.com.....	13
BG www.bg-group.com.....	41	Noble Energy www.nobleenergyinc.com.....	20
C-Ray Media www.c-raymedia.com.....	72	Ocean Rig ASA www.ocean-rig.com.....	58
Cairn Energy www.cairnenergy.com.....	35	Oceaneering www.oceaneering.com.....	22
Center Rock www.centerrock.com.....	18	OMV www.omv.com.....	23
Centrica www.centrica.com.....	23	Petrobras www.petrobras.com.....	22, 33
CGGVeritas www.cggveritas.com.....	46	PGS www.pgs.com.....	47
Chevron www.chevron.com.....	23, 25, 39, 45, 69	Polarcus www.polarcus.com.....	46
CNOOC www.cnoocld.com.....	23	Reef Subsea www.reefsubsea.com.....	23
Cobalt International Energy www.cobaltintl.com.....	23	Reflect Geophysical www.reflectgeo.com.....	46
ConocoPhillips www.conocophillips.com.....	25, 35, 45	Repsol www.repsol.com.....	35
Daewoo Shipbuilding & Marine Engineering www.dsme.co.kr.....	57	Repsol Sinopec Brasil SA www.repsolsinopec.com.br.....	58
Dana Petroleum www.dana-petroleum.com.....	22	Rosneft www.rosneft.com.....	23, 35
DeepStar www.deepstar.org.....	66	Saab Seaeeye www.seaeeye.com.....	63
Delek Group www.delek-group.com.....	20	Samsung Heavy Industries www.shi.samsung.co.kr/eng.....	57
DNV Maritime www.dnv.com/industry/maritime.....	13, 50	Salamander Energy www.salamander-energy.com.....	22
Dolphin Geophysical www.dolphingeo.com.....	46	Sanco www.sancoind.com.....	46
Douglas-Westwood www.douglas-westwood.com.....	31, 40	Santos www.santos.com.....	22, 40
Dragon Offshore www.dragonoffshore.com.....	46	Saudi Aramco www.saudiaramco.com.....	27
Drillers Supply www.drill-supplies.com.....	18	Schilling Robotics www.schilling.com.....	66
Ecopetrol www.ecopetrol.com.co.....	23	Seadrill www.seadrill.com.....	58
EMGS www.emgs.com.....	23, 47	Sembcorp Marine www.sembcorpmarine.com.sg.....	57
ENI www.eni.com.....	22, 34, 41	Shell www.shell.com.....	23, 26, 35, 40, 45, 52
Expro www.exprogroup.com.....	23	Sovcomflot www.sovcomflot.ru.....	46
ExxonMobil www.exxonmobil.com.....	22, 26, 31, 34, 40, 45	Statoil www.statoil.com.....	13, 23, 35, 40, 66
Faroe Petroleum www.fp.fo.....	23	Subsea 7 www.subsea7.com.....	23, 66
Frank Mohn Houston www.framo.com.....	50	Swire Oilfield www.swireos.com.....	13
Fugro www.fugro.com.....	47	Technip www.technip.com.....	72
Gazprom www.gazprom.com.....	20, 34, 40	TECHNI www.techni.no.....	50
GC Rieber Shipping www.gcrieber.com.....	46	Total www.total.com.....	34, 40, 45, 63
Grope, Long and Littell www.groppelong.com.....	32, 37, 40	Transkor Group Inc www.transkorgroup.com.....	51
GDF Suez E&P www.gdfsuezep.no.....	23, 40	Tullow Oil www.tullowoil.com.....	23
Guarapari Drilling www.sembcorp.com.....	59	Turkish Petroleum Corp www.tpao.gov.tr.....	46
Heerema www.heerema.com.....	23	Wartsila www.wartsila.com.....	23
Helix Energy Solutions Group www.helixesg.com.....	22	Weatherford www.weatherford.com.....	13
Hess www.hess.com.....	69	WesternGeco www.slb.com/services/westerngeco.....	47
Hyperdynamics www.hyperdynamics.com.....	23	William Partners http://co.williams.com.....	69
Iceland Petroleum www.icelandpetroleum.com.....	23	Wood Group Mustang www.mustangeng.com.....	33
INTSOK www.intsok.no.....	50	Wood Mackenzie www.woodmacresearch.com.....	40, 57
ION Geophysical www.iongeo.com.....	35, 51	Woodside www.woodside.com.au.....	20
Iranian Offshore Eng & Const www.ioec.com.....	23		

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Gregory Hale is the Editor and Founder of Industrial Safety and Security Source (ISSSource.com), a news and information web site covering safety and security issues in the manufacturing automation sector. Hale has over 30 years in the publishing industry, covering manufacturing automation for 10 years as the Chief Editor of *InTech* magazine.



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Advertiser Index



Advertising sales

Aero Tec Laboratories Inc www.atlinc.com.....	70
AtComedia Directories www.oilonline.com/directory.....	61
Bredero Shaw www.brederoshaw.com.....	2/3
Cameron www.c-a-m.com.....	8
Challenges in Geoscience www.challengesingeoscience.com.....	7, 42/43, 82
Clarion www.clarion.org.....	75
Det Norske Veritas AS, DNV www.dnvsoftware.com/OE.....	21
FMC Technologies www.fmctechnologies.com.....	67
Fuel for Thought www.oedigital.com.....	9
Fugro www.fugro.com.....	4
Ion Geophysical www.iongeo.com.....	44
KBR www.kbr.com.....	6
Kobelco/Kobe Steel Ltd www.kobelcocompressors.com.....	24
Kongsberg Maritime Ltd www.km.kongsberg.com/bop.....	41
LAGCOE 2013 www.lagcoe.com.....	79
Magnetrol International www.magnetrol.com.....	14
OE Events www.oedigital.com.....	68
OE Reprints www.oedigital.com.....	79
Orion www.orioninstruments.com.....	73
ORR Safety www.orrsecurity.com/kong.....	56
PECOM pecomexpo.com.....	36
Postle Industries www.hardbandingsolutions.com.....	10
Saudi Aramco www.aramco.jobs/oe.....	83
Schlumberger Technology Corp www.slb.com.....	84
Scott Safety www.UniversalByScott.com.....	55
Seacon www.seaconworldwide.com.....	71
Seanic Ocean Systems/Ashtead Technologies www.seanicusa.com.....	19
Society of Petroleum Engineers www.spe.org/go/OE.....	12
TDW Offshore www.tdwilliamson.com.....	30
TEKNA www.teknakurs.no.....	70, 75
Tiger Offshore Rental Ltd www.tigeroffshorerentals.com.....	16/17
Tradequip www.tradequip.com.....	72
Williams www.williams.com/gulfstar.....	53

NORTH AMERICA

Bill Krull

Tel: +1 713 535 1521

bkrull@atcomedia.com

Diana Smith

Tel: +1 713 874 2212

dsmith@atcomedia.com

John Lauletta

Tel: +1 713 874 2220

jlauletta@atcomedia.com

Rhonda Warren

Tel: +1 713 285 5072

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Media Point & Communications

Tel: +39 (0)10 570 4948

Fax: +39 (0)10 553 0885

info@mediapointsrl.it

NETHERLANDS/AUSTRIA/GERMANY

Arthur Schavemaker, Kenter & Co BV

Tel: +31 547 275 005

Fax: +31 547 271 831

arthur@kenter.nl

FRANCE

Paul Thornhill, Alad Ltd

Tel: +44 (0)1732 459683

paul@aladltd.co.uk

MALAYSIA

Koh Earn Soo

Market Intelligence (M) Sdn Bhd

Tel: +60 (0)3 6280 4136

Fax: +60(0)3 6274 7660

kes.marketintelligence@gmail.com

SINGAPORE/AUSTRALIA

June Jonet, The Silverback

Tel: +(65) 8112 6844

junejonet@thesilverback.com



A message to our readers

It takes collaborative partnerships and support to successfully implement innovative change.

AtComedia would like to recognize and thank the companies that supported our brand transformation with their presence in the premiere issue of the "new **OE**." We are committed, as are our customers, in meeting the needs of the global oil & gas industry. The new **OE** is for you – our readers! Enjoy.

January 2013 **OE** Advertisers



Numerology

582

Global rig count as of December 2012, up 2.7% from 12 months ago.

(Source: Rigzone.com)

#3

US is third largest oil producer behind Saudi Arabia and Russia.

(Source: US Energy Information Administration)



36,000

The depth, in feet, down to which the *Nereus* ROV can sample and survey.

► See full story on page 62.

69

Offshore reefs created under the Rigs to Reefs program since 1986. (Source: Louisiana Department of Wildlife & Fisheries)

87%

US federal offshore acreage that is off limits to development. (Source: API)



260,000

The amount of steel, in tons, required to build Prelude FLNG. (Source: Shell)

28

The amount of flowlines, in miles, Technip will supply for Hess' Tubular Bells project. ► Read more on page 69.

30,000

Saudi Aramco computers wiped out by Shamoon cyber attack.

► See full story on page 25.



2006

OE's last redesign.



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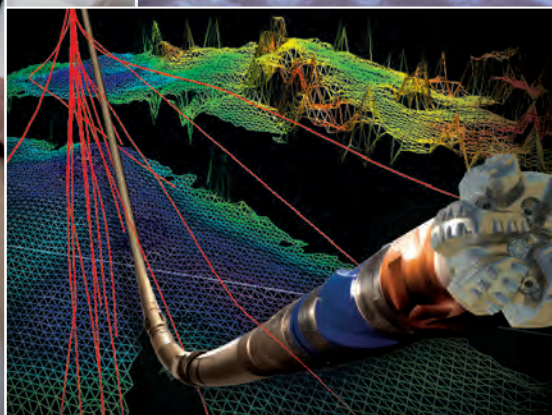
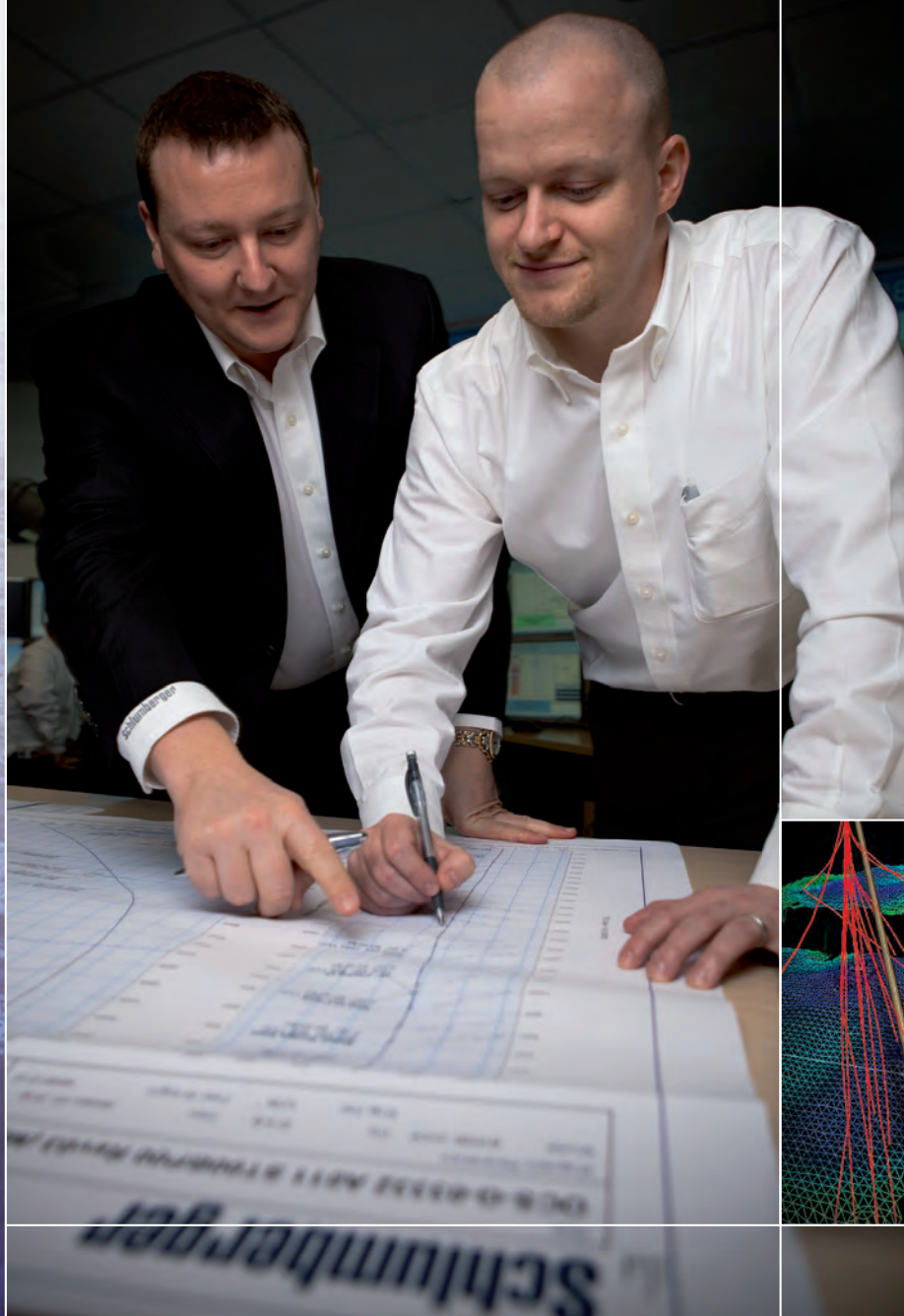
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